MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT 1999 - 2010

ENVIRONMENTAL IMPACT STATEMENT AND ENVIRONMENTAL IMPACT REPORT

FINAL

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ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT
MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT
1999-2010

Lead Agencies: U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region, Sacramento, California; and
San Joaquin River Group Authority, Modesto, California

Cooperating Agencies: U.S. Fish and Wildlife Service; National Marine Fisheries Service; California Department of Water Resources; California Department of Fish and Game

This Environmental Impact Statement/Environmental Impact Report (EIS/EIR) has been prepared in compliance with the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), and the U.S. Bureau of Reclamation (Reclamation) procedures for NEPA compliance.

Reclamation and the Authority are jointly preparing this EIS/EIR for meeting the flow objectives for the Draft San Joaquin River Agreement (Agreement) over the period 1999-2010. The Agreement developed as an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives contained in the State Water Resources Control Board's 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP)*. Discussion over the flow objective led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies to support that plan. The process of developing the Vernalis Adaptive Management Plan (VAMP) resulted in the Agreement in April 1998. The Agreement identifies where the water to support the VAMP study would be obtained, specifically from the San Joaquin River Group Authority whose members are willing sellers.

The purpose of the proposed action is to acquire water identified in the Agreement and use the water for:

- a pulse flow for a 31-day period at Vernalis during April and May, and
- other flows identified by the CVPIA water acquisition plan to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study to support anadromous fish and provide environmental benefits in the project area.

This water is needed to support VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement is to change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The Agreement provides for up to 137,500 acre-feet of water.

The EIS/EIR examines one other alternative that was determined to meet the project's purpose and need: the State Water Right Priority System. This alternative is identical to Flow Alternative 3 in the SWRCB's DEIR for implementation of the 1995 WQCP for the Bay/Delta Estuary.

The proposed action is located in the following counties in California: San Joaquin, Stanislaus, Madera, Merced, Fresno, Tuolumne, Mariposa, and Calaveras.

For further information regarding this EIS/EIR, contact Mr. Michael Delamore, U.S. Bureau of Reclamation, South-Central California Area Office, 2666 N. Grove Industrial Dr., #106, Fresno, CA 93727-1551, (209) 487-5039, fax: (209) 487-5130; or Mr. Dan Fults, Friant Water Users Authority, 1521 I Street, Sacramento, CA 95814, (916) 441-1931, fax: (916) 441-1581.

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Meeting Flow Objectives for the San Joaquin River Agreement 1999 - 2010

Environmental Impact Statement and Environmental Impact Report

Prepared for

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

and

San Joaquin River Group Authority
Modesto, California

Prepared by

EA Engineering, Science, and Technology
Lafayette and Sacramento, California

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EXECUTIVE SUMMARY

ES.1 BACKGROUND

The San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay/Delta Estuary) is a critically important part of California's natural environment and economy. In recognition of the serious problems facing the region and the complex resource management decisions that must be made, the Federal government and the State of California are working together to stabilize, protect, and restore ecological health and improve water management for beneficial uses in and from the Bay/Delta Estuary. The San Joaquin River Group Authority (Authority or SJRGA) is working with the State and Federal governments to facilitate meeting these needs as related to the San Joaquin River: increased instream flows, the 1995 State Water Resources Control Board (SWRCB) Water Quality Control Plan (WQCP) flow objectives at Vernalis, and the Delta Smelt Biological Opinion.

As part of these ongoing efforts, the Draft San Joaquin River Agreement (SJRA)[1] was developed as an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives contained in the State Water Resources Control Board's 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (1995 WQCP: SWRCB 1995). Discussion over the flow objectives led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies (from willing sellers on the San Joaquin River system) to support that plan. The SJRA includes the Vernalis Adaptive Management Plan (VAMP).

The SJRA identifies where the water to support the VAMP study would be obtained, specifically from the San Joaquin River Group Authority whose members are making the water available[2]. It is a "performance agreement" (VAMP flows) and a water acquisition (other flows) wherein the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and the Department of Water Resources (DWR) pay the Authority to ensure that water supplies are available for instream flows as needed up to prescribed limits.

There are two appendixes to the SJRA that relate to the proposed action. Appendix A is the VAMP, a conceptual framework for protection and experimental determination of juvenile chinook salmon survival within the lower San Joaquin River, the adaptive management study. Appendix B provides for planning and operation coordination for VAMP.

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1 The SJRA proposes, among other things, a San Joaquin River flow and State Water Project/Central Valley Project export study during the April-May Pulse Flow Period and a mechanism by which the SWRCB can issue an order to implement the San Joaquin River portion of the 1995 Water Quality Control Plan for the Bay/Delta Estuary. Implement means to provide the flows and establish the pumping regimen called for in the SJRA which the parties to the SJRA intend will provide environmental benefits in the lower San Joaquin River and Delta at a level of protection equivalent to the San Joaquin River Portion of the 1995 WQCP.

2 Members of the San Joaquin River Group Authority (Authority) are: Modesto Irrigation District (MID), Turlock Irrigation District (TID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), Merced Irrigation District (Merced ID), Oakdale Irrigation District (OID), and the Friant Water Users Authority. Willing sellers for the proposed action are: MID, TID, SSJID, Exchange Contractors, Merced ID, and OID.

The SJRA was completed in April 1998, and its implementation requires that the NEPA and CEQA documentation be completed by March 1, 1999. This Final Environmental Impact Statement / Environmental Impact Report (EIS/EIR) is prepared in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The affected portions of the San Joaquin River and its tributaries (Stanislaus, Tuolumne, and Merced rivers) are located in the Central Valley of California. The rivers and related storage and conveyance facilities are located in the following counties: Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tuolumne, and Calaveras.

ES.2 PROJECT PURPOSE AND NEED

The purpose of the proposed project is to acquire water identified in the SJRA and use the water for:

- a pulse flow for a 31-day period at Vernalis during April and May, and
- other flows identified by the Central Valley Project Improvement Act (CVPIA) water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and environmental benefits in the project area.

This water is needed to support VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement would change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The additional water for other flows would be used for ramping around the pulse flow to assist in protection of salmon redds, to assist in control of water temperature, and to assist in improving water quality. Since the water released would increase instream flows in the lower San Joaquin River, it also improves compliance with the 1995 WQCP Vernalis objectives and with the San Joaquin River component of Delta Smelt Biological Opinion. (See Section ES.4 for additional information on the sources, amounts, and timing of the flows.)

Section 3406(b)(1) of the CVPIA requires the development of a program that will make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991. As one element of the Draft Anadromous Fish Restoration Program (AFRP), Reclamation has a need to obtain water on the Stanislaus, Tuolumne, Merced, and Lower San Joaquin rivers to provide additional flows at times that will facilitate migration, attraction, production, and survival of anadromous fish on these rivers in accordance with specific fish, wildlife, and habitat restoration purposes authorized by the CVPIA.

Reclamation proposes to contract for water on the San Joaquin River and its tributaries under P.L. 102-575, Title 34, Section 3406(b)(3) of the CVPIA. Water may be acquired by Reclamation to meet fish and wildlife needs within the San Joaquin Valley under the authority of Sections 3406(b)(3) of the CVPIA. The CVPIA amended the purposes of the Central Valley Project (CVP) to achieve a reasonable balance among competing demands for use of CVP water for fish and wildlife, agriculture, municipal and industrial, and power contractors.

The State Water Resources Control Board (SWRCB) approved the final *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* in May 1995. The 1995 WQCP includes objectives for Delta outflow, Sacramento and San Joaquin River flows, salinity, dissolved oxygen, and State Water Project (SWP) and Central Valley Project (CVP) operations. It presents a combination of Delta inflow and outflow objectives, water quality objectives, and project operation criteria. These requirements are specified temporally and vary depending on the hydrologic condition and the biological needs of various fish species.

The March 6, 1995 Biological Opinion (Opinion) for Threatened Delta Smelt, Delta Smelt critical habitat, and the proposed Threatened Sacramento Splittail approved Reclamation's operations to provide flows and pursue acquisition of additional water (acquired flow) in order to provide San Joaquin River flows at Vernalis in excess of those exported by the CVP and SWP (USFWS 1995). Any such enhancement flows would be in excess of those attributable to CVP New Melones releases, unregulated accretions, or unstorable flows, and would not be exported at the Delta pumping facilities. As a result of this Opinion, Reclamation has a requirement to acquire water within the San Joaquin River Watershed to maximize the ability of the CVP to meet this commitment.

ES.3 PUBLIC AND AGENCY INVOLVEMENT

Reclamation and the Authority distributed a Notice of Preparation of a Joint EIS/EIR on supplying water to meet the flow objectives for the proposed VAMP on November 25, 1997 to about 160 agencies and individuals. The notice announced three public scoping meetings for January 6–8, 1998, and requested that comments on the content of this EIS/EIR be submitted by January 16, 1998. Issues raised at the meetings and in comment letters are discussed in each section of Chapter 4, Environmental Consequences and Mitigation Measures. Public review of the Draft EIS/EIR was conducted over the period September 25, 1998 to November 10, 1998. (See Appendix H, Responses to Comments.) Recirculation of the Draft EIS/EIR is not necessary, because all of the comments received resulted in minor modifications to the Draft EIS/EIR. This Final EIS/EIR has been sent to all agencies and individuals who commented on the Draft EIS/EIR.

Reclamation has also issued a newsletter covering topics related to the San Joaquin River Agreement. The first newsletter was published in May 1998, a second was distributed in September 1998 to 225 agencies and individuals, and a third newsletter was sent to 250 agencies and individuals in January 1999. Information on the proposed action is also available on Reclamation's web page

(www.mp.usbr.gov), and the detailed model results for the hydrologic analysis are available upon request.

The principal mechanism for agency involvement in the EIS/EIR is the San Joaquin River Agreement Joint Steering/Cooperating Agency Committee. Participating agencies are described in Chapter 5, Consultation and Coordination.

ES.4 ALTERNATIVES CONSIDERED AND PREFERRED ALTERNATIVE

The proposed action/proposed project is a 12-year, long-term water supply program, outlined in the San Joaquin River Agreement, for instream flows in the San Joaquin River system and has three components:

- VAMP Flow: Water from the Authority, for achieving the VAMP 31-day pulse flow (April-May), is provided by the Authority member agencies and is capped at 110,000 acre-feet in any year (Table 2.1-1 in Section 2.1). There is also the potential for additional water from willing sellers who are members of the Authority for VAMP implementation above the 110,000 acre-feet.

- October Flow: Additional water (12,500 acre-feet) from Merced Irrigation District (Merced ID) would be available for delivery during October of all years.

- OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water committed to the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID would be used for various fish and wildlife benefits including additional instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.

The proposed project is for the Authority to make water available over the period 1999–2010 for release to the San Joaquin River and its tributaries. The quantity and precise timing of the proposed releases vary depending on hydrologic conditions.

In addition to the no action and proposed action, one other alternative was determined to meet the project's purpose and need, the SWRCB Water Right Priority System Alternative. This alternative is assumed to be Flow Alternative 3 in the SWRCB's *Draft Environmental Impact Report for*

Implementation of the 1995 Bay/Delta Water Quality Control Plan (DEIR; SWRCB 1997). This alternative has the capabilities to meet the SWRCB's 1995 Water Quality Control Plan Vernalis flow objectives assigned to water right holders based on a water right priority system. Under this alternative, up to 38 water right holders share responsibility to implement flow objectives. Junior appropriative water right holders are required to cease diversions before senior appropriative water right holders are affected (based on the "first-in-time, first-in-right" principle). This alternative would involve different water right holders than the proposed action and different quantities of water being released into the San Joaquin River system.

ES.5 SUMMARY OF SIGNIFICANT ENVIRONMENTAL EFFECTS AND MITIGATION

Table ES-1 provides a summary of all of the environmental effects and mitigation for both the proposed action and the alternative action. Impact statements are often abbreviated; see Chapter 4 for the complete statements of impact. The Mitigation Monitoring Program required by CEQA is described in Appendix G. Symbols used in the table are:

S:	Significant adverse impact	LS:	Less-than-significant adverse impact
SU:	Significant unavoidable adverse impact	N:	No adverse impact
PS:	Potentially significant adverse impact	B:	Beneficial impact
PSU:	Potentially significant unavoidable adverse impact	na:	Not applicable

Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS

	Proposed Action		Alternative Action	
Impact	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Surface Water				
Water Deliveries				
Deliveries reduced to Merced Irrigation District during critically dry years and under below normal or dry hydrologic conditions under certain sequential hydrologic conditions; however, implementation of a conjunctive use program would augment surface water supplies.	PS	LS	na	na
Deliveries reduced to Oakdale Irrigation District during critically dry years; however, implementation of conjunctive use, reclamation, and increased efficiencies would augment surface water supplies.	PS	LS	na	na
Average annual deliveries reduced within the San Joaquin River Basin by 62,000 acre-feet; at times, complete curtailment of junior water rights appropriators. Mitigation unknown.	na	na	PS	PS

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Water Storage				
Carryover water storage improved for New Melones Reservoir.	B	na	B	na
Carryover water storage reduced for New Don Pedro Reservoir.	LS	na	SU	na
Carryover water storage reduced for Lake McClure during below normal or dry hydrologic conditions.	PSU	na	PSU	na
Water Quality				
Exceedence of water quality standards reduced on San Joaquin River at Vernalis in October.	B	na	na	na
Exceedence of salinity standards reduced on San Joaquin River at Vernalis in June and July, and potentially in November or August.	B	na	na	na
Salinities reduced with April or May pulse flow.	B	na	na	na
Water quality would improve at Vernalis from November through March.	na	na	B	na
Exceedence of salinity standards increased on San Joaquin River at Vernalis in June, July, and August. Mitigation would require additional releases from New Melones.	na	na	PS	LS
Groundwater				
Overdrafting				
No groundwater from the SSJID service area would be used to provide water for pulse flow; overdrafting would be unaffected.	N	na	na	na
A minor amount of groundwater from the OID service area (up to 15,000 acre-feet) would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River.	LS	na	na	na
No groundwater from the Modesto Groundwater Basin would be used to provide water for the pulse flow.	N	na	na	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
No groundwater from the Turlock Groundwater Basin would be used to provide water for the pulse flow.	N	na	na	na
Groundwater could indirectly be used to replace surface water used for the flows from the Merced ID (up to 67,500 acre-feet, 12% of the typical annual production); however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.	PS	LS	na	na
Groundwater from the Exchange Contractors service area could provide all of the water for the pulse flow (up to 11,000 acre-feet, 2.2% of the Delta Mendota Basin production rate).	LS	na	na	na
Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.	na	na	PS	LS
Water Levels				
No groundwater from the SSJID service area would be used to provide water for pulse flow; water levels would be unaffected.	N	na	na	na
Up to 15,000 acre-feet of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; the water levels would be unaffected.	N	na	na	na
No groundwater would be used to provide water for the pulse flow from MID; water levels in the Modesto Groundwater Basin would be unaffected.	N	na	na	na
No groundwater from the Turlock Groundwater Basin would be used to provide water for the pulse flow; water levels would be unaffected.	N	na	na	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Groundwater from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows (up to 67,500 acre-feet, 12% of the typical annual production); however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.	PS	LS	na	na
Groundwater from the Exchange Contractors service area could provide all of the water for the pulse flow (up to 11,000 acre-feet, 2.2% of the Delta Mendota Basin production rate).	LS	na	na	na
Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; however, implementation of conjunctive use, reclamation, and increased efficiencies would mitigate use of groundwater.	na	na	PS	LS
Water Quality				
No groundwater from the SSJID service area would be used to provide water for pulse flow; there would be no impact on water quality.	N	na	na	na
A minor amount of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; there would be no impact on water quality.	N	na	na	na
No groundwater from the Modesto Groundwater Basin would be used to provide water for the pulse flow; there would be no impact on water quality.	N	na	na	na
No groundwater from the Turlock Groundwater Basin would be used to provide water for pulse flow; there would be no impact on water quality.	N	na	na	na
Groundwater from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows; TDS levels may increase slightly.	LS	na	na	na
Groundwater could provide all of the water for the pulse flow from the Exchange Contractors service area; TDS levels may increase slightly.	LS	na	na	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; there could be an impact on water quality; however, limiting or restricting groundwater pumping in restricted areas, conjunctive use, and increased efficiencies could augment groundwater supplies.	na	na	PS	LS
Subsidence				
No groundwater from the SSJID service area would be used to provide water for pulse flow; there would be no impact on subsidence.	N	na	na	na
Up to 15,000 acre-feet of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; there would be no impact on subsidence.	N	na	na	na
No groundwater from the Modesto Groundwater Basin would be used to provide water for the pulse flow; there would be no impact on subsidence.	N	na	na	na
No groundwater from the Turlock Groundwater Basin would be used to provide water for pulse flow; there would be no impact on subsidence.	N	na	na	na
Groundwater (up to 67,500 acre-feet) from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows; there could be an impact on subsidence. However, limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas would reduce the impact.	PS	LS	na	na
Groundwater (up to 11,000 acre-feet) could provide all of the water for the pulse flow from the Exchange Contractors; the impact on subsidence is less than significant.	LS	na	na	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Approximately 62,000 acre-feet of groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; there could be an impact on subsidence. However, limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas could reduce the impact to less than significant.	na	na	PS	LS
Agricultural Subsurface Drainage				
The 31-day pulse flow and other flows would not have an impact on agricultural seepage.	N	na	na	na
Raised water levels in the San Joaquin River could affect seepage, but groundwater pumped to replace reductions in surface water deliveries would produce a less-than-significant effect on agricultural drainage.	na	na	LS	na
Terrestrial Resources				
Riparian Vegetation				
May pulse flows interfere with Fremont cottonwood initiation; most likely operation would be for pulse flows to begin mid-April. Ramping flows to minimize flow changes are part of the proposed project.	LS	na	LS	na
Stable summer base flows would increase likelihood of invasion by narrowleaf willow, but FERC mandated flows in the Tuolumne would preclude such an impact.	LS	na	LS	na
No threatened or endangered plant species and no relic vegetation types would be affected.	LS	na	LS	na
Wildlife				
Ramping rates and April pulse flows would reduce loss of wildlife habitat and decrease the potential for riparian corridor fragmentation.	LS	na	LS	na
The impacts to wildlife, especially TES species would be insignificant.	LS	na	LS	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Aquatic Resources				
Factors Affecting Distribution and Abundance of Aquatic Resources				
Water quality improved; no adverse impacts on aquatic resources.	N	na	N	na
Chinook Salmon				
Flow changes on all rivers would result in non-measurable or less-than-significant impacts to fall-run chinook salmon.	N/LS	na	LS	na
Flows increased in April/May and October on all rivers that benefit emigrating salmon smolts and immigrating adults.	B	na	na	na
Rapid changes in flows in the spring and fall may affect juvenile salmon and salmon redds; however, ramping of flows would ensure the impacts would be less than significant.	PS	LS	na	na
Impacts to female fecundity in November from possibly high water temperature would have a low frequency of occurrence.	LS	na	na	na
Minimal effects on water temperature in Merced River. Decreasing seasonal air temperature dominates release temperatures.	LS	na	na	na
Reduced flows in February on the Merced River and in May on the Stanislaus River in critically dry periods would affect juvenile salmon. Mitigation could include increased smolt production.	na	na	PS	LS
Steelhead				
Steelhead found only in the Stanislaus River. Flows increased during most months, in all water year types.	B	na	na	na
Reduced flows in May on the Stanislaus River during critically dry periods could affect juvenile steelhead. Mitigation could include increased smolt production.	na	na	PS	LS

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Occasional flow increases during summer months on the Stanislaus River would benefit over-summering juveniles.	na	na	B	na
Striped Bass				
Flows increased during the spawning period, especially during dry and critically dry years.	B	na	na	na
Flows reduced in the Merced River during above normal and wet years with a potential reduction of available spawning.	LS	na	na	na
Flows increased during the spawning period in the Merced River.	na	na	B	na
Flows reduced in the Stanislaus and Tuolumne rivers during the spawning period.	na	na	LS	na
Increased flows in the summer months may benefit maturing striped bass fry in offsite locations (within the Delta).	na	na	B	na
Splittail				
Flows increased during the spawning period, especially during dry and critically dry years.	B	na	na	na
Flows decreased on the Merced River during the spawning period during above normal and wet years.	LS	na	na	na
Flows increased during the spawning period in the Merced River.	na	na	B	na
Flows reduced in the Stanislaus and Tuolumne rivers during the spawning period.	na	na	LS	na
Increased flows in the summer months of the critically dry period may benefit young splittails in all rivers.	na	na	B	na
Reservoir Species				
No impacts to largemouth bass.	N	na	na	na
Habitat impacted at New Don Pedro Reservoir and Lake McClure.	na	na	LS	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Habitat impacted at New Melones Reservoir.	na	na	B	na
Delta smelt and longfin smelt				
Flows provided by the proposed action would be in compliance with the 1995 Biological Opinion for the operation of the CVP and SWP. No significant impacts to delta or longfin smelt would occur during the spring or fall pulse flows or with the alternative action's increased flows.	N	na	N	na
Land Use				
Population and Population Density				
No adverse impacts on local populations or local population growth.	N	na	na	na
No impacts on municipal users, therefore no impact to population density.	N	na	na	na
Users with junior water rights who serve municipal water users would have deliveries curtailed 20 to 60% of the time in April-May. Groundwater could be used to replace surface water reductions.	na	na	PS	LS
Population densities under constrained growth would remain stable.	na	na	LS	na
Regional Economy and Employment				
Short-term impacts on jobs from reduced farm production avoided by substituting groundwater for surface water supplies.	LS	na	na	na
Job losses less than significant, but output and income losses could be significant. Mitigation measures include groundwater substitution, conjunctive use, conservation, and tailwater recovery.	na	na	S	LS

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Agricultural Land Use				
Potential reduction of 104,500 acre-feet of Authority's water to irrigation customers could adversely impact cropping patterns and productivity. However, most of this surface water would be replaced by groundwater including conjunctive use water or come from carryover storage.	PS	LS	na	na
Reduced deliveries by Merced ID could adversely affect agricultural production in the short term, but this decline in productivity would be mitigated through a conjunctive use project and by groundwater pumping by individual farmers.	PS	LS	na	na
Cropping patterns could change and crop production could be reduced. Mitigation measures include alternative sources of water.	na	na	PS	LS
Cultural Resources				
Reservoirs				
Recreation use increased at New Melones during critically dry years; potential for cultural resource damage could increase.	LS	na	LS	na
Recreation use not affected at New Don Pedro Reservoir and Lake McClure, so no indirect impact.	na	na	N	na
Lower reservoir levels at New Don Pedro Reservoir may expose potential cultural resources to impact from recreationists.	na	na	LS	na
Rivers				
No adverse impacts to cultural resources on San Joaquin, Stanislaus, or Tuolumne rivers.	N	na	na	na
Frequency of streamflows below critical flow decreased in critical, dry, and below normal years on Merced River; recreation use could increase and therefore could increase potential for cultural resource damage.	LS	na	na	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Frequency of flows above the critical threshold increase on the San Joaquin River, but the short-term impact on cultural resources is less than significant.	na	na	LS	na
During critical water years, recreation use could increase or decrease on the San Joaquin River depending on the various critical thresholds or optimal ranges; the short-term impact on cultural resources is less than significant.	na	na	LS	na
Recreation use is beneficially impacted on the Stanislaus River and could, therefore, increase the potential for damage to cultural resources. Mitigation measures could include implementation of a protection plan.	na	na	PS	LS
Recreation				
Reservoirs				
No adverse impact to recreationists at any of the reservoirs.	N	na	na	na
Reservoir levels increased at New Melones in critical years in September.	B	na	B	na
Reservoir levels decreased at New Don Pedro Reservoir during critical water years.	na	na	LS	na
No impacts on reservoir levels at Lake McClure.	na	na	N	na
Rivers				
Frequency of streamflows below critical flow decreased in critical, dry, and below normal years on Merced River.	B	na	na	na
No adverse impacts to recreation on San Joaquin, Stanislaus, or Tuolumne rivers.	N	na	na	na
Frequency of streamflows above critical flow increased in all years on San Joaquin River; however, the recreation opportunities above this threshold are unknown.	na	na	PSU	na
During critically dry years, San Joaquin River streamflows would provide both beneficial and adverse impacts to recreationists.	na	na	LS	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Frequency of streamflows in optimal ranges for boating increased on the Stanislaus River.	na	na	B	na
No adverse impacts to recreation on Tuolumne or Merced rivers.	na	na	N	na
Energy Resources				
Reservoirs				
Storage increased at New Melones Reservoir during June, July, and August thus increasing potential for hydropower generation.	B	na	na	na
Storage decreased at New Don Pedro Reservoir during peak power production months thus decreasing potential for hydropower generation.	LS	na	na	na
Storage decreased greater than 10% at Lake McClure in critical, dry, and below normal years during peak power production months thus decreasing potential for hydropower generation.	PSU	na	na	na
There are less-than-significant impacts to potential hydropower production on any of the reservoirs.	na	na	LS	na
Rivers				
Releases increased on Stanislaus River could increase hydropower generation.	LS	na	na	na
Releases increased on Tuolumne River could increase hydropower generation.	B	na	na	na
Flows decreased more than 10% on Merced River in above normal years in June thus decreasing potential for hydropower generation.	PSU	na	na	na
There are less-than-significant impacts to potential hydropower production on the Stanislaus, Tuolumne, or Merced rivers.	na	na	LS	na
No hydropower generation is generated on the lower San Joaquin River so there are no impacts.	N	na	N	na

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Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS (CONT.)

Impact	Proposed Action		Alternative Action	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Indian Trust Assets				
Reservoirs				
Indian Trust Assets are not located at any of the reservoirs.	N	na	N	na
Rivers				
Indian Trust Assets do not occur along any of the rivers in the project area.	N	na	N	na
Environmental Justice				
Aquatic Resources				
Beneficial impacts to fisheries would not affect environmental justice.	N	na	N	na
Recreation Resources				
Beneficial impacts to recreation in rivers and reservoirs would not affect environmental justice.	N	na	na	na
Less-than-significant adverse impacts to New Don Pedro Reservoir during critical water years would not impact environmental justice.	na	na	N	na
Potentially significant adverse or beneficial impacts to recreationists on the San Joaquin River would not impact environmental justice.	na	na	N	na
There are no impacts on either the Stanislaus, Tuolumne, or Merced rivers.	na	na	N	na

S: Significant adverse impact
SU: Significantly unavoidable adverse impact
PS: Potentially significant adverse impact
PSU: Potentially significant unavoidable adverse impact
LS: Less-than-significant adverse impact
N: No adverse impact
B: Beneficial impact
na: Not applicable

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LIST OF ACRONYMS

AF	Acre-Feet
AFRP	Anadromous Fish Restoration Program
AL	action level
(b)(2)	CVPIA Section 3406(b)(2) Water Management ("Dedication of 800,000 acre-feet")
(b)(3)	CVPIA Section 3406(b)(3) Water Management
bgs	below the ground surface
BMP	best management practice
BP	Before Present
CCC	Columbia Canal Company
CCID	Central California Irrigation District
CCSF	City and County of San Francisco
CDFA	California Department of Food and Agriculture
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
COA	Coordinated Operations Agreement
COE	United States Army Corps of Engineers
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization amendment
DBCP	dibromochloropropane
DEIR	Draft Environmental Impact Report
DFG	California Department of Fish and Game
DMC	Delta Mendota Canal
DPC	Delta Protection Commission
DPR	Department of Parks and Recreation
DWR	California Department of Water Resources
DWRSIM	Department of Water Resources Simulation Model
EA/IS	Environmental Assessment/Initial Study
EDB	ethylene dibromide
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESJCGB	Eastern San Joaquin County Groundwater Basin

FCWB	Firebaugh Canal Water District
FERC	Federal Energy Regulatory Commission
FPPA	Farmland Protection Policy Act
FWCA	Fish and Wildlife Coordination Act
GIS	Geographic Information System
GWh	gigawatt hours
IOP	Interim Operations Plan
ISDP	Interim South Delta Program
ITA	Indian Trust Assets
KWh	kilowatt hours
MAF	million acre-feet
MCL	maximum contaminant level
MCLG	maximum containment level goals
Merced ID	Merced Irrigation District
mg/l	milligrams per liter
MID	Modesto Irrigation District
MRFF	Merced River Fish Facility
MTBE	methyl tertiary butyl ether
MW	megawatt
MWh	megawatt hours
NCCP	National Community Conservation Plan
NDDB	National Diversity Data Base
NDPP	New Don Pedro Project
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRHP	National Register of Historic Places
OHV	off-highway vehicle
OID	Oakdale Irrigation District
PCE	perchloroethylene
PEIS	Programmatic Environmental Impact Statement
PG&E	Pacific Gas & Electric Company
ppt	parts per thousand
RM	river mile
RTES	rare, threatened, endangered, and sensitive
RVD	recreation visitor days
SHPO	State Historic Preservation Officer

SJRA	San Joaquin River Agreement
SJRGA	San Joaquin River Group Authority
SLCC	San Luis Canal Company
SRA	shaded riverine aquatic
SRA	State Recreation Area
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TCE	trichloroethylene
TDS	total dissolved solids
TES	threatened and endangered species
TID	Turlock Irrigation District
USBR	United States Bureau of Reclamation
USDOI	United States Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
VAMP	Vernalis Adaptive Management Plan
VOC	volatile organic compounds
WQCP	Water Quality Control Plan
WUA	weighted usable area

1. PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The Bureau of Reclamation (Reclamation) and the San Joaquin River Group Authority (Authority) are jointly preparing this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for meeting the flow objectives for the Draft San Joaquin River Agreement (SJRA or Agreement) over the 12-year period 1999-2010. It documents the environmental consequences of acquiring and using flows specified in the Agreement. This chapter describes the purpose of the proposed action or project, why it is needed, and what the project proposes to accomplish (objectives). Also it provides information on the history of the proposed project and the regulatory authority to conduct it.

The Agreement developed as an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives contained in the State Water Resources Control Board's 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (1995 WQCP: SWRCB 1995). Discussion over the flow objectives led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies (from willing sellers on the San Joaquin River system) to support that plan. The SJRA includes the Vernalis Adaptive Management Plan (VAMP) and identifies where the water to support the fishery study would be obtained, specifically from the San Joaquin River Group Authority whose members are making the water available.[1] The Agreement is a "performance agreement" (VAMP flows) and a water acquisition program (other flows) wherein Reclamation and the Department of Water Resources pay the Authority to ensure that water supplies are available for instream flows as needed up to prescribed limits.

Reclamation proposes to contract for water on the San Joaquin River and its tributaries under P.L. 102-575, Title 34, Section 3406(b)(3) of the Central Valley Project Improvement Act (CVPIA).

1.1 HISTORY OF PROJECT

On December 15, 1994, the federal government, the State of California, and urban, agricultural and environmental interests reached the principles for agreement on a comprehensive, coordinated package of actions designed to provide interim protection to the San Francisco Bay and Sacramento-San Joaquin River Delta Estuary. That agreement is referred to as the 1994 Bay-Delta Accord (Accord), which was recently extended to December 15, 1998. Many of the coordinated package of actions agreed upon in the Accord were subsequently adopted by the State Water Resources

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1 Members of the San Joaquin River Group Authority (Authority) are: Modesto Irrigation District (MID), Turlock Irrigation District (TID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), Merced Irrigation District (Merced ID), Oakdale Irrigation District (OID), and Friant Water Users Authority. Willing sellers for the proposed action are: MID, TID, SSJID, Exchange Contractors, Merced ID, and OID.

Control Board (SWRCB) in their 1995 Water Quality Control Plan (1995 WQCP) (95-1 WR by SWRCB Resolution No. 95-24).

In June 1995, the San Joaquin Tributaries Association (SJTA) filed a lawsuit over the State Board's adoption of the 1995 WQCP. SJTA's complaint asserted that the 1995 WQCP was invalid for several reasons, chief among these was: (1) the lack of adequate scientific review and data necessary to design a flow objective for the San Joaquin River; (2) inadequate capability of the San Joaquin Basin water users to supply these flows without significant social and economic harm; and (3) the dispute over the State Board's authority to require senior water rights holders to supply increased flows while the junior export projects were still allowed to pump significant quantities of San Joaquin flow (SJRTA 1996). In an effort to resolve the issues related to this legal dispute, the Authority proposed, in May 1996, an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives in the 1995 WQCP. This proposed agreement was presented to the State and Federal governments in a document titled "Letter of Intent among Export Interests and San Joaquin River Interests to Resolve San Joaquin River Issues Related to Protection of Bay/Delta Environmental Resources" and became known as the Letter of Intent (LOI). The LOI resulted in an attempt to resolve the San Joaquin River flow objective dispute through a consensus building and problem-solving process.

A "Conceptual Framework for Protection and Experimental Determination of Juvenile Chinook Salmon Survival within the Lower San Joaquin River" (SJRA Appendix A) in response to river flow and State Water Project/Central Valley Project (SWP/CVP) exports was developed by Dr. Bruce Herbold and Dr. Chuck Hanson.[2] From that study framework, a collaborative effort of scientists from state and federal agencies and stakeholder groups developed the VAMP to gather additional scientific fisheries information on the lower San Joaquin River. Based on the San Joaquin River flow and export targets identified in VAMP, a program was developed between the state and federal resource agencies, export interests, environmental community representatives, and San Joaquin River stakeholders. This process culminated in the development of the San Joaquin River Agreement. The VAMP study is joined with the other provisions of the Agreement to provide environmental benefits in the lower San Joaquin River and Delta, at a level of protection equivalent to the 1995 WQCP for the duration of the project.

In 1997, prior to completion of the Agreement, Reclamation initiated a one-year water acquisition on the San Joaquin River to help meet the VAMP target flows. In 1998, water acquisition contracts were completed with willing sellers to ensure that water would be available for the 1998 Spring Pulse Flow. Due to the wet hydrologic condition in April-May 1998, the supplemental water was not required.

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2 Bruce Herbold, Ph.D.; Ecologist with the U.S. Environmental Protection Agency is a member of DOI's CVPIA's Core Team and b(2) Fish Team. Chuck Hanson, Ph.D., Ecology and Fisheries Biology, is Senior Biologist, Principal, with Hanson Environmental, Inc..

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1.2 PURPOSE OF AND NEED FOR ACTION

As required under the National Environmental Policy Act of 1969 as amended (NEPA), this section presents a concise statement of the proposed action's purpose and need, followed by a more complete explanation.

1.2.1 Statement of Purpose and Need

The purpose of the proposed project is to acquire water identified in the SJRA and use the water for:

- a pulse flow for a 31-day period at Vernalis during April and May, and
- other flows identified by the CVPIA water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area.

This water is needed to support the VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement is to change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The additional water for other flows would be used for ramping around the pulse flow, to assist in the protection of salmon redds, to assist in control of water temperature, and to assist in improving water quality. Since the water would increase instream flows in the lower San Joaquin River, it also improves compliance with the 1995 WQCP Vernalis objectives and with the Delta Smelt Biological Opinion.

1.2.2 Explanation of Need for Project

The San Francisco Bay/Sacramento-San Joaquin Delta Estuary is a critically important part of California's natural environment and economy. In recognition of the serious environmental problems facing the region and the complex resource management decisions that must be made, the Federal government and the State of California are working together with stakeholders to stabilize, protect, and restore ecological health and improve water management for beneficial uses in and from the Bay/Delta Estuary. The proposed project is needed to help these environmental activities by providing necessary information on what flows are needed in the San Joaquin River system. The results of the adaptive management studies will be evaluated to help determine the appropriate Vernalis flow objective after 2010.

The Authority is working cooperatively with the State and Federal governments to assist in meeting the following needs as explained below: increased instream flows, the 1995 WQCP Vernalis

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objectives, and the Delta Smelt Biological Opinions (the 1995 Operations Criteria and Plan opinion and the April 26, 1996 opinion on temporary barriers).

Increased Instream Flows

Section 3406(b)(1) of the Central Valley Project Improvement Act (CVPIA) requires the development of a program that will "...make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991...." As one element of the Draft Anadromous Fish Restoration Program (AFRP), Reclamation has a need to obtain water on the Stanislaus, Tuolumne, Merced, and Lower San Joaquin rivers to provide additional flows at times that will facilitate migration, attraction, production, and survival of anadromous fish on these rivers in accordance with specific fish, wildlife, and habitat restoration purposes authorized by the CVPIA.

1995 WQCP Objectives

SWRCB approved the final *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* in May 1995. The 1995 WQCP includes objectives for Delta outflow, Sacramento and San Joaquin River flows, salinity, dissolved oxygen, and SWP and CVP operations. It presents a combination of Delta inflow and outflow objectives, water quality objectives, and project operation criteria. These requirements are specified temporally and vary depending on the hydrologic condition and the biological needs of various fish species. In accordance with the 1994 Principles for Agreement and the Delta Smelt and Winter-Run Chinook Salmon Biological Opinions, the CVP and SWP are meeting these 1995 WQCP objectives for the Delta. Specifically for the San Joaquin River objectives, the CVP attempts to meet the objectives to the extent possible and consistent with its other obligations.

The flow objectives for the San Joaquin River as measured at Vernalis have been debated in regards to the inadequacy of scientific information relating to salmon smolt survival. In an effort to clarify the scientific basis for the flow objective and resolve the uncertainty, the San Joaquin River and State/Federal export interests (federal and state agencies, irrigation districts, water authorities, and other water interests) collaborated to identify feasible voluntary actions to protect the San Joaquin River's fish resources; help implement the State Board's fishery objectives; and evaluate flow, export pumping, and salmon smolt survival relationships. This collaboration led to a scientifically-based adaptive fishery management plan known now as the VAMP. The Draft San Joaquin River Agreement to implement VAMP provides the basis for the project information here and in Chapter 2. The SJRA provides water to enhance instream flows for anadromous fish and a methodology for establishing flows.

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Delta Smelt Biological Opinion

The March 6, 1995 Biological Opinion (Opinion) for Threatened Delta Smelt, Delta Smelt critical habitat, and the proposed Threatened Sacramento Splittail approved Reclamation's operations to provide flows and pursue acquisition of additional water (acquired flow) in order to provide San Joaquin River flows at Vernalis in excess of those exported by the CVP and SWP (USFWS 1995). Any such enhancement flows would be in excess of those attributable to CVP New Melones releases, unregulated accretions, or unstorable flows, and would not be exported at the Delta pumping facilities. As a result of this Opinion, Reclamation has a requirement to acquire water within the San Joaquin River Watershed to maximize the ability of the CVP to meet this commitment.

1.3 PROJECT OBJECTIVES

The proposed project's objective is to use water secured from willing sellers to provide additional instream flows for the San Joaquin River system. The additional instream flows include a 31-day pulse flow during April and May and other fishery-related flows (e.g., October flow) identified by the CVPIA water acquisition program (Section 3406 (b)(3)) and contained in the SJRA. A description of the proposed stream flow enhancements, or underlying action with specific quantities by willing seller, is provided in Section 2.1, Proposed Action.

Flows for VAMP would be targeted to reach the Vernalis gaging station on the San Joaquin River. The specific objectives of VAMP are: (1) to implement protective measures for San Joaquin River fall-run chinook salmon within the framework of a carefully designed management and study program which is designed to achieve, in conjunction with other non-VAMP measures, a doubling of natural salmon production by improving smolt survival through the Delta; (2) to gather scientific information on the effects of flows in the lower San Joaquin River, CVP and SWP export pumping rates, and operation of a fish control structure at the head of Old River, on the survival and passage of salmon smolts through the Delta; and (3) to provide environmental benefits in the lower San Joaquin River and Delta at a level of protection equivalent to the San Joaquin River portion of the 1995 WQCP for the duration of the Agreement (1999-2010).

The VAMP is also intended to provide benefits through managed and unmanaged flow regimens (underlying action), reduced rates of export during the Spring Pulse Flow Period (related action), and installation of a fish control structure at the head of Old River (related action). All of these actions are expected to contribute to improved conditions aimed at assisting in achieving a doubling of natural production of chinook salmon consistent with the provisions of state and federal law. Some of these actions (exports and barrier operation) are not part of this document's proposed action which is to provide the water to support VAMP and related flows.

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The SJRA (1998) contains three flow components.

- It obligates the Authority and its members to provide the amount of water needed to achieve the April–May Target Flow for VAMP or 110,000 acre-feet, whatever is less. Additional water, in excess of the 110,000 acre-feet required to be provided by the Authority members, may be purchased from willing sellers (if available) to meet the Target Flow for VAMP.

- The Agreement provides for Merced Irrigation District to sell 12,500 acre-feet above the existing flow for release to the Merced River during October of all years as attraction flow.

- The Agreement also provides for Oakdale Irrigation District (OID) to sell 15,000 acre-feet in every year of the Agreement plus the difference between the water made available by OID for VAMP pulse flow (11,000 acre-feet) and the amount actually used. The additional water from OID could be used for ramping around the Spring or October pulse flows or at other times to supplement spawning flows or control water temperature on the Stanislaus River. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.

The Agreement is a "performance agreement" for the VAMP flows in that Reclamation and the California Department of Water Resources will make annual payments to the Authority so long as Authority members perform under the terms of the Agreement. It is also a water acquisition program for the related flows. An important source of funding will be the CVPIA Restoration Fund. The funds paid to the Authority are intended to be used substantially to enhance efficient water management within the districts including, but not limited to, water reclamation, conservation, conjunctive use, and system improvements.

In addition to the total water available from the Agreement for VAMP (110,000 acre-feet), an additional amount of water would be purchased from Merced ID and OID for release at other times during the year to meet objectives of Public Law 102-575, Title 34, Section 3406(b)(3) of the CVPIA. This section requires that a program be developed and implemented in coordination with and in conformance to the AFRP. The U.S. Department of the Interior is developing a long-term program to address the acquisition of water to sustain long-term fish and wildlife supply needs for the entire Sacramento-San Joaquin Delta watershed. The objectives of the long-term program include securing long-term water supplies to supplement the available CVP yield that was dedicated for fish and wildlife purposed under Section 3406 (b)(2). The San Joaquin River Agreement will be included in the long-term program. Additional amounts of water not specified in the Agreement (and not evaluated here) that are to be included in the long-term program would undergo an independent analysis for NEPA/CEQA compliance.

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1.4 AUTHORITY FOR PROJECT

The authority for the proposed project is derived principally from the CVPIA. The CVPIA amended the purposes of the CVP to achieve a reasonable balance among competing demands for use of CVP water for fish and wildlife, agriculture, municipal and industrial, and power contractors.

Section 3406(b)(1) requires the development and implementation of a program (AFRP) that will make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable on a long-term basis, at levels that are at least twice the average levels attained during the period 1967-1991. Reclamation will attempt to meet these requirements through habitat and instream flow improvements in the Delta and the San Joaquin River Basin.

Water may be acquired by Reclamation to meet fish and wildlife needs within the San Joaquin Valley under the authority of Section 3406(b)(3) of the CVPIA. Section 3406(b)(3) provides for the acquisition of water from willing sellers on the streams for the following two specific purposes: "... to supplement the quantity of water dedicated to fish and wildlife purposes under Section 3406(b)(2)... and to fulfill the Secretary's obligations under Section 3406(d)(2)...." Water obtained from willing sellers would be used to provide increased instream flows in specific months to improve habitat, in accordance with preliminary information developed by the AFRP. Acquiring water for the proposed action on the Stanislaus, Tuolumne, Merced, and San Joaquin rivers is authorized specifically under this section of the CVPIA.

In addition, the CVPIA "Final Administrative Proposal on the Management of Section 3406(b)(2) Water" (USBR 1997n) identifies supplemental instream flows including a 31-day pulse flow during April and May for VAMP.

1.5 RELATED PROJECTS

This EIS/EIR is one piece of a "puzzle" to manage resources in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay/Delta). Figure 1.5-1 illustrates that this EIS/EIR relates to other major projects and programs in the Bay/Delta region. This EIS/EIR covers a water management program for the San Joaquin River system, and this system is also affected by the other programs. The Agreement water under CVPIA Section 3406 (b)(3) influences the following actions:

- State Water Resources Control Board Bay/Delta Process (SWRCB 95-1) including water rights hearings
- Central Valley Project Improvement Act (especially Section 3406(b)(2))
- Interim South Delta Program (Reclamation and DWR)
- CALFED Bay-Delta Program

Each of these actions is described in Section 4.12, Cumulative Effects.

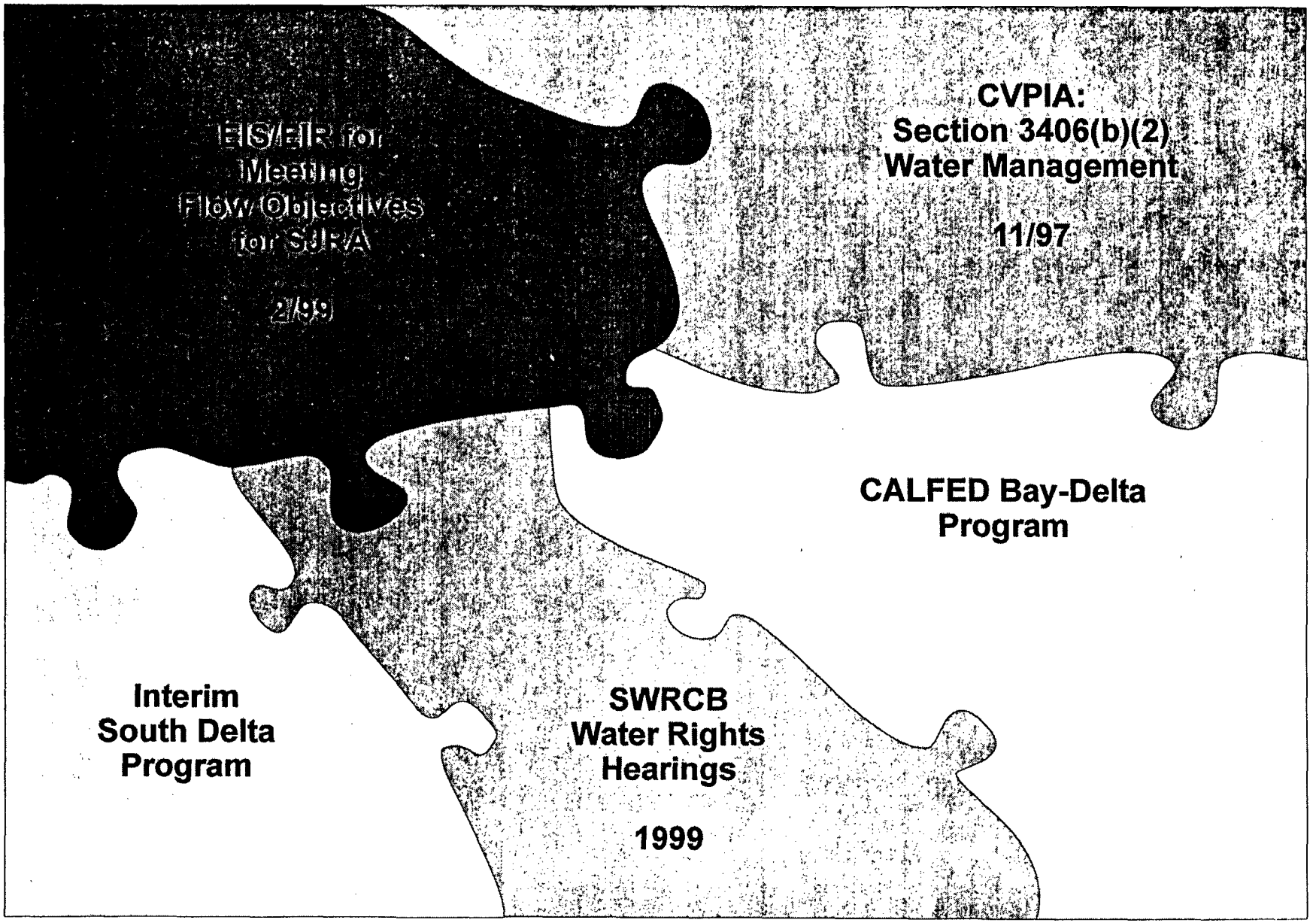

Figure 1.5-1. Delta related programs addressed in cumulative analysis.

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2. ALTERNATIVES INCLUDING PROPOSED ACTION

This section describes the range of alternatives that were identified as potential options to the proposed action. In order to determine if each alternative was reasonable and practicable in meeting the project's purpose and need, evaluation criteria were developed. A screening process, utilizing the evaluation criteria, was employed to select those alternatives which were determined to be reasonable and practicable thus warranting detailed impact analyses.

2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

2.1.1 Description

The proposed action/proposed project is a 12-year, long-term water supply program, outlined in the San Joaquin River Agreement, for instream flows in the San Joaquin River system and has three components:

- Vernalis Adaptive Management Plan (VAMP) Flow: Water from the San Joaquin River Group Authority (Authority), for achieving the VAMP 31-day pulse flow (April-May), is guaranteed water from Authority member agencies and is capped at 110,000 acre-feet in any year (Table 2.1-1). There is also the potential for additional water from willing sellers who are members of the Authority for VAMP implementation above the 110,000 acre-feet required under the Agreement.

- October Flow: Additional water (12,500 acre-feet) from Merced Irrigation District (Merced ID) would be available for delivery during October of all years.

- OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water made available for the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID would be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.

Each of these components is described in greater detail in Section 2.1.3. The proposed project is for the Authority to make water available over the period 1999–2010 for release to the San Joaquin River and its tributaries. The proposed releases vary both in total amount and in the tributaries as

shown in Table 2.1-1 and explained as a single- or double-step target flow in Section 2.1.3.1, depending on hydrologic conditions.

The Agreement obligates the Authority to provide water at Vernalis, and members of the Authority have flexibility under the Division Agreement (Table 2.1-1) on a year to year basis for who would provide the water.

Table 2.1-1: HIERARCHY FOR THE PROVISION OF THE PULSE FLOW (31-DAY PERIOD) FOR VERNALIS ADAPTIVE MANAGEMENT PLAN (110,000 ACRE-FEET CAP)

Entity (in order of providing flow)	First 50,000 AF	Next 23,000 AF	Next 17,000 AF	Next 20,000 AF	Totals 110,000 AF
Merced	25,000	11,500	8,500	10,000	55,000
OID/SSJID	10,000	4,600	3,400	4,000	22,000
Exchange Contractors	5,000	2,300	1,700	2,000	11,000
MID/TID	10,000	4,600	3,400	4,000	22,000

Note: Water is available in the amounts listed such that the water needed is distributed throughout the system. For purposes of this analysis, these are the flows that were used. The San Joaquin River Technical Committee (Operations Group) will determine best management of flow releases during the pulse flow period to achieve target flows.

2.1.2 Location

The affected portions of the San Joaquin River and its tributaries (Stanislaus, Tuolumne, and Merced Rivers) are located in the Central Valley of California (Figure 2.1-1). The rivers and related storage and conveyance facilities are located in the following counties: Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, and Tuolumne. The project area is defined by river as follows:

- **San Joaquin River**: From Vernalis to point of release by the San Joaquin River Exchange Contractors Water Authority. The point of release is most often north of the town of Los Banos, but releases could be made as far upstream as the Mendota Pool.

- **Stanislaus River**: From its confluence with the San Joaquin River to and including New Melones Dam and Reservoir.

- **Tuolumne River**: From its confluence with the San Joaquin River to and including New Don Pedro Dam and Reservoir.

- **Merced River**: From its confluence with the San Joaquin River to and including New Exchequer Dam/Lake McClure.

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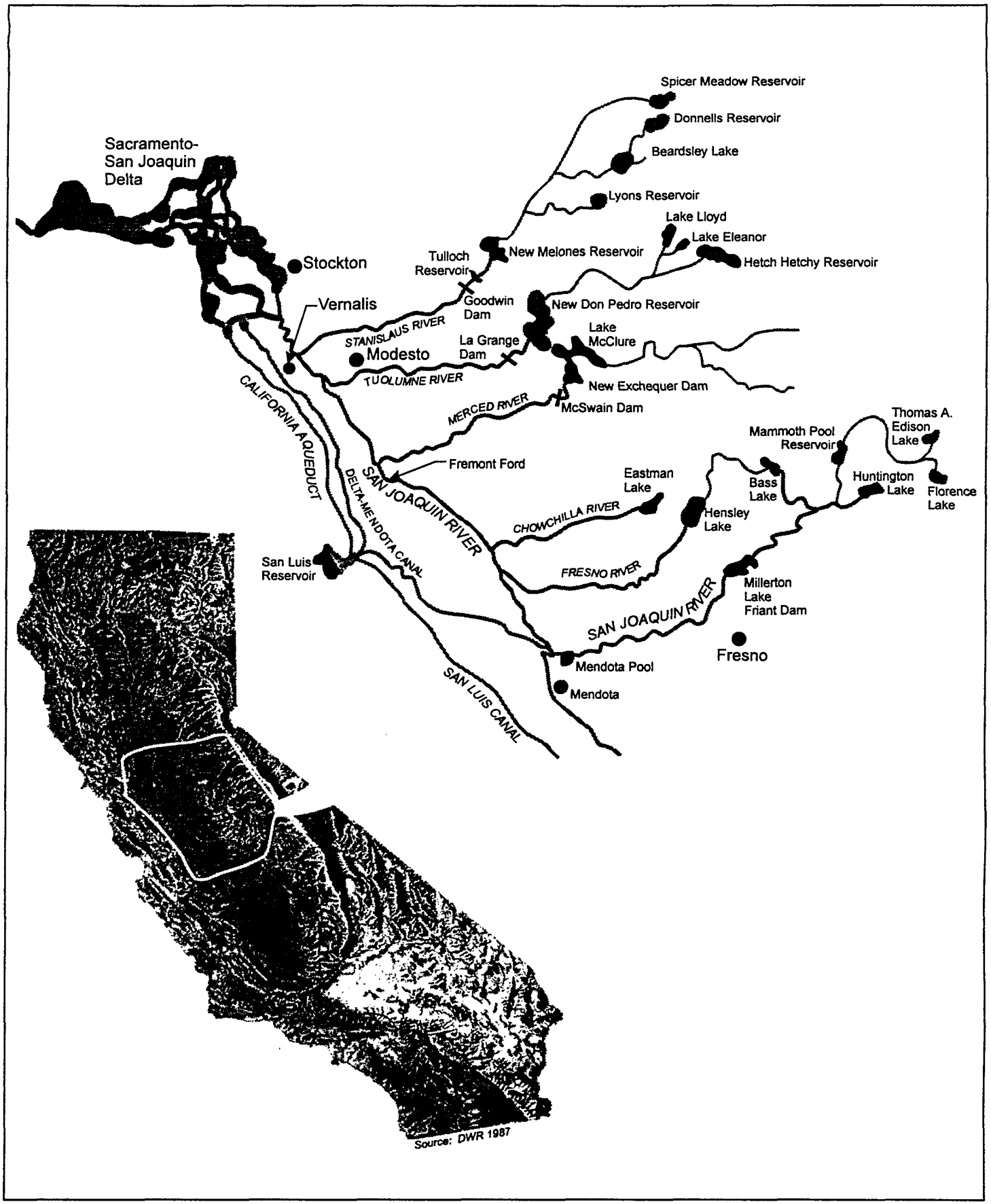

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Figure 2.1-1. Map of San Joaquin Valley project area and vicinity

These rivers are located between the communities of Stockton on the north and Mendota on the south. Figure 2.1-1 illustrates the project area and vicinity.

2.1.3 Characteristics

The specific characteristics of the proposed project (preferred alternative) consist of three flow components.

2.1.3.1 VAMP Flows

VAMP flows are guaranteed water supplies for the April-May pulse flow from the Authority of up to 110,000 acre-feet per year to support VAMP. The Authority proposes to cause to flow in the San Joaquin River at Vernalis during each April and May, a 31-day pulse flow period, the amount of water needed to achieve the Target Flow (described below) or up to 110,000 acre-feet, whichever is less. Additional water (in excess of the required water, possibly up to a total of 160,000 acre-feet) necessary to achieve VAMP Test Target Flow may be available on a "willing seller basis."[1]

- The Pulse Flow Period is defined as a period of 31 continuous days during the months of April and May. This is anticipated to be the period that most of the juvenile anadromous fish migrate out of the tributaries, through the Delta, and into the Pacific Ocean in order to complete their life cycle. It is expected to occur most often between mid-April and mid-May. The timing of the pulse flow is to coincide with the peak period of time when naturally spawned smolts are migrating out of the San Joaquin River Basin.

- The Target Flow is a specific flow regime between 2,000 and 7,000 cubic feet per second (cfs) for the Pulse Flow Period. It consists of the existing flow, plus either a single-step incremental increase in flow (over existing flow) or a double-step increase, depending on hydrologic conditions.

The 31-day out-migration Target Flow would be established as follows:

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1 The need for "up to" 160,000 acre-feet derives from the mathematics of the double-step target flows and the 110,000 acre-feet cap as described in Appendix A, Hydrologic Analysis. In the maximum exposure case where the "existing flow" is 4,450 cfs and the double-step increment requires a target flow of 7,000 cfs, the required flow would amount to approximately 2,550 cfs to get to 7,000 cfs. This amounts to approximately 156,800 acre-feet for the 31-day period. The SJRA identifies that willing sellers could provide the 50,000 acre-feet over and above the 110,000 acre-feet cap when it is available. Additional NEPA/CEQA analysis would be required, as who would provide the water and on which river is not known at this time.

Single-Step Target Flow. Unless modified by the subsequently listed criteria, the annual 31-day out-migration Target Flow equals:

Existing Flow (cfs)	Target Flow (cfs)
0–1,999	2,000
2,000–3,199	3,200
3,200–4,449	4,450
4,450–5,699	5,700
5,700–6,999	7,000
7,000 or greater	Existing flow

When the existing flow exceeds 7,000 cfs, the Authority would use its best efforts to maintain a constant or stable flow rate during the Pulse Flow Period to the extent reasonably possible through cooperating in development of an operations plan and coordination of operations during the Spring Pulse Flow. During high flow events such as those occurring in Spring 1998 (20,000 cfs), it may not be possible to maintain a constant flow rate at Vernalis during the 31-day pulse flow period.

Double-Step Target Flow. In any year when the sum of the current year's 60-20-20 Indicator and previous year's 60-20-20 Indicator is seven or greater, an annual 31-day out-migration flow target will be the Target Flow one level higher than that established by the single-step Target Flow. The 60-20-20 Indicator is the numeric adjunct to the State Water Resource Control Board's (SWRCB's) San Joaquin Valley Water Year Hydrologic Classification that is used to establish Target Flows and certain responsibilities of the parties to the Agreement. The San Joaquin Valley Water Year Hydrologic Classification was developed as an index of wetness and water supply availability within the San Joaquin River basin. The index is mathematically derived as the summation of 0.6 times the current year's April–July San Joaquin Valley unimpaired runoff, plus 0.2 times the current year's October–March unimpaired runoff, plus 0.2 times the lesser of 4.5 or the previous year's index (thus the "60-20-20" reference). The streams used in the index are the Stanislaus, Tuolumne, Merced and the San Joaquin. The index defines five different year types: wet, above normal, below normal, dry and critical. Each of these year types has been designated a numeric indicator by the Agreement.

The 60-20-20 Indicator for VAMP is as follows:

SJR Basin 60-20-20 Classification	60-20-20 Indicator
Wet	5
Above Normal	4
Below Normal	3
Dry	2
Critical	1

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For example, assuming a dry year followed by a wet year results in the sum of 7 (i.e., 2 + 5 = 7). Assuming the single-step Target Flow is 5,700 cfs, one step higher would be 7,000 cfs.

If achieving the double-step requires more than the 110,000 acre-feet of supplemental water, additional water from willing sellers on the San Joaquin, Stanislaus, Tuolumne, and Merced rivers (approximately 50,000 acre-feet) may be acquired by the Bureau of Reclamation (Reclamation) for the Pulse Flow Period, and it would require additional NEPA/CEQA analysis.

Sequential Dry Year Relaxation. During years when the sum of the current year's 60-20-20 indicator and the previous two years' 60-20-20 Indicator is four (4) or less, the Authority's members will not be required to make water available above existing flow, except as may be provided by Merced and Oakdale Irrigation Districts or any of the districts under the willing sellers provision of the SJRA. Reclamation has continuing obligations to meet San Joaquin River flows pursuant to the March 6, 1995 Biological Opinion and may acquire water in excess of the amounts to be provided by Authority members under the Agreement.

Operations Plan. Reclamation and the California Department of Water Resources (DWR) will develop an operations plan in conjunction with tributary facilities operators (the San Joaquin River Technical Committee). By February 15 of each year 1999–2010, the initial version of this plan will be described. The plan would be evaluated for NEPA/CEQA compliance, and related actions not covered in this EIS/EIR or other NEPA/CEQA documentation would be evaluated at that time for potential environmental impacts. Then in early April, flow and export targets would be finalized and releases scheduled to meet the target flows at Vernalis. The operations plan is to be updated periodically.

2.1.3.2 October Flow

Merced ID would provide 12,500 acre-feet of water to enhance flows in October to attract adult salmon returning into the tributaries to spawn. It would be released from storage or provided as re-operated flood control releases.

2.1.3.3 Oakdale Irrigation District

Contained within the Agreement is the provision that Reclamation would purchase up to 15,000 acre-feet of water from OID. In addition, Reclamation will purchase any remaining share from OID after it has met its commitment (11,000 acre-feet) to support the target flows at Vernalis. The Agreement states that this water may be used for any authorized purpose of the New Melones Project. The water would be held in storage and subsequently reallocated to these authorized uses in subsequent years.

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If this water is purchased under the authority of Central Valley Project Improvement Act (CVPIA) Section 3406 (b)(3), its use would be to "...supplement the quantity of water dedicated to fish and wildlife purposes...." It could also be used to firm up other environmental purposes of the New Melones Project and CVPIA. The environmental purposes of New Melones which could benefit from the additional water provided by OID would include the following: instream flows on the Stanislaus, ramping of flow changes on the Stanislaus, implementation of VAMP and post-VAMP ramping objectives under CVPIA, releases of water to meet San Joaquin base flows consistent with X2 requirements, releases of water to provide fall attraction flows, salinity control at Vernalis, temperature control in the lower Stanislaus, and improved carryover storage in New Melones for the purpose of reducing risk of future shortage. Full use of the acquired OID water for environmental purposes may result in New Melones Project supplies being available for other purposes. The specific allocation of the New Melones Project supplies will be addressed in future interim operations plans and ultimately in the long-term operations plan for New Melones Reservoir.

2.1.4 Sources of Water

The sources for the water provided to Reclamation under the San Joaquin River Agreement are: re-regulation or surface water storage, groundwater, tailwater recovery, and conservation. The amounts of water available by source per the Agreement (Table 2.1-2) represent a potential range to reflect varying hydrologic conditions that could occur over the 12-year period of the proposed project. The total amount of water for all three components described in Section 2.1.1 is up to 137,500 acre-feet.

Table 2.1-2 includes only the 110,000 acre-feet for the VAMP Target Flow. It does not include the 50,000 acre-feet above the 110,000 acre-feet cap that may be needed for the maximum exposure case (see Section 2.1.3.1).

A brief discussion of these types of sources follows.

Regulation or Surface Water Storage. Much of the water would come from changes in existing diversions or release patterns at non-Central Valley Project (CVP) facilities pursuant to the sellers' applicable water rights. Water may also be provided from willing sellers that have water stored in New Melones Reservoir. The end of year storage could change, depending on the amount of water provided by re-regulation or within the year pattern of storage during the year.

Groundwater. Several districts pump groundwater to meet part of their water delivery needs. Although surface water storage is the principal source of water to meet instream flow objectives under the Agreement, some willing sellers may be able to rely on groundwater supplies directly or indirectly to replace surface water depending on hydrologic conditions.

Table 2.1-2: SOURCES OF AVAILABLE WATER FOR PROPOSED PROJECT (TAF)

Source	Exchange Contractors	OID[1]	SSJID	MID	TID	Merced ID[2]	All
Regulation or Surface Water Storage	0	0-26	0-11	0-11	0-11	0-67.5	0-126.5
Groundwater	0-11	0-15	0	0	0	0[3]	0-26
Tailwater Recovery[4]	0-11	0-15	0	0	0	0-5[5]	0-31
Conservation	0-11	0-20	0-5	0[6]	0-11	0[6]	0-47
Range of Available Water	0-11.0	0-26.0	0-11.0	0-11.0	0-11.0	0-67.5	0-137.5[7]

Notes:

[1]Water includes 15,000 acre-feet for release at any time during the year.
[2]Water includes 12,500 acre-feet for delivery in October for fall attraction flow.
[3]No groundwater will be provided directly for meeting VAMP target flows. Groundwater would be pumped to help meet potential water supply impacts from increased releases from New Exchequer Reservoir (Lake McClure).
[4]Tailwater is not used as a direct release to canals/rivers for pulse flow. Rather it replaces other water released.
[5]Merced ID will attempt to recover greater quantities of tailwater; however, the current tailwater quantities are small and drain to areas that are not hydraulically connected to the San Joaquin River.
[6]Conservation projects will be undertaken on an "as needed" basis to improve operations and reduce unrecoverable losses. These projects may include improvements to canals and other projects.
[7]Total includes the 110,000 acre-feet for the Spring Pulse Flow plus the additional water in notes 1 and 2 above.

Tailwater Recovery. Reuse of tailwater flows is defined as the act or act(s) of reclaiming surface water from irrigated lands into a surface supply system. This can be achieved either by gravity or by low lift pumps. The recovered water would be reused within the political boundaries of the agency or agencies from which it originated.

Conservation. Water conservation measures are those that would result in water savings from increased water management efficiencies. Conserved water is water that has historically been used and is now available for use as a result of implementing specific conservation measures that create a water savings by reducing water uses or losses. These savings can be achieved by reducing losses to evaporation, transpiration, percolation, or surface outflows. For example, lining canals reduces water lost to percolation. Savings can also be achieved by implementation of different means of water distribution such as drip irrigation.

2.1.5 Scope of Project

The proposed project would occur on an annual basis over the period 1999 through 2010. The results of the experimental studies would be evaluated to help determine the appropriate Vernalis flow objective after 2010. The Agreement covers the 12-year period 1999-2010. Any project for the post-2010 period would be subject to additional NEPA and CEQA analyses.

This EIS/EIR addresses only the underlying action in the SJRA of providing for San Joaquin River water identified in the Agreement for VAMP and for other related flows in the San Joaquin River.

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Non-flow aspects of VAMP and other aspects of CVPIA-related water operations are related actions that are not within the scope of this document and have independent applicability to NEPA or in some cases have no NEPA requirement. This document evaluates the impacts of the flows on the environment with a focus on potential impacts to the following resources and concerns: surface water, groundwater, biological resources (vegetation, wildlife, fisheries), land use (including agriculture), recreation, cultural resources, Indian Trust Assets, and environmental justice. This EIS/EIR focuses on potentially significant impacts and addresses non-significant issues at a reduced level of detail. Cumulative and other short- and long-term impacts are evaluated as well. What is being evaluated herein is the underlying action of providing water and its subsequent release for instream flow according to the amounts and schedule of the Agreement.

There are several related projects contained in the Agreement that are not part of the project being evaluated herein. DWR's barrier at the head of Old River is part of the Interim South Delta Program (ISDP) and is addressed in separate NEPA/CEQA proceedings (DWR 1996). Finally, export targets and operations are outside of the scope of the water supply action and this document. Exports of water from the Delta include actions under the CVPIA and are included in the range of actions evaluated in the 1997 Draft PEIS. This range of actions includes both no export and export of acquired water for streams under Section 3406(b)(3). Also, see Figure 1.5-1, programs for the cumulative analysis.

The combined Central Valley Project/State Water Project (CVP/SWP) exports for the VAMP are set at 1,500, 2,250, or 3,000 cfs (as provided in the Agreement) during the April through May, 31-day Pulse Flow Period, or the exports are further constrained by other Delta criteria. These export targets (Table 2.1-3) are necessary to complete the salmon survival studies which constitute the monitoring and adaptive management component of VAMP. The combination of flow and export targets are consistent with the existing Biological Opinions. Export limits would be included in the operations plan described in Section 2.1.3.1. If the operations plan is unacceptable to any Party in the Agreement, then the export limits in Table 2.1-3 shall not apply during that calendar year. However, Reclamation and DWR shall not be constrained in the operation of their respective project.

Table 2.1-3: VAMP TARGET FLOWS AND EXPORT RATES

	Vernalis Flow Rate - cfs				
Exports	7,000	5,700	4,450	3,200	2,000
1,500 cfs	X		X	X	X
2,250 cfs		X			
3,000 cfs	X				

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2.1.6 Required Approvals and Permits

No alterations of stream channels would occur under the proposed action. No permit is required from the U.S. Army Corps of Engineers to implement the flows. There are SWRCB permits required for the water purchases for release to the rivers. The SJRGA agencies have filed a petition for a change in place and purpose of use to preserve or enhance wetlands habitat, fish and wildlife resources, and recreation in or on the water pursuant to Water Code Section 1707. OID and SSJID are applying/filing petitions for a change in place and purpose of use for exchanges with Modesto Irrigation District (MID). A description of environmental commitments from Federal and State agencies is provided in Section 5.3.

2.2 OTHER REASONABLE ALTERNATIVE

In addition to the no action and proposed action, one other alternative was determined to meet the project's purpose and need, the SWRCB Water Right Priority system. This alternative is assumed to be identical to Flow Alternative 3 in the SWRCB's *Draft Environmental Impact Report for Implementation of the 1995 Bay/Delta Water Quality Control Plan* (1995 WQCP DEIR; SWRCB 1997). Detailed analyses of this alternative are included in Chapter 4. This alternative has the capabilities to meet the SWRCB's 1995 Water Quality Control Plan Vernalis flow objectives assigned to water right holders based on a water right priority system. Under this alternative, water right holders share responsibility to implement flow objectives. Junior appropriative water right holders are required to cease diversions before senior appropriative water right holders are affected (based on the 'first-in-time, first-in-right" principle).

Under this Water Right Priority Alternative, the SWRCB analysis assumes water right holders are assigned to groups based on their priority (see SWRCB 1997; Table II-5 and II-6). Groups of appropriators are directed to cease both diversions to storage and direct diversions when flow is inadequate to meet outflow objectives. The number of groups of water right holders receiving notification is based on the amount of water necessary to ensure that the SWP and CVP storage releases do not exceed their downstream inbasin and export delivery obligations (SWRCB 1997; pg. II-17) and the amount of water necessary to meet the flow objectives at Vernalis. A detailed description of the water right holders, their relative priority, and the calculations used to determine water availability under this alternative (and its subalternatives) is provided in the DEIR (SWRCB 1997; Chapter II and Chapter IV, Section F).

2.3 NO ACTION ALTERNATIVE

The No Action alternative represents existing conditions plus reasonably foreseeable future conditions that would exist without the proposed action. This No Action alternative is the

benchmark for comparison of impacts of the other alternatives, and assumes the following conditions:

- Implementation, to the extent possible, of the SWRCB's 1995 Water Quality Control Plan through operations of the CVP and SWP.
- Adherence by the CVP and SWP to the March 6, 1995 delta smelt and February 12, 1993 winter-run chinook salmon Biological Opinions.
- November 1997 Draft Anadromous Fish Restoration Program (AFRP) actions for instream flows in Clear Creek and below Keswick and Nimbus reservoirs, and a Trinity River maximum release of 340 TAF. No additional AFRP Delta actions other than the 1995 WQCP.
- New Melones is operated consistent with the Interim Plan of Operation, dated May 1, 1997.
- San Joaquin River tributary (Merced and Tuolumne rivers) minimum instream flows pursuant to existing agreements and regulatory requirements (for example, Davis-Grunsky and FERC). Operations of the tributaries are also governed by existing required flood control protocols.
- Current level of hydrology and operations in the San Joaquin Valley, including delivery of Level 4 refuge supplies.

The No Action alternative does not always meet the requirements for fishery flows contained in the 1987 Stanislaus Fishery Agreement between Reclamation and California Department of Fish and Game (DFG). The Interim Operations Plan (USBR 1997c) does not prescribe a specific allocation of fishery water in critical years. However, the Interim Operations Plan is adaptive; and while other releases not specifically allocated for the fishery assist in meeting the 1987 agreement, it is understood that critical fishery flows will need to be addressed on a case by case basis. The interim plan is to be revised and a long-term operation plan developed for New Melones Reservoir through the Stanislaus River Stakeholders process. Assumptions used in the hydrologic modeling for the SJRA flows contained in this EIS/EIR are not statements of Reclamation's policy for the long-term operations plan.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

A list of 26 alternatives was developed based on current knowledge of the basin, knowledge of other initiatives (e.g., 1995 WQCP DEIR, CVPIA PEIS, etc.), and information gained in the public scoping process. Three public meetings were held where concerns, input and suggestions from stakeholders were solicited, recorded, and considered in formulating the list of alternatives.

The alternatives were screened during a two step process. During the first step, all 26 alternatives were considered and screened using evaluation criteria that are based on the project's purpose and need as explained in Chapter 1. This culminated in six alternatives which were considered in more detail. Comments were solicited from four resource agencies and members of the Authority regarding the concerns about potential impacts, which eliminated most of the remaining alternatives from further consideration. A final screening resulted in the final alternatives to receive a detailed impact analysis in this EIS/EIR.

2.4.1 Description of Each Alternative

Each of the 26 alternatives was assigned a number and an acronym to facilitate the screening process described in a subsequent section of this chapter.

1: NA — No Action: See description in Section 2.3.

2: REC — Recirculation: Responsibility for meeting Vernalis flow objectives for anadromous fish is with the CVP through releases from New Melones and releases into the San Joaquin River from the Delta-Mendota Canal (DMC) via the Newman Wasteway. Increased pumping of Tracy is required. Combined use of SWP/CVP points of diversion are allowed.

3: FR — Friant Releases: Water would be made available from the CVP through releases into the San Joaquin River from Friant Dam.

4: CFR — Combined Federal Releases: Water would be made available from the CVP through a combination of releases from: (a) the Stanislaus River (New Melones Reservoir), (b) Friant Dam, and (c) the Delta-Mendota Canal (via Newman Wasteway).

5: NM — New Melones Reservoir: Responsibility for meeting Vernalis flow objectives would be solely the CVP through releases into the Stanislaus River from New Melones Reservoir.

6: HH — Hetch Hetchy Reservoir: The City and County of San Francisco would re-operate Hetch Hetchy (and New Don Pedro Reservoir would be re-operated) with releases into the Tuolumne River.

7: EFS — Ecological Fair-Share: Responsibility for meeting Vernalis flow objectives would be based on the unimpaired flow of all tributaries to the San Joaquin River (Stanislaus, Tuolumne, Merced, upper San Joaquin rivers). Water would come from willing

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sellers/willing buyers. This alternative is similar to the SWRCB Flow Alternative 5.

8: WCT — Worst Case by Tributaries: This alternative would assign responsibility for meeting Vernalis flow objectives solely to each of the water right holders within the San Joaquin River Basin. This taking of water could be done through various administrative, legal, or legislative actions.

- Alt 8a: Stanislaus River has all the responsibility
- Alt 8b: Tuolumne River has all the responsibility.
- Alt 8c: Merced River has all the responsibility.
- Alt 8d: Upper San Joaquin River above the Merced confluence has all the responsibility.

9: RSL — Re-operate San Luis Reservoir: The SWP and CVP would make water available through re-operation of San Luis Reservoir and releases into the San Joaquin River from the DMC via the Newman Wasteway similar to recirculation. However, increased pumping at Tracy is not required. Combined use of SWP/CVP points of diversion would be allowed.

10: CRR — Conservation Plus Re-operation of Reservoirs: Responsibility for meeting Vernalis flow objectives is met equally on Stanislaus, Tuolumne and Merced rivers, and Upper San Joaquin River Basin (Friant Dam). Water would be obtained through conservation efforts within each basin and subsequent re-operation of reservoirs.

11: GW — Groundwater: Responsibility for meeting Vernalis flow objectives is met equally on Stanislaus, Tuolumne and Merced rivers, and Upper San Joaquin River Basin (Friant Dam). Water would be obtained through groundwater pumping within each basin and possible re-operation of reservoirs.

12: ASF — Additional Storage Facilities: Water would be made available by altering and re-operating existing facilities to accommodate more storage and provide more flow:

- Alternative 12a: Raise New Melones Reservoir on the Stanislaus River.
- Alternative 12b: Raise New Don Pedro Reservoir on the Tuolumne River.
- Alternative 12c: Raise Hetch Hetchy Reservoir and Cherry Lake on the Tuolumne River.
- Alternative 12d: Raise New Exchequer Dam/Lake McClure on the Merced River.

Alternative 12e: Raise Friant Dam/Millerton Lake on the Upper San Joaquin River.

13: WRP SWRCB Water Right Priority System: See above (Section 2.2) for description.

14: ESP East Side Project: As once proposed by Reclamation, this project was to have been an extension of the Folsom Canal along the Sierra Foothills from Folsom Dam to the San Joaquin River, including new reservoirs.

15: CON Condemnation by Federal and/or State: Vernalis flow objectives would be met by condemnation of water rights associated with each project. Each scenario would start with junior appropriators and move to senior water rights holders until sufficient water was obtained to meet Vernalis flow objectives or until all the available water is condemned.

Alternative 15a: Condemn Stanislaus River water rights and re-operate New Melones Reservoir.

Alternative 15b: Condemn Tuolumne River water rights and re-operate New Don Pedro Reservoir.

Alternative 15c: Condemn San Francisco's water rights on the Tuolumne River and re-operate New Don Pedro Reservoir.

Alternative 15d: Condemn Merced River water rights and re-operate Lake McClure.

Alternative 15e: Condemn Upper San Joaquin River water rights and re-operate Friant Dam.

Alternative 15f: Condemn San Joaquin River Exchange Contractors Water Authority water rights.

Alternative 15g: Condemn San Joaquin River basin water rights based on water right priority system. See SWRCB's DEIR, Flow Alternative 3.

16: MAQ Mountain aquifers used: Water would be obtained from pumping of perched aquifers located in the Sierras with possible re-operation of projects.

17: POB Purchases outside the SJR Basin with Delta re-operations: Water from outside the San Joaquin River Basin would be purchased or otherwise acquired. This alternative would include water transfers and possible Delta facility re-operation, and it may not make water available at Vernalis.

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18: SJR — Acquire water from the SJRGA (VAMP and other flows in the SJRA): This is the proposed project/preferred alternative (see Section 2.1 above for description).

19: URW — Reclaimed wastewater from municipal and/or large industrial sewage treatment plants: Vernalis flow objectives would be met by using reclaimed wastewater within the San Joaquin River Basin. Treated effluent from municipal or industrial sites would need to be stored on-site and then conveyed into the San Joaquin River system in April–May and in October.

20: WMR — Weather modification and re-operation: Vernalis flow objectives would be met by using weather modification processes to increase San Joaquin River Basin precipitation, increase storage/yield, and re-operate reservoirs.

21: ESL — Eliminate seepage losses from San Joaquin River: In this alternative, seepage losses in the upper San Joaquin River (between the Mendota Pool and Friant Dam) would be eliminated to increase effective flow. Responsibility for meeting Vernalis flow objectives would fall solely on the CVP through subsequent re-operation of Friant Dam.

22: DDW — Desalt drainage water: Vernalis flow objectives would be met by treatment and desalinization of agricultural drainage water providing increases in storage/yield, and possible re-operation of reservoirs.

23: PWD — Purchase one or more water districts and their water rights: Vernalis flow objectives would be met by purchasing one or more of the water districts on the Stanislaus, Tuolumne, Merced, San Joaquin rivers (upper San Joaquin and Exchange Contractors) and using the acquired water rights to meet the VAMP water needs at Vernalis.

24: BFC — Buy out Federal contracts: Vernalis flow objectives would be met by purchasing the CVP contracts serviced by New Melones Reservoir and Friant Dam (including the Exchange Contractors) and using the acquired contracts to meet the VAMP water needs at Vernalis.

25: SWP — State Water Project re-operation (State would cease their project during pulse flows): Vernalis flow objectives would be met by re-operation of the State Water Project, curtailment of exports, re-operation of San Luis Reservoir, and releases of water into the San Joaquin River via the Delta-Mendota Canal.

26: WSB Willing Sellers/Willing Buyers: Vernalis flow objectives would be achieved via water purchases (similar to the interim water acquisitions now occurring) based on willing sellers/willing buyers in all tributaries to the San Joaquin River (Stanislaus, Toulumne, Merced, upper San Joaquin River). This would be a market driven alternative in that the prices offered for water would determine which and how many buyers would be willing to provide water to meet the Vernalis fish flow objectives. Water availability, acquisition needs, water prices, and sellers would vary throughout the project lifetime.

2.4.2 Screening of Alternatives

Both NEPA and CEQA require that an EIS or EIR identify and analyze only reasonable alternatives. These reasonable alternatives are developed through a systematic evaluation of all alternatives based on a set of pre-defined screening criteria to evaluate their feasibility. A general definition of feasibility is: capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors. Alternatives may not be rejected merely because they are beyond an agency's authority, would require new legislation, or would be too costly. For CEQA, reasonable alternatives are to be limited to only those that would avoid or substantially lessen at least one of the significant environmental effects of the proposed project. NEPA requirements to review and screen alternatives as options, prior to completing the impact analyses, were utilized. The results of the review are incorporated into this chapter. The CEQA requirement to select a short list of reasonable, practicable alternatives was also addressed during screening by taking into consideration the following areas of potential environmental concern or impact: surface water quality and quantity, groundwater, vegetation and wildlife, fisheries, land use including agriculture, recreation, and energy production.

The following screening criteria are comprised of objectives related to the Purpose and Need Statement (see Section 1.1) and other criteria.

2.4.2.1 Screening Criteria from Project Objectives

VAMP criteria: Is there sufficient water availability necessary to meet VAMP flow criteria for 31-day pulse flow in April/May (for downstream emigration of fall-run chinook salmon smolts in the San Joaquin Basin)? Increased water needs to be available to meet VAMP criteria under varying hydrological conditions.

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Reliable water supplies: Are there reliable water supplies available for VAMP and related flows over the term of the Agreement and proposed action (1999–2010)? Water will be needed starting in April 1999, and reliance on a series of 1-year acquisitions is not acceptable over the long term.

Implement in Near Term: Is implementation possible in the near term, both physically and legally? Are the facilities to store and convey the water in place or can they be provided quickly (within a year)? Is the alternative likely to be subject to protracted litigation such that it cannot be implemented in the near term?

Fall Attraction Flows: Water must be available for fall attraction flows (October) for upstream migration of fall-run chinook salmon adults.

Water at Vernalis: Water from the alternative has to be made available as flow at Vernalis (at Airport Way Bridge) on the San Joaquin River. Vernalis is the point of entry into the Delta on the San Joaquin River where flow measurements are taken. The water must be available at Vernalis as required by the SWRCB.

2.4.2.2 Other Criteria

No new TES: Does the alternative have the potential to contribute to triggering of a threatened or endangered listing of any species? A reasonable outcome or positive effect is that the alternative would not lead to the listing of new species as threatened or endangered under the Endangered Species Act (ESA) or California Endangered Species Act (CESA) or cause a species to be of special concern under CESA.

Impacts to 3rd parties: Does the alternative have minimal or mitigable impacts to third parties (for example, economic, social, cultural, environmental justice), a type of indirect impact, due to flow releases? This would potentially include impacts to downstream water users.

Cost: Would the alternative have a reasonable cost for implementation? Major construction of new facilities is assumed to be costly. Cost alone cannot be used to exclude an alternative.

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State Water Law: Is the alternative reasonable and implementable under California Water Law? Does the alternative comply with all state and federal laws?

Different from SJRA: Is the alternative a distinctly different approach from the preferred alternative of making water available for the SJRA including VAMP (No. 18)?

2.4.2.3 Initial Screening

The results of the initial screening (Table 2.4-1, alternative screening matrix) summarize the evaluation of all 26 alternatives, including the no action (1:NA), the preferred action (18:VAM), and the other reasonable alternative (13:WRP). The resultant selection of the reasonable, practicable alternatives (1:NA, 18:SJR, and 13:WRP) are analyzed in detail in the impacts section of this EIS/EIR (Chapter 4). Each of the 26 alternatives have been examined against the criteria and scored as follows:

+ = a potentially positive effect or is reasonable relative to the criterion
o = a neutral or no impact
- = a potentially negative effect or is unreasonable relative to the criterion
? = unknown effect or not enough information presently available
Y = yes
N = no

The greater the number of positive effects, and the fewer the negative effects, the more feasible (reasonable or practicable) the alternative becomes. "Reasonable (or "unreasonable") relative to a criterion applies when a positive or negative effect is not applicable. For example, a reasonable response to scoring for cost means that a large financial investment is unlikely in relation to the cost of implementation or of new facilities. The cost criterion is not simply positive or negative but rather reasonable or unreasonable.

The alternatives screening matrix was developed based upon specific knowledge, published reports, and professional judgement and is presented in Table 2.4-1. In short, the set of 26 potential alternatives was reduced to six for further evaluation using this matrix.

TABLE 2.4-1 INITIAL SCREENING OF ALTERNATIVES FOR EIS/EIR

	Screening Criteria									
Alternative	VAMP Criteria	Reliable Water Supplies	Implementable in Near Term	Fall Attrac. Flows	Water at Vernalis	No new TES	Impacts to 3rd Parties	Cost	State Water Law	Different from SJRA?
1: NA	–	–	+	–	–	–	–	–	–	Y
2: REC	–	–	–	–	+	–	–	–	O	Y
3: FR	–	–	–	–	+	O	–	–	+	Y
4: CFR	+	+	–/O	+	+	+	–	–	+	Y
5: NM	–	–	–	+	–	O	–	+	O	Y
6: HH	–	–	–	+	+	O	–	–	?	Y
7: EFS	+	+	–	+	+	+	–	–	–	Y
8: WCT	–	–	–	+	+	O	–	–	–	Y
9: RSL	–	–	–	–	+	O	–	–	O	Y
10: CRR	–	–	–	–	–	+	O	–	+	N
11: GW	–	–	+/?	–	–	+	–	–	–	N
12: ASF	+	+	–	+	+	–	O	–	+	Y
13: WRP	+	+	+	+	+	+	–	–	?	Y/?
14: ESP	+	+	–	+	–/+	–	–	–	+	Y
15: CON	+	+	–	+	+	+	–	–	+	?
16: MAQ	–	–	–	–	–	–	–	–	–	Y
17: POB	–	–	–	–	–	–	–	–	–	Y
18: SJR	+	+	+	+	+	+	+	+	+	N
19: URW	–	–	–	–	–	–	O	–	+	Y
20: WMR	–	–	–	–	–	?	–	–	?	Y
21: ESL	+	–	–	–	+	–	–	–	+	Y
22: DDW	+	+	–	–	+	+	+	–	+	Y
23: PWD	+	+	–	+	+	+	–	–	–	Y
24: BFC	+	+	–	+	+	+	–	–	+	Y
25. SWP	+	+	–	+	+	+	–	–	–	Y
26. WSB	+	+	–	+	+	+	–	–	–	N/?

+ Potentially positive effects or reasonable.
O Potentially neutral or no effect.
– Potentially negative effects or unreasonable.
? Unknown or not enough information presently available.
Y Yes.
N No.

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2.4.2.4 Secondary Screening

In addition to the no-action and proposed-action alternatives, the following alternatives were examined by several agencies and districts (SJRA/Cooperating Agency Steering Committee) during secondary screening using the criteria (see Section 2.4.2.1): Recirculation, Willing Seller/Willing Buyer, Worst Case by Tributary, and SWRCB Water Right Priority System. The additional review led to the following conclusions:

Recirculation (2:REC)

This alternative could cause major adverse impacts to fisheries and endangered species. Preliminary modeling for this alternative has been completed by DWR and described in a draft report *(SJRIO Studies of San Joaquin River Recirculation and Reoperation of Wetland Discharge and Tile Drainage)* (DWR 1998). The modeling included determining the flows from the Tuolumne, Merced and Stanislaus rivers which are regulated in part by FERC agreements or FERC orders. The amount of additional water needed to meet the Vernalis spring pulse flows was determined. For modeling purposes, this additional water was supplied by releases from the DMC to the San Joaquin River via the Newman Wasteway, which was then recovered by re-exporting an equivalent volume of water from the Delta. This recirculation was superimposed on the flows and pumping that would occur in the absence of the supplemental water. Due to flow time delays, the system would be primed at the beginning of the pulse flow period with water from San Luis Reservoir (which would be re-filled during the end of the pulse flow). Tile drainage water, discharged through Salt and Mud sloughs, would be partially withheld (for example, 50 percent between March 1 and April 15) and released during the pulse flow between April 15 and May 15.

This alternative involved no reduction in export pumping, since it required maximum pumping all the time (to achieve the increase in flow during the pulse flow period). Therefore, this alternative was in direct conflict with the stated purpose and need for the project. Recirculation also had problems providing fall attraction flows for the same reasons (for example, increased flows at Vernalis were accompanied by increased exports, so gain in net systems flows were questionable). Consequently, this alternative was dropped from further consideration.

Willing Seller/Willing Buyer (26:WSB)

This alternative evolved from alternative 7, Ecological Fair Share, specifically the willing seller/willing buyer component. While this could be considered as the No Action alternative (for example, no sellers), this also could be considered to be the same as providing flows under the San Joaquin River Agreement for VAMP (where all the willing sellers in the basin were identified). The range of possibilities was considered by looking at the No Action and the Agreement. There are an infinite number of subtle options in between these two alternatives, and the impacts could vary greatly because the water would come from different places. The major difference between this alternative and the Agreement is that the sellers and the impacts may vary but in an unknown, and

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undefinable way. This entire alternative would be similar to the status quo in that a series of one year acquisitions would occur. It is not practically possible to get water out of Friant Dam. Therefore, this alternative involves subtle differences in allocation of the other three tributaries. In essence, all willing sellers have identified themselves (and have signed the statement of support for the San Joaquin River Agreement); other combinations of willing sellers, therefore, are not reasonable. Under the interim acquisition program, the only sellers that stepped forward are those included in the Agreement. As a result, this alternative was not carried forward for detailed analysis.

Worst Case by Tributary (8:WCT)

This alternative represents an alternative scenario to the Willing Seller/Willing Buyer wherein either the Stanislaus, Tuolumne, Merced, or Upper San Joaquin rivers (above Merced) would provide all of the water. This alternative arose from the "Ecological Fair Share" concept based on historical unimpaired flows put forward in the 1995 WQCP DEIR (SWRCB 1997; Flow Alternative 5). Multiple parties could be responsible for meeting flow requirements on a tributary. The Service is not necessarily in favor of the alternative as stated, but the Service would consider a distribution of water across the tributaries based on unimpaired flows (Jewell 1998). There are significant legal, administrative, and technical feasibility problems with implementing this alternative. It is not an achievable alternative, as there simply is not enough water from any single tributary to meet the purpose and need of the project. As a result, this alternative was not carried forward for detailed analysis, since it was neither reasonable nor implementable.

Summary of Findings

After secondary screening, two reasonable practicable alternatives remained: the preferred alternative (SJRA, Alternative 18) and the SWRCB Water Rights Order (Alternative 13). The other alternatives were excluded because they either had several to many potentially significant negative effects or were not significantly different from the SJRA or the SWRCB Water Rights Priority System. Both of these reasonable, practicable alternatives had significant positive effects in all or almost all of the screening criteria and were, therefore, considered for more detailed environmental impact analysis in Chapter 4.

2.5 SUMMARY COMPARISON OF ALTERNATIVES

Table ES-1, contained in the Executive Summary, provides a summary comparison of abbreviated impact statements for the proposed action and the alternative action. Full impact statements are provided in Sections 4.2 through 4.11. Table 2.5-1 below is an abbreviated comparison of characteristics of the No Action, SJRA, and Water Right Priority System alternatives. In summary, the SJRA alternative (proposed action) is the environmentally superior alternative because it has the fewest significant and potentially significant impacts on the environment.

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Table 2.5-1: COMPARISON OF NO ACTION, PROPOSED ACTION AND ALTERNATIVE ACTION FOR MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT

	No Action	SJRA Proposed Action	Water Right Priority System Alternative
Spring Pulse Flow	0	VAMP Target	1995 WQCP
October Flow	0	12,500 AF	28,000 AF subject to conditions of 1995 WQCP
Number of Potentially Affected Sellers	Unknown	6	up to 38
Type of Action	Current regulatory action with willing sellers	Willing sellers	Regulatory
Period of Action	Annual, continues current practices	12 years	Permanent with 3 year review
Consensus Driven	No	Yes	No
Supports a Scientific Study	No	Yes	No

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3. AFFECTED ENVIRONMENT

This chapter presents a general description of the physical environment of the project area and vicinity. The existing condition of resources sets the baseline against which the proposed action and alternative to the proposed action are evaluated subsequently in Chapter 4 to determine environmental effects.

3.1 GENERAL DESCRIPTION OF PROJECT AREA AND WILLING SELLERS

As described in Section 2.1.2, Alternatives Including Proposed Action, the immediate project area is comprised of portions of the Stanislaus, Tuolumne, and Merced rivers and the San Joaquin River from the Mendota Pool to Vernalis. These are the primary rivers that would be affected by the additional water. The points of release occur primarily at three reservoirs: New Melones Reservoir on the Stanislaus River, New Don Pedro Reservoir on the Tuolumne River, and Lake McClure on the Merced River. Additional releases would occur on the San Joaquin River, almost entirely near Los Banos from surface water conveyance facilities into Mud or Salt sloughs (which discharge into the San Joaquin River), or into Orestimba Creek, but also possibly upstream at the Mendota Pool.

3.1.1 Project Area and Vicinity

Inflows from the Merced, Tuolumne, and Stanislaus rivers historically contribute more than 60 percent of the flows in the San Joaquin River, as measured at Vernalis. The San Joaquin River enters the Delta at Vernalis which is widely used as a monitoring point for Delta inflows and standards. The U. S. Geological Survey (USGS) has operated a gaging station on the San Joaquin River near the community of Vernalis (Station 11303500) since 1922 (CALFED 1998).

The project area rivers are highly managed due to extensive water supply, hydroelectric, and flood control projects. As a result, the aquatic resources have undergone significant changes. Of concern is the protection and enhancement of economically important species such as chinook salmon and the adjacent riparian habitat which supports numerous plants and animals including some rare, threatened, and endangered species. Fall-run chinook salmon inhabit the three tributaries to the San Joaquin River during spawning and development stages of their life cycle. The ecological health of the project area rivers in the San Joaquin River Basin is important to the health of the Bay/Delta Estuary.

Land uses within the project area are primarily open space, agriculture, and recreation. Agricultural lands are often adjacent to the river corridors. There are three reservoirs in the project area that are used for a variety of purposes: water supply, regulation of river flows including flood control, hydroelectric power generation, and recreation. Recreation activities at project area reservoirs and rivers include boating, fishing, swimming, picnicking, camping, hunting, and wildlife observation.

The sections in this chapter on affected environment cover not only the immediate area of direct project impact but also the project area vicinity and adjacent areas that could potentially experience

indirect impacts such as the larger San Joaquin River Basin and the Bay/Delta Estuary. Definition of the larger area, such as the San Joaquin River Region, varies depending on the source of information. Groundwater in the basin is used for municipal, industrial, and agricultural purposes. Cultural resources in the San Joaquin River Region have been documented from the excavation of reservoirs and other sites to reveal numerous prehistoric resource locations. Agriculture and mining activities characterize historic resources.

The water supply for Vernalis Adaptive Management Plan (VAMP) and related flows is to be provided by the San Joaquin River Group Authority as identified in the San Joaquin River Agreement and reported in Section 2.1.1. Members of the Authority who have agreed to sell water for release to the San Joaquin River system are the following: South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), Modesto Irrigation District (MID), Turlock Irrigation District (TID), Merced Irrigation District (Merced ID), and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors). The Exchange Contractors have four members: San Luis Canal Company, Central California Irrigation District, Firebaugh Canal Water District, Columbia Canal Company. The service areas of these districts and agencies are shown on Figure 3.1-1. Annual surface water and groundwater use by the San Joaquin River Group's willing sellers is shown in Table 3.1-1. Each willing seller is introduced in the following sections.

3.1.2 Willing Sellers on the San Joaquin River

3.1.2.1 San Joaquin River Exchange Contractors Water Authority

The Exchange Contractors include four separate entities located in the San Joaquin Valley (three on the west side of the San Joaquin River and one on the east): the Central California Irrigation District (CCID), San Luis Canal Company (SLCC), Firebaugh Canal Water District (FCWD), and Columbia Canal Company (CCC). The service area of 240,000 acres covers parts of Fresno, Madera, Merced, and Stanislaus Counties. The primary economy in this area is agriculture or agriculturally related businesses (NEA 1997).

Annual crops comprise 92 percent of the 225,562 acres of cropland in the Exchange Contractors service area. Cotton is the largest single crop grown in the area. Other annual crops grown include tomatoes, garlic, melons, and alfalfa hay (NEA 1997). Permanent crops grown in the area include walnuts and almonds.

The Exchange Contractors hold Miller and Lux water rights dating back to the 1880s. Because of this early water usage, the water rights of the Exchange Contractors are based on their riparian and pre-1914 diversions. The Exchange Contractors have an agreement with the Bureau of Reclamation (Reclamation) in which they agree not to exercise their San Joaquin River water rights in exchange for guaranteed deliveries of substitute Central Valley Project (CVP) water from the Delta-Mendota Canal.

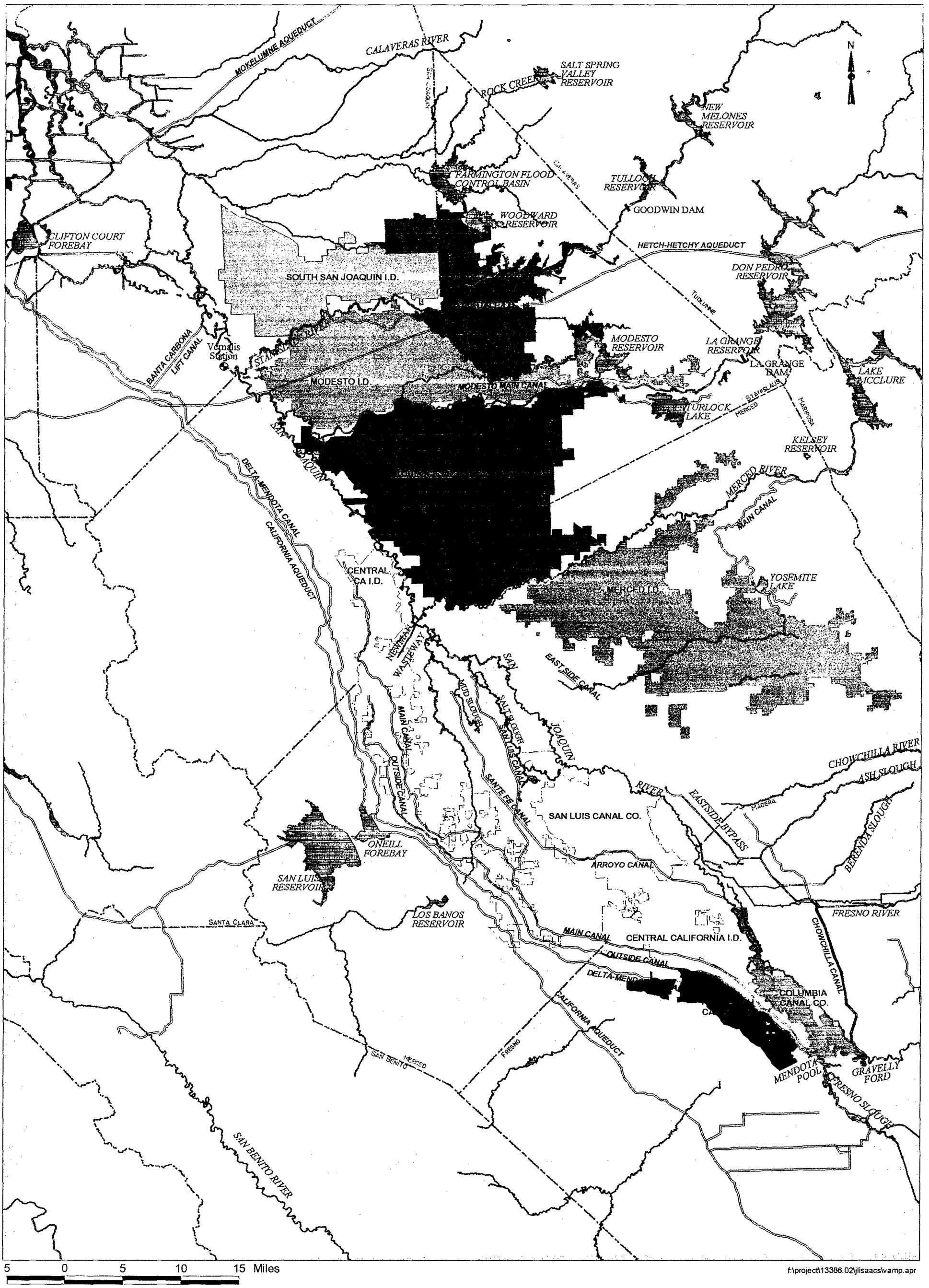

Figure 3.1-1 Willing Sellers in the Project Area

Table 3.1-1: SURFACE AND GROUNDWATER USE BY WILLING SELLERS (AF/Yr)

	Exchange Contractors	OID	SSJID	MID	TID	Merced ID
Surface Water:						
Maximum Available (AF)	840,000	300,000	300,000	See Note 1	See Note 1	Not Available[1]
Average Annual Diversion	840,000	300,000	242,000[2]	320,000	541,000[3]	Not Available
Avg Annual Use for Irrigation	840,000	300,000	242,000	193,000	498,000[3]	522,000
Groundwater[4]:						
Total Average Annual Use	144,000	9,668[5]	11,200[6]	23,500	120,000[3]	25,000-30,000[7]
Avg Annual Use for Irrigation	144,000	8,130	7,800	15,000	110,000[3]	25,000-30,000

[1]The operations of TID, MID and Merced ID are supported by a variety of water rights which include pre-1914 appropriations and riparian rights in addition to post-1914 licenses which have been issued by the SWRCB. Absent an adjudication, it is not possible to identify the maximum amount of water available. However, The MID/TID water diversion varies between 900,000 and 1,100,000 acre feet per year(AF/Yr).

[2]This figure represents a 15-year average. SSJID's historical use has ranged much higher and has exceeded 300,000 AF/Yr in some years. However, primarily as a result of conservation efforts, the district has diverted an average of approximately 242,000 AF/Yr over the last 15 years. The district sold to Interior 40,000 AF in 1997 and 25,000 AF in 1998. The district has contractual commitments to deliver up to 15,000 AF/Yr to the Stockton East Waster District beginning in October 1998 and 32,000 AF/Yr to a domestic water plant, beginning in approximately 2002.

[3]TID usage based on 25 year average (1973-1997).

[4]Groundwater use is by District

[5]Over last 15 years. Source: OID/SSJID, *Draft Initial Study and Proposed Negative Declaration for the OID/SSJID Water Transfer Project*, 1997.

[6]Based on the Groundwater Management Database Development report, Montgomery Watson, September 1993. This includes approximately 3,400 AF/Yr of shallow groundwater pumped and discharged by SSJID to lower saline groundwater from the crop root zone. This does not include other private pumping within the SSJID service area for agricultural use.

[7]Range of water pumped is 10,000 AF – 167,000 AF. Most of this water is pumped in dry and critical years, and the 167,000 AF was pumped in 1977. Approximately 10,000 AF is pumped in all years.

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3.1.3 Willing Sellers on the Stanislaus River

3.1.3.1 South San Joaquin Irrigation District

Organized in 1909, SSJID is located on the east side of the San Joaquin Valley. The District encompasses approximately 72,000 acres of land that are predominantly agricultural with almonds and grapes as the primary crops. Total acres of irrigated agriculture are estimated at 62,000 acres since urban areas cover about 10,000 acres of the total area, including the cities of Manteca, Escalon, and Ripon, which provide water service separately from SSJID. Over the past 15 years, SSJID has experienced substantial urban development. By 2025, urban areas are projected to increase to over 35 percent of the land area. (MW 1993)

SSJID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. This surface water supply has been used historically to meet agricultural water demands (MW 1993). SSJID is part-owner (with OID) of the Goodwin Dam and the SSJID/OID Joint Main Canal which is used to divert water to SSJID and OID (USBR 1997f).

3.1.3.2 Oakdale Irrigation District

Organized in 1909, OID is located in the eastern San Joaquin Valley and encompasses parts of San Joaquin and Stanislaus Counties. The District encompasses approximately 72,000 gross acres of land with cropping patterns that include irrigated pasture (clover), oats-corn, rice, fruit and nuts, and miscellaneous crops, such as berries, melons, onions, and home gardens and yards (OID 1995). OID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. The District's distribution system which is co-owned in large part with SSJID, includes the Tulloch Dam and Reservoir and the Goodwin Diversion Dam on the Stanislaus River below New Melones Dam. Water is diverted into the SSJID/OID Joint Main Canal and OID's South canals (OID 1998). In addition, the District owns and operates deep well water reclamation pumps and two downstream river diversions. OID and SSJID jointly own and operate the Tri-Dam Project, an irrigation and hydroelectric project in the Stanislaus River that consists of three dams and associated appurtenant structures. OID's service area is approximately 73,000 acres (USBR GIS 1998), and the city of Oakdale is the principal community.

3.1.4 Willing Sellers on the Tuolumne River

3.1.4.1 Modesto Irrigation District

Organized in 1887, MID is located in Stanislaus County on the east side of the San Joaquin Valley. The District encompasses a 108,000-acre service area and supplies surface water, groundwater, and electrical service to agricultural (64,000 irrigated acres) and municipal users including the cities of Waterford, Empire, Modesto, and Salida. The primary economy in the District is agriculture or agriculturally related businesses, and the primary crops are trees (primarily almond), vines, grain, row, and pasture. The average farm size is 20 acres, and there are approximately 3,200 farms within MID (MID 1996). MID has pre-1914 and post-1914 water rights.

3.1.4.2 Turlock Irrigation District

Organized in 1887, TID is located on the east side of the San Joaquin Valley, and it encompasses portions of Stanislaus and Merced Counties. The District's service area covers 272,000 acres and includes the cities of Turlock, Ceres, Hughson, part of Modesto, and the unincorporated communities of Keyes, Denair, Hickman, Delhi, and Hilmar (Goldman, Sachs & Company 1998). Over the past 25 years, TID has provided on average 608,000 acre-feet of water to irrigators for 149,000 acres (TID 1998, personal communication). The primary agricultural crops grown in the District include almonds, tomatoes, walnuts, peaches, grapes, and melons (Stanislaus County General Plan 1994). The District also generates hydroelectricity within its service area. TID has a firm supply of developed surface water and operates surface diversions from the Tuolumne River. TID jointly operates the New Don Pedro Reservoir with Modesto ID. Surface water accounts for about 81 percent of the total delivery for irrigation (TID 1997, 1998, personal communication).

3.1.5 Willing Sellers on the Merced River

3.1.5.1 Merced Irrigation District

Organized in 1919, the Merced ID is located on the east side of the San Joaquin Valley in Merced County. Merced has a firm supply of developed surface water and operates surface diversions from the Merced River. More than 140,000 acres are located within Merced ID's boundaries, of which approximately 70 percent are irrigated with Merced ID water (Merced ID 1998). Merced ID uses surface and groundwater to supply approximately 552,000 acre-feet per year to irrigation customers. Surface water accounts for about 95 percent of the total delivery (MBK 1998, personal communication). Agricultural crops grown within the Merced ID service area include almonds (nearly 12,000 acres), corn (nearly 10,000 acres), alfalfa and cotton (nearly 8,000 acres each) (Merced ID 1998).

3.2 SURFACE WATER RESOURCES

This section of the EIR/EIS focuses on the surface waters of the San Joaquin River Basin and the resulting flows from the basin into the Delta as measured at the U.S. Geological Survey (USGS) gauging station at Vernalis. Most of the information for this section was taken directly from Reclamation's Draft PEIS on the Central Valley Project Improvement Act (CVPIA) (Reclamation 1997d) with some information from the State Water Resources Control Board's (SWRCB's) Draft EIR on the 1995 Bay/Delta Water Quality Control Plan (SWRCB 1997).

The San Joaquin River Basin is contained within the southern portion of the vast Central Valley of California. The basin extends approximately 250 miles north-to-south, encompasses about 32,000 square miles, and is bounded by the Sierra Nevada mountains on the east and the Diablo Range on the west. The southern extent of the San Joaquin River Basin is formed by a relatively low hydrological divide separating it from the Tulare Lake Basin and the northern boundary is formed by the Sacramento-San Joaquin Delta. The Delta separates the San Joaquin River Basin from the Sacramento River Basin and ultimately drains all of the watersheds found within both basins.

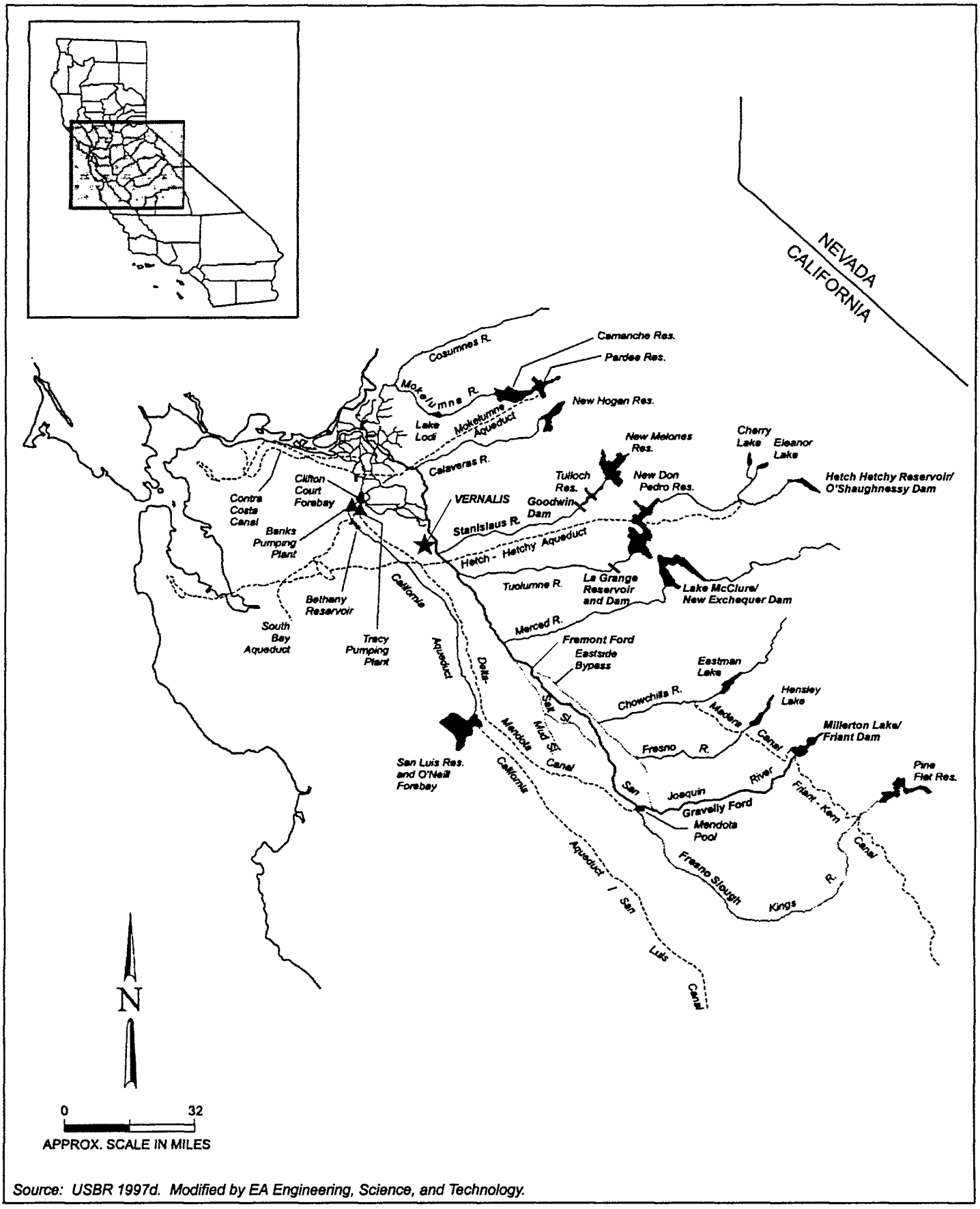
Extensive water supply, hydroelectric, and flood control efforts during the past century have resulted in the construction of dams and reservoirs that now control the flow on nearly all major streams in the San Joaquin River Basin. Figure 3.2-1, Major features of the San Joaquin River Basin (Map) adapted from the Draft PEIS, shows major rivers and streams that drain the San Joaquin River Basin watersheds and major dams that affect stream flows.

Most of the following sections were taken directly from Reclamation's Draft PEIS for the CVPIA (1997d), with minor edits.

3.2.1 Surface Water in the San Joaquin River Basin

The San Joaquin River Basin covers approximately 32,000 square miles in the northern part of the San Joaquin Valley, roughly from Fresno to Stockton. The climate of the San Joaquin River Basin is semiarid, characterized by hot, dry summers and mild winters, except at the highest altitudes, where distinct wet and dry seasons prevail. Most of the precipitation falls from November to April, with rain at the lower elevations and snow in the higher regions. On the valley floor, precipitation decreases from north to south, ranging from 14 inches in Stockton to eight inches at Mendota.

The primary sources of surface water to the basin are rivers that drain the western slope of the Sierra Nevada Range. Each of these rivers, the San Joaquin, Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes, drain large areas of high elevation watershed that supply snowmelt runoff during the late spring and early summer months. Historically, peak flows occurred in May and June and flooding occurred in most years along all of the major rivers. When flood flows reached the valley floor, they spread out over the lowlands, creating several hundred thousand acres



Source: USBR 1997d. Modified by EA Engineering, Science, and Technology.

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Figure 3.2-1. Major features of the San Joaquin River Basin.

of permanent tule marshes and more than 1.5 million acres of seasonally flooded wetlands. Construction and operation of the numerous water supply, hydroelectric, and flood control efforts during the 20th century have significantly modified the historic flows.

The three northernmost streams, the Calaveras, Mokelumne, and Cosumnes rivers, flow into the San Joaquin River (within the boundaries of the Delta) without affecting the flows at Vernalis and consequently are not considered in this document. Streams on the west side of the basin are intermittent, and their flows during high rainfall periods frequently reach the San Joaquin River. Natural runoff from westside sloughs is augmented with agricultural drainage.

3.2.2 Upper San Joaquin River and Tributaries

The San Joaquin River originates in the Sierra Nevada at an elevation over 10,000 feet and flows into the San Joaquin Valley at Friant. The river then flows to 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. The upper San Joaquin River section, upstream of the confluence with the Merced River, was historically characterized by the runoff of the San Joaquin River.

Flows in the upper San Joaquin River are regulated by the CVP Friant Dam (Figure 3.2-1), which was completed in 1941 to store and divert water to the Madera and Friant-Kern canals for irrigation and municipal and industrial water supplies in the eastern portion of the San Joaquin Valley. In the reach between Friant Dam and the Gravelly Ford, flow is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. During the past 100 years, development in this area has resulted in groundwater overdraft conditions, and the river loses much of its flow through infiltration/percolation to the groundwater. Releases from Friant Dam are generally limited to those required to satisfy downstream water rights and instream flows. Millerton Lake, formed by Friant Dam, has a capacity of 520,000 acre-feet.

Above Friant Dam, the San Joaquin River drains an area of approximately 1,676 square miles and has an annual average unimpaired runoff of 1.7 million acre-feet. The median historical unimpaired runoff is 1.4 million acre-feet, with a range of 0.4 to 4.6 million acre-feet. Several reservoirs in the upper portion of the San Joaquin River watershed, including Edison, Florence, Huntington, Mammoth Pool, and Shaver Lake, are primarily used for hydroelectric power generation. The operation of these reservoirs affects the inflow to Millerton Lake.

3.2.3 Lower San Joaquin River and Tributaries

The lower San Joaquin River, from the confluence with the Merced River to the Delta, is characterized by the combination of flows from tributary streams, major rivers, groundwater accretions, and agricultural drainage water. The lower San Joaquin River is the section of river from

the confluence with the Merced River (below Fremont Ford) to Vernalis, which is generally considered the southern limit of the Delta. The drainage area of the San Joaquin River above Vernalis includes approximately 13,356 square miles, of which approximately 2,100 square miles are drained by Fresno Slough (James Bypass) as well as the much longer Kings River watershed. Little water is contributed from the upper San Joaquin River, except during flood events. Flow patterns in the lower San Joaquin River are therefore primarily governed by the tributary inflows from the Merced, Tuolumne, and Stanislaus rivers.

Merced River. The Merced River originates in the Sierra Nevada, drains an area of approximately 1,273 square miles east of the San Joaquin River, and produces an average unimpaired runoff of approximately 1 million acre-feet.

Agricultural development in the Merced River watershed began in the 1850s, and significant changes have been made to the hydrologic system since that time. The enlarged New Exchequer Dam, forming Lake McClure with a capacity of 1,024,000 acre-feet, was completed in 1967 and now regulates releases to the lower Merced River. New Exchequer Dam is owned and operated by the Merced Irrigation District for power production, irrigation, and flood control. Releases from Lake McClure pass through a series of powerplants and smaller diversions and are re-regulated at McSwain Reservoir. Below McSwain Dam, water is diverted to Merced Irrigation District at the Pacific Gas and Electric Company (PG&E) Merced Falls Dam and further downstream at the Crocker Huffman Dam.

Tuolumne River. The Tuolumne River originates in the Sierra Nevada Mountains, drains a watershed of approximately 1,540 square miles, and produces an average annual unimpaired runoff of approximately 1.8 million acre-feet.

Flows in the lower portion of the Tuolumne River are controlled primarily by the operation of New Don Pedro Dam, which was constructed in 1971 jointly by TID and MID with participation by the City and County of San Francisco. The 2.03-million-acre-foot reservoir stores water for irrigation, hydroelectric generation, fish and wildlife enhancement, recreation, and flood control purposes. The districts divert water to the Modesto Main Canal and the Turlock Main Canal a short distance downstream from New Don Pedro Dam at La Grange Dam. The existing dam at La Grange was completed in 1893.

The City and County of San Francisco (CCSF) operates several water supply and hydroelectric facilities within the Tuolumne River Basin upstream of New Don Pedro Reservoir. O'Shaughnessy Dam on the main stem of the Tuolumne River, completed in 1923, impounds approximately 0.36 million acre-feet of water in Hetch Hetchy Reservoir. Water from Hetch Hetchy is used primarily to meet the municipal and industrial water needs of the CCSF and to provide instream flows in the Tuolumne River below O'Shaughnessy Dam. Two other storage facilities upstream of New Don

Pedro Reservoir, Lake Eleanor and Cherry Lake, are also operated by CCSF for hydropower and water supply purposes. The combined capacity of these two reservoirs is about 0.3 million acre-feet.

Stanislaus River. The Stanislaus River originates in the Sierra Nevada Mountains, drains a watershed of approximately 900 square miles, and produces an average unimpaired runoff of approximately 1.056 million acre-feet. Snowmelt runoff contributes the largest portion of the flows in the Stanislaus River, with the highest monthly flows in May and June.

Flow control in the lower Stanislaus River is provided by the New Melones Reservoir, which has a capacity of 2.4 million acre-feet, and is operated by Reclamation as part of the CVP. Releases from New Melones Reservoir are re-regulated downstream by Tulloch Reservoir. Prior to the construction of New Melones Dam, average monthly flows in the Stanislaus River were generally uniform between January and June, with peak flows in May. As a result of limited storage capacity of facilities on the river, average monthly flows in August and September approached zero in many years downstream of Goodwin Dam. Following construction of New Melones Dam, average monthly flows included peak flows in March, with releases in all months.

The main water diversion point on the Stanislaus River is Goodwin Dam, which provides for delivery to OID and SSJID. Goodwin Dam is also used to divert water into the Goodwin Tunnel for deliveries to Central San Joaquin Water Conservation District and the Stockton East Water District.

San Joaquin River at Vernalis. Flows in the San Joaquin River at Vernalis are affected by the operation of upstream facilities on the San Joaquin, Merced, Tuolumne, and Stanislaus rivers, as well as by deliveries to the Mendota Pool from the Delta-Mendota Canal and overflows from the Kings River in the Tulare Lake Region. Prior to the construction of major dams on the San Joaquin River and its tributaries, average monthly flows peaked during May and June in response to snowmelt runoff. Unrestricted flows have not occured since the construction of the original Exchequer and Don Pedro reservoirs in the 1920s. Between 1941 and 1978, flows were altered from natural conditions in response to the operations of Friant, New Exchequer, New Don Pedro, and New Melones dams. New Melones Dam, the most recently constructed dam in the San Joaquin River Basin, was completed in 1978. Since that time, average monthly flows in the San Joaquin River at Vernalis have been more uniform throughout the year, with maximum flows less than historical levels.

3.2.4 Surface Water Quality in the San Joaquin River Basin

Surface water quality in the San Joaquin River Basin is affected by several factors, including natural runoff, agricultural return flows, biostimulation, construction, logging, grazing, operations of flow regulating facilities, urbanization, and recreation. In addition, irrigated crops grown in the western portion of the San Joaquin Valley have accelerated the leaching of minerals from soils, altering water quality conditions in the San Joaquin River system.

Water quality in the San Joaquin River varies considerably along the stream's length. Above Millerton Lake and downstream towards Mendota Pool, water quality is generally excellent. The reach from Gravelly Ford to Mendota Pool (about 17 miles) is frequently dry except during flood control releases because all water released from Millerton Lake is diverted to satisfy contract agreements, or percolates to groundwater. 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 Delta-Mendota Canal, and 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. Between Sack Dam and the confluence with Salt Slough, the San Joaquin River is often dry. From Salt Slough to Fremont Ford, most of the flow in the river is derived from irrigation returns 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 progresses downstream from Fremont Ford, water quality generally improves at successive confluences, specifically at those with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, however, mineral concentrations tend to increase due to agricultural drainage water return flows, other wastewaters, and effluent groundwater (DWR 1965 as cited in USBR 1997f). TDS in the San Joaquin River near Vernalis has historically ranged from 52 milligrams per liter (mg/l) (at high stages) to 1,220 mg/l during the 1951-1962 period (DWR 1965 as cited in USBR 1997f). While other contemporary periods (1976-1977 and 1986-1992) have had elevated mineral content (and reduced flows), the period of record from 1951-1962 is the most appropriate and inclusive of the greatest frequency of elevated TDS. During the mid to late 1960s, San Joaquin River water quality continued to decline. In 1972, the SWRCB included a provision in Decision 1422 (D-1422) that Reclamation maintain average monthly concentrations of TDS in the San Joaquin River at Vernalis of 500 mg/l as a condition of the operating permit for New Melones Reservoir on the Stanislaus River.

3.2.5 Water Facilities and Operations

3.2.5.1 CVP Facilities and Operations

The CVP is the largest surface water storage and delivery system in California, with a geographic scope covering 35 of the state's 58 counties. The project includes 20 reservoirs, with a combined storage capacity of approximately 11 million acre feet; 8 powerplants and 2 pump-generating plants, with a combined generation capacity of approximately 2 million kilowatts; 2 pumping plants; and approximately 500 miles of major canals and aqueducts. The CVP supplies water to more than 250 long-term water contractors in the Central Valley, the Santa Clara Valley, and the San Francisco Bay Area.

Historically, approximately 90 percent of the CVP water has been delivered to agricultural users, including senior water right holders. Total annual contracts exceed 9 million acre-feet, including

over 1 million acre-feet of Friant Division Class II supply, which is generally available only in wet years. At present, increasing quantities of water are being provided to municipal customers, including the cities of Redding, Sacramento, Folsom, Tracy, and Fresno; most of Santa Clara County; and the northeastern portion of Contra Costa County.

CVP operations are influenced by a myriad of general operating rules, regulatory requirements, and facility-specific concerns and requirements. This section summarizes the operations of the CVP, beginning with a description of factors that influence operations decisions, descriptions of regulatory requirements, and specific operating constraints at CVP facilities. It concludes with a discussion of CVP contract types, including water rights contracts, and criteria used to determine annual water delivery levels to those contractors.

General Criteria for the Operation of CVP Facilities

In the development of operations decisions, criteria related to reservoir operations, downstream conditions, and water rights in the Delta must be considered. This section describes how these issues generally influence CVP operational decisions.

Reservoir Operating Criteria. Inflow and release requirements are the principal elements influencing reservoir storage. Operational decisions must consider not only conditions at an individual reservoir, but also downstream conditions and conditions at other project reservoirs. The possibility of using multiple water sources for some requirements adds flexibility to project operations and complexity to operations decisions. Storage space south (upstream) of the Delta that can only be filled with water exported from the Delta is a major operational consideration involving the geographic distribution of water in storage. Other factors that influence the operation of CVP reservoirs include flood control requirements, carryover storage objectives, lake recreation, power production capabilities, cold water reserves, and pumping costs.

The U.S. Army Corps of Engineers (COE) is responsible for determining flood control operational requirements at most CVP reservoirs. If CVP reservoir storage exceeds COE requirements, water must be released at rates of flow defined in the COE's flood control manuals. These manuals require lower reservoir storage levels in the fall in anticipation of inflow from winter precipitation. To avoid excess releases at the end of the summer, releases in excess of minimum flow requirements are made over the course of the summer such that reservoir storage levels are at or below maximum flood control levels in the fall.

Streamflow Criteria. Streams below CVP dams support both resident and anadromous fisheries, recreation, and water diversions. While resident fisheries are slightly affected by release fluctuations, the anadromous fisheries (e.g., salmon and steelhead) are the most sensitive and are present year-round in several CVP streams. Maintaining water conditions favorable to spawning, incubation, rearing, and outmigration of the young anadromous fish is one of the main objectives.

CVP operations are coordinated to anticipate and avoid streamflow fluctuations during spawning and incubation whenever possible.

In the management of releases prescribed by the COE for flood control, CVP operators have some latitude in controlling the magnitude and duration of the releases, based on criteria for downstream public safety and levee stability. Flood control releases are typically accomplished through a series of stepped increases defined by such factors as powerplant capability, minor flooding of adjacent lands, erosion, and channel capacity. Flood releases are established at the lowest step of the progression that will satisfy the requirements for evacuating storage, maximizing public safety, and minimizing the downstream effect of flood releases.

Regulations and Agreements that Affect CVP Operations

The operation of the CVP is, and has historically been, affected by the provisions of several regulatory requirements and agreements. Prior to the passage of CVPIA, the operation of the CVP was affected by SWRCB Decisions 1422 and 1485, and the Coordinated Operations Agreement (COA). Decisions 1422 and 1485 identify minimum water flow and water quality conditions at specified locations, which are to be maintained in part through the operation of the CVP. The COA specifies the responsibilities shared by the CVP and State Water Project (SWP) for meeting the requirements of D-1485.

Beginning in 1987, a series of actions by the SWRCB, U.S. Environmental Protection Agency (USEPA), the National Marine Fisheries Services (NMFS), and the U.S. Fish and Wildlife Service (Service) affected interim water flow and water quality standards in the Delta. However, at the time CVPIA was enacted (October, 1992), the water quality standard in the Delta remained D-1485, and the CVP and SWP were operated in accordance with the COA to maintain this requirement.

In 1993, the Service released a biological opinion and included restrictions on water management in and upstream of the Delta regarding delta smelt and associated habitat of operational actions by the CVP and SWP. This biological opinion was revised in 1994 and in 1995.

In December 1994, representatives of the state and federal governments and urban, agricultural and environmental interests agreed to the implementation of a Bay/Delta protection plan through the SWRCB, in order to provide ecosystem protection for the Bay/Delta Estuary. SWRCB WR Order 95-6 modified D-1485 and D-1422 to reflect the objectives of, and remove some inconsistencies with the Draft Bay/Delta Water Quality Plan, released May 1995. The coordinated operations of the CVP and SWP continue to be based on the COA.

Operations of CVP Divisions and Facilities South of the Delta

The facilities included in CVP divisions north of the Delta are known collectively as the Northern CVP System. Facilities in CVP divisions south of the Delta include the Delta, West San Joaquin, and San Felipe divisions and are known collectively as the Southern CVP System. Both the Eastside and the Friant divisions are operated independently of the remainder of the CVP, due to the nature of their water supplies and service areas. The Northern and Southern CVP Systems are operated as an integrated system, and demands for water and power can be met by releases from any one of several facilities. Demands in the Delta and south (upstream) of the Delta can be met by the export of excess water in the Delta, which can result from releases from northern CVP reservoirs. As a result, operational decisions are based on a number of physical and hydrological factors that tend to change depending on conditions.

West San Joaquin Division. The West San Joaquin Division of the CVP consists of the San Luis Unit, and includes federal as well as joint federal and State of California water storage and conveyance facilities to provide for delivery of surplus water to CVP contractors in the San Joaquin Valley and in the San Felipe Division. Facilities in the West San Joaquin Division are San Luis Dam and Reservoir, O'Neill Dam and Forebay, the San Luis Canal, Coalinga Canal, Los Banos and Little Panoche Detention dams and reservoirs, and the San Luis Drain.

San Luis Dam and Reservoir are located on San Luis Creek near Los Banos (Figure 3.2-1). The reservoir, with a capacity of 2.0 million acre-feet, is a pumped-storage reservoir primarily used to store water exported from the Delta. It is a joint federal and State of California facility that stores CVP and SWP water. San Luis Reservoir waters are released for delivery to CVP and SWP contractors served by the San Luis Canal, through the Pacheco Tunnel to serve the San Felipe Unit of the CVP, and to the Delta-Mendota Canal to serve CVP water service and San Joaquin River Exchange Contractors on the west side of the San Joaquin Valley.

O'Neill Dam and Forebay are located on San Luis Creek downstream of San Luis Dam along the SWP California Aqueduct. The forebay is used as a hydraulic junction point for state and federal waters. CVP water is lifted from the Delta-Mendota Canal to the O'Neill Forebay by the O'Neill Pumping-Generating Plant. The San Luis Canal, a joint federal and state (CVP/SWP) facility, conveys water southeasterly from O'Neill Forebay along the west side of the San Joaquin Valley for delivery to CVP and SWP contractors.

The CVP operation of the San Luis Unit requires coordination with the SWP, since some of the facilities are joint state and federal facilities. Like the CVP, the SWP also has water demands it must meet with limited water supplies and facilities. Coordinating the operations of the two projects avoids inefficient situations such as one entity pumping water into San Luis Reservoir at the same time the other is releasing water.

San Felipe Division. The San Felipe Division provides CVP water to Santa Clara and San Benito counties, through conveyance facilities from the San Luis Reservoir. Specific facilities include the Pacheco Tunnel and Conduit, the Hollister Conduit, San Justo Dam and Reservoir, and the Santa Clara Conduit. The Pajaro Valley, in southern Santa Cruz County, was originally authorized to receive irrigation water to reduce seawater intrusion caused by groundwater pumping. Although studies to reduce seawater intrusion and determine conveyance requirements have continued, no facilities have yet been constructed in the Pajaro Valley to receive the authorized water deliveries.

Eastside Division. The Eastside Division of the CVP includes water storage facilities on the Stanislaus River (New Melones Dam, Reservoir, and Powerplant), Chowchilla River (Buchanan Dam and Eastman Lake), and Fresno River (Hidden Dam and Hensley Lake). All of the dams and reservoirs in this division were constructed by the COE. Upon completion in 1978, the operation of New Melones was assigned to Reclamation to provide flood control, satisfy water rights obligations, provide instream flows, maintain water quality conditions in the Stanislaus River and in the San Joaquin River at Vernalis, and provide deliveries to CVP contractors.

The operating criteria for New Melones Reservoir are governed by water rights, instream fish and wildlife flow requirements, instream water quality, Delta water quality, CVP contracts, and flood control considerations. Flows in the lower Stanislaus River serve multiple purposes. These include providing water for instream water rights obligations, meeting instream fishery flow requirements, maintaining instream water conditions of dissolved oxygen, and maintaining water quality conditions in the San Joaquin River at Vernalis, in accordance with D-1422 and the SWRCB May 1995 Water Quality Plan (WQP). Water is also released from New Melones Reservoir to meet, to the extent available, the San Joaquin River flow requirements in the SWRCB May 1995 WQP. The operating criteria have been revised (May, 1997) and are currently being refined by stakeholders.

Friant Division. The Friant Division includes facilities to collect and convey water from the San Joaquin River in order to provide a supplemental water supply to areas along the east side of the southern San Joaquin River Basin and the Tulare Basin. The delivery of CVP water to this region augments groundwater and local surface water supplies in an area that has historically been subject to groundwater overdraft. The Friant Division is an integral part of the CVP, but is hydrologically independent and, therefore, operated separately from the other divisions of the CVP. The water supply to this division was made available through an agreement with San Joaquin River water right holders, who entered into an exchange contract and purchase agreement with Reclamation for delivery of water through the Delta-Mendota Canal. Major facilities of the Friant Division include Friant Dam and Millerton Lake, the Madera Canal, and the Friant-Kern Canal.

Flood control releases from Millerton Lake (Friant Dam) may be used to satisfy portions of deliveries to the Mendota Pool Contractors and the San Joaquin River Exchange Contractors on the San Joaquin River below Mendota Pool. Millerton Lake operations are coordinated with operations of the Delta-Mendota Canal in the Delta Division to use all available Millerton Lake flood control

releases before additional water is delivered to Mendota Pool. During wet hydrologic periods, overflow from the Kings River may also enter the San Joaquin River Basin at the Mendota Pool through the Fresno Slough.

CVP Water Users South of the Delta

During development of the CVP, the United States entered into long-term contracts with many of the major water right holder in the Central Valley. In part, the CVP is operated to satisfy downstream water rights, meet the obligations of the water rights contracts, and deliver project water to CVP water service contractors.

Many of the CVP water rights originated from applications filed by the state in 1927 and 1938 to advance the California Water Plan. After the Federal Government authorized the construction of the CVP, those water rights were transferred to Reclamation, who made applications for the additional water rights needed for the CVP. In granting water rights, the SWRCB set certain conditions within the permits to protect prior water rights, fish and wildlife needs, and other prerequisites it deemed in the public interest.

San Joaquin River Exchange Contractors. San Joaquin River Exchange Contractors are water right holders who receive substitute CVP water from the Delta-Mendota Canal (DMC) at the Mendota Pool. Under the Exchange Contract, the parties agree to not exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. Under the water rights of the United States, these exchanges allow for water to be diverted from the San Joaquin River at Friant Dam and stored at Millerton Lake.

The purchase contract dealt with riparian and pre-1914 water rights. Under the Exchange Contract, the parties agree not to exercise their rights in exchange for a substitute water supply from the Delta. However, under the Exchange Contract, no transfer of water rights occurs, and Reclamation is responsible for delivering substitute water to these contractors in accordance with the Exchange Contract.

CVP Water Service Contractors. Before construction of the CVP, many irrigators on the west side of the Sacramento Valley, on the east and west sides of the San Joaquin Valley, and in the Santa Clara Valley relied primarily on groundwater. With the completion of CVP facilities in these areas, the irrigators signed contracts with Reclamation for the delivery of CVP water as a supplemental supply. Several cities also have similar contracts.

CVP water service contracts are between the United States and individual water users or districts and provide for an allocated supplemental supply of CVP water to be applied for beneficial use. In addition to CVP water service contracts, the Exchange Contract includes a supply of water that recognizes a previous water right. The purposes of a water service contract are to stipulate

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provisions under which a water supply is provided, to produce revenues sufficient to recover an appropriate share of capital investment, and to pay the annual operations and maintenance costs of the project.

In the Friant Division, a two-class system of water service contracts is employed to support the conjunctive use of surface water and groundwater that has long been a practice in the San Joaquin River and Tulare Lake Basins. Class I contracts relate to "dependable supply," typically assigned to users with limited access to good quality groundwater. Class II contracts are generally held by water users with access to good quality groundwater that can be used during periods of surface water deficiency. Groundwater recharge and recharge/exchange agreements are frequently employed in the management of Class II water supplies.

Criteria for Water Deliveries to CVP Contractors

Decision-making criteria are similar in most units and divisions of the CVP. The criteria applicable to CVP water service contractors served by the North System (Trinity, Shasta, Sacramento River, and American River divisions) and the South System (Delta, West San Joaquin, and San Felipe divisions) are similar. The decision-making criterion is unique for the Exchange Contractors because it is based solely on forecasted inflows to Shasta only. The criteria applied to establish water delivery deficiencies in the Friant Division are somewhat different, because this division is operated to provide water supplies for conjunctive use. In addition, the criteria for operations of New Melones Reservoir and contract deliveries on the Stanislaus River are affected by conditions unique to the Stanislaus River watershed as well as the May 1997 New Melones Interim Plan of operation (which is the subject of stakeholder refinement as of the writing of this document).

Criteria for Deliveries to CVP Contractors in the North and South Systems. Except in times of water shortages, the CVP makes available the amounts of water specified in the terms of its water rights and water service contracts in the CVP North and South systems. Water availability for delivery to CVP water service contractors during periods of insufficient water supply is determined based on a combination of operational objectives, hydrologic conditions, and reservoir storage conditions. Reclamation is required to allocate shortages among water service contractors within the same service area, as individual contracts and CVP operational capabilities permit.

Criteria for Deliveries to CVP Contractors in the Friant Division. The determination of annual water supply from the Friant Division is done independently of other CVP divisions. In February, Reclamation estimates the water supply for the coming contract year based on hydrologic conditions, storage in upstream reservoirs, and assumptions based on statistical analysis of historic records.

Criteria for Deliveries to CVP Contractors in the Eastside Division. Reclamation has had difficulty meeting all of the demands on New Melones Reservoir. This difficulty became apparent during the period of 1987-1992 when New Melones Reservoir was drawn down to approximately

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80,000 acre-feet by 1992. Numerous unanticipated operational factors influenced the drawdown of New Melones during this period. These include the severity of drought conditions from 1989 through 1992, the effect of return flow water quality in the San Joaquin River at Vernalis, and low flows on the Merced and Tuolumne rivers. During the drought period, many Stanislaus River stakeholder meetings were convened to coordinate management of limited water supplies. Consequently the May 1997 New Melones Interim Plan of Operation provides examples of operation under the 50 percent (most probable) and 90 percent probability of exceedance (90 percent chance of having increased flows) hydrologic conditions which include water years 1997 and 1998. This interim plan is currently the subject of stakeholder refinement as of the writing of this document.

3.2.5.2 SWP Facilities and Operations

SWP facilities consist of 22 dams and reservoirs that capture and store water on the Feather River, in order to deliver water to service areas in the Feather River Basin, the San Francisco Bay area, the San Joaquin Valley, the Tulare Basin, and Southern California. Lake Oroville, SWP's largest reservoir, with a storage capacity of approximately 3.5 million acre-feet, regulates the Feather River for release to Sacramento River and the Delta. The water is diverted by various facilities of the SWP for delivery to contractors or salinity control. In addition, Lake Oroville provides flood control, fish and wildlife habitat, irrigation water, hydroelectric generation, and recreation (Water Education Foundation 1997).

The SWP operates two diversion facilities in the Delta. The North Bay Aqueduct diverts water from the north Delta near Cache Slough for agricultural and municipal uses in Napa and Solano counties. In the southern portion of the Delta, the Banks Delta Pumping Plant lifts water into the California Aqueduct from the Clifton Court Forebay. The California Aqueduct is the state's largest and longest water conveyance system (444 miles), beginning at the Banks Pumping Plant and extending to Lake Perris south of Riverside, in Southern California. Water in the California Aqueduct flows to O'Neill Forebay, from which a portion of the flow may be lifted to the joint CVP/SWP San Luis Reservoir for storage. From O'Neill Forebay, the joint-use portion of the aqueduct, San Luis Canal, extends south to the southern end of the San Joaquin Valley. The SWP portion of the aqueduct continues over the Tehachapi Mountains to the South Coast Region. To cross the Tehachapis into southern California, water is elevated some 2,000 feet–more water pumped higher than anywhere else in the world.

SWP Water Users

About 30 percent of SWP water is used for irrigation, mostly in the San Joaquin Valley. Approximately 70 percent is used for residential, municipal, and industrial use, mainly in southern California. Currently, the SWP has contracted a total of 4.22 million acre-feet for delivery in San Joaquin River Region, the Central Coast Region, and the San Francisco and South Coast regions. Of this amount, about 2.5 million acre-feet is designated for the Southern California Transfer Area,

nearly 1.36 million acre-feet to the San Joaquin Valley, and the remaining 0.37 million acre-feet to the San Francisco Bay area, the Central Coast Region, and the Feather River area.

Contracts executed in the early 1960s established the maximum annual water amount (entitlement) that each long-term contractor may request from the SWP. The annual quantities reflect each contractor's projected annual water needs at the time the contracts were signed. SWP delivers water to agricultural and municipal and industrial water contractors based on the criteria established in the 1996 Monterey Agreement, which applies equal deficiency levels to all contractors.

3.2.5.3 San Joaquin River Group Authority Willing Sellers

San Joaquin River

San Joaquin River Exchange Contractors Water Authority. The operating scheme used by the CVP to service the Exchange Contractors is fairly straight forward. Shasta Reservoir, which has a capacity of 4,552,000 acre-feet, stores winter runoff from the upper Sacramento River. Some of this water is transferred to the southern delta CVP Tracy Pumping Plant via the Sacramento River, the Delta Cross-Channel, and interior central delta channels and is lifted into the Delta-Mendota Canal. This 117-mile-long canal carries water south by gravity flow to the Mendota Pool (which is located 30 miles west of Fresno). The water is used in the San Joaquin Valley to replace the San Joaquin River water that is diverted at Friant Dam near Fresno. Thus, Sacramento River water is brought down to replace the San Joaquin River water that is captured, stored in Millerton Lake, and diverted for use farther south through the Friant-Kern Canal and for use farther north through the Madera Canal (Littleworth and Garner 1995).

The Exchange Contractors have a total allotment of 840,000 acre-feet per year under a best-case wet year scenario. They are allowed a maximum of 719,000 acre-feet in a normal year to be diverted during the April-October period. In a critical drought year, the Exchange Contractors are limited to 529,000 acre-feet of CVP water during the same period.

Stanislaus River

Oakdale Irrigation District. The OID encompasses approximately 72,345 acres in Stanislaus and San Joaquin counties. Approximately 62,000 acres (or 86 percent) of land within the district is irrigated by OID through a gravity system of canals, tunnels, and pipelines. OID maintains more than 330 miles of laterals and pipelines and 40 miles of main canals and tunnels. The Stanislaus River runs throughout the central portion of the district.

OID has an adjudicated pre-1914 water right held jointly with SSJID to divert 1,816.6 cubic feet per second (cfs) of flow from the Stanislaus River. In addition to its pre-1914 rights, OID also has licenses and permits to direct divert and divert to storage waters of the Stanislaus River above its

1,816.6 cfs pre-1914 right. Most of these rights are also held jointly with SSJID. When New Melones Reservoir was constructed, it flooded OID's and SSJID's Melones Reservoir. In settlement of that action and the Districts' protests of Reclamation's application to obtain a permit from the SWRCB, Reclamation, OID and SSJID entered into an Agreement and Stipulation in 1972. In 1988, the 1972 Agreement and Stipulation was amended. The Agreement entitles OID/SSJID to receive 600,000 acre-feet of water when the projected flow in the Stanislaus River is greater than 600,000 acre-feet. OID and SSJID have an internal agreement to equally divide the water available to them under the 1988 Agreement.

Historically, more than 95 percent of the water served by OID has been surface water diverted from the Stanislaus River at Goodwin Dam into the Joint Supply Canal and the South Main Canal. Water diversions historically have occurred from March 1 through October 30 of a calendar year. The bulk of the diversions occurred in May through August. OID still diverts the majority of its water for irrigation use in the months of May through August.

Surface water is supplemented by groundwater pumping, especially during dry periods when surface water supplies are limited, from 22 groundwater wells (approximately 200 feet deep) located throughout the district on both sides of the Stanislaus River. An approximate average of 8,130 acre-feet per year of water has been pumped from these wells directly into the surface conveyance system to balance flows for irrigation customers. OID also pumps a small quantity (average 1,358 acre-feet per year) from four shallow wells to control water table levels in certain portions of the district. Over the last fifteen years, OID has pumped an approximate average of 9,668 acre-feet per year of groundwater, or less than four percent of their total water usage (OID/SSJID 1997).

Other components of OID operations include river pumps and reclamation pumps that recover and re-distribute a portion of operational spills, operational fluctuations, and a portion of irrigation tailwater. Excess water in the surface system south of the Stanislaus River drains into the Modesto Irrigation Canal (MID), the Tuolumne River, and eventually into the Stanislaus River as surface water return flows. Surface water runoff on OID property north of the river drains into the SSJID main distribution canal and flows west into SSJID and Lone Tree Creek (not a tributary to the Stanislaus River). In addition to pumping for irrigation use, OID also owns and/or operates nine independent domestic water systems. Over the last ten years, these wells have produced an average of 1,100 acre-feet per year. An undetermined number of privately-owned agriculture and domestic wells are located within the OID but are not operated by OID. Production from these wells has been estimated at 30,000 acre-feet per year (OID/SSJID 1997).

South San Joaquin Irrigation District. The SSJID covers approximately 71,112 acres in San Joaquin County. The predominant land use in SSJID is agricultural with urban areas comprising approximately 10 percent of the total district area. Pursuant to the 1988 Agreement and Stipulation, SSJID is entitled to divert jointly with OID up to 600,000 acre-feet per year from the Stanislaus River. SSJID has rights to divert one-half of the total diversion, up to 300,000 acre-feet per year.

Diverted Stanislaus River surface water flows into the SSJID/OID Joint Main Canal at the Goodwin Dam and is channeled into Woodward Reservoir. The District releases water from Woodward Reservoir into a conveyance system of canals to provide irrigation water for agricultural customers. Unused surface water drains north to the French Camp Outlet Canal. A small portion of irrigation runoff drains south as surface water return flows to the Stanislaus River. The return flows to the Stanislaus River have been monitored for the last two years and total approximately 3,124 acre-feet and 3,906 acre-feet for the 1996 and 1997 irrigation seasons, respectively (OID/SSJID 1997).

SSJID has made significant improvements to its irrigation delivery system over the last 15 years. As a result, SSJID is able to meet existing agricultural needs using less water and devote the conserved water to other uses, including additional conjunctive use projects which recharge the groundwater basin in wetter water years. SSJID is currently designing additional changes to its delivery system in some portions of the district to better meet the needs of existing agricultural customers and to enable farmers who currently use groundwater for sprinkler and drip irrigation to use surface water. SSJID has agreed to build a domestic water treatment plant to address the needs of four cities in the area which currently rely largely on groundwater. SSJID, along with OID, has agreed to make available up to 30,000 acre-feet of water annually to Stockton East Water District and the City of Stockton to reduce groundwater pumping.

SSJID has, in recent years, sold water that is temporarily surplus to the District's needs as a result of water conservation. The District, along with OID, sold water to the Department of the Interior in 1994 and signed an agreement for a two year sale in 1997 and 1998. As part of the two year sale, SSJID sold 40,000 acre-feet in 1997 and 25,000 acre-feet in 1998 (OID/SSJID 1997).

After existing irrigation needs are met and after accounting for any sales of water, SSJID stores any additional water in the conservation account established by the 1988 Agreement and Stipulation with Reclamation. Water stored in the conservation account is reserved for SSJID's use in years of very low inflow to New Melones. SSJID is entitled to store up to 100,000 acre-feet in the conservation account, which is half of the amount available by the 1988 Agreement and Stipulation. By the terms of an agreement with OID, OID is entitled to the remaining portion of the conservation account. Water stored in the conservation account is lost to the extent of flood control releases by Reclamation.

Tuolumne River

Modesto Irrigation District and Turlock Irrigation District. Tuolumne River water has been used for irrigation in the Central Valley since the late 1890s, when MID/TID (the Districts) constructed storage and conveyance facilities. The water resources of the upper basin were developed for water supply by the City and County of San Francisco during the early decades of the 20th century. This and later development modified the natural flow regime of the Tuolumne River; on average, more than 60 percent of the annual flow has been diverted for agricultural or municipal

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and industrial use. The three reservoirs in the Hetch Hetchy System (not including storage in CCSF's Don Pedro Water Bank) can store up to 35 percent of the mean annual unimpaired flow of the river as measured below La Grange. New Don Pedro Reservoir, along with the two smaller district-specific storage reservoirs (Modesto Reservoir and Turlock Lake), can store up to 112 percent of the mean annual flow of the river (FERC 1996).

The New Don Pedro Project (NDPP) is owned and operated by the Districts and consists of the New Don Pedro Dam, Don Pedro Reservoir (New Don Pedro Lake), and the New Don Pedro Powerhouse. Diversions from the NDPP system as well as from La Grange Dam, the TID and MID diversion facilities at the La Grange Dam, the TID canal system, TID's Turlock Lake, the MID canal system, and MID's Modesto Reservoir currently supply water to agricultural users. TID has considered using diversion from the NDPP system to supply the city of Turlock for municipal and industrial supply purposes; MID recently began supplying Tuolumne River water to the city of Modesto in 1995. NDPP also provides flood control, hydropower production, reservoir-based recreation, and fish and wildlife conservation.

The New Don Pedro Dam is an earth and rockfill structure located at Tuolumne river mile 54.5. It has a crest length of 2,300 feet and a maximum height of 585 feet above the streambed. The dam was constructed in 1971 to replace the original Don Pedro Dam, which was located approximately 2 miles upstream. The New Don Pedro Reservoir has a gross capacity of 2,030,000 acre-feet and a net usable capacity for irrigation, flood control, and hydropower generation of 1,721,000 acre-feet (FERC 1996).

La Grange Dam is a diversion facility also owned and operated by the Districts and is located 2.3 miles downstream of New Don Pedro Dam. The dam is a 130-foot-high overflow structure built in 1893 and impounds approximately 500 acre-feet of water. The Turlock Main Canal and the Modesto Main Canal divert water from just above La Grange Dam into an extensive network of irrigation canals on both sides of the Tuolumne River, with TID's canals on the south and MID's on the north. Both irrigation districts have an intermediate storage reservoir at the upper end of their canal network to help regulate flows. Turlock Lake, on the south side of the Tuolumne River, has a capacity of 48,000 acre-feet. Modesto Reservoir, on the north side of the river, has a capacity of 28,000 acre-feet (FERC 1996).

The Hetch Hetchy System is owned and operated by City and County of San Francisco and is not part of the FERC licensed NDPP facilities. CCSF regulates the upper portion of the Tuolumne basin through the operation of its Hetch Hetchy System for municipal and industrial water supply and hydropower generation. Hetch Hetchy facilities include O'Shaughnessy Dam at the Hetch Hetchy Reservoir; the Hetch Hetchy Aqueduct; the Canyon Power Tunnel; the Kirkwood Powerhouse; the Early Intake Diversion Dam; and the Cherry Creek Power Development. Although CCSF has no authority over the operation of Don Pedro Reservoir, a portion of the storage in Don Pedro is

allocated to CCSF through a water bank arrangement (FERC 1996). CCSF is not a willing seller under the proposed project.

Merced River

Merced Irrigation District. Flows in the Merced River are regulated primarily by four major facilities: New Exchequer Dam (Lake McClure), McSwain Reservoir and Powerplant, Merced Falls Dam and Crocker-Huffman Dam. The largest reservoir, Lake McClure, has a capacity of 1,024,000 acre-feet and is created by New Exchequer Dam. Merced ID owns and operates the reservoir for power, irrigation, recreation and flood control purposes. Water released from Lake McClure passes through a series of powerplants and smaller diversions before reaching the main diversion point. McSwain Reservoir, a part of Merced ID's Merced River Development Project, serves as an afterbay to New Exchequer Dam and Powerplant, re-regulating power generation releases to the Merced River. The capacity of McSwain Reservoir is 9,200 acre-feet (Merced ID 1977). Merced Falls Dam, from which diversions are made to Merced ID's Northside Canal, is owned and operated by PG&E. Downstream of Merced Falls Dam is the Crocker-Huffman Dam, from which diversions are made to Merced ID's Main Canal. On average, just over 50 percent of the annual streamflow in the Merced River below Merced Falls Dam is diverted to Merced ID's Main Canal (500,900 acre-feet per year between 1955 and 1980) (Merced ID 1997).

3.3 GROUNDWATER RESOURCES

This section identifies the existing groundwater resources that could be affected by implementation of flow objectives of the San Joaquin River Agreement (Agreement). It presents general information on the regional groundwater resources within the San Joaquin Groundwater Basin. Area-specific information on the groundwater basins underlying the service areas of the willing sellers is described in Appendix B. Section 4.3, subsequently, describes the impacts to groundwater within the local groundwater basins.

3.3.1 Introduction

The discussion of groundwater conditions in this section is for the San Joaquin River Region. Included in the discussion are hydrogeology, groundwater storage and production, groundwater levels, land subsidence, groundwater quality, agricultural subsurface drainage, and seepage-induced waterlogging of farm lands. It covers the following basins and service areas:

- Turlock Groundwater Basin
- Modesto Basin
- Merced Groundwater Basin
- Eastern San Joaquin County Basin
- San Joaquin River Exchange Contractors Service Area

3.3.2 Historical Perspective and Recent Conditions

Groundwater resources of the San Joaquin Valley are described with regard to regional hydrogeology, groundwater storage and production, groundwater levels, and groundwater quality. The discussion of groundwater quality covers those constituents of concern that affect agricultural productivity and others that are noted to be in high concentrations and known to affect human health and wildlife, including: TDS, boron, nitrates, arsenic, selenium, and dibromochloropropane (DBCP).

In addition, three other issues are related to groundwater conditions: agricultural drainage associated with shallow groundwater, seepage-induced waterlogging of farm lands, and land subsidence caused by groundwater level declines. Agricultural subsurface drainage has historically been affected by the presence of perched shallow groundwater conditions in parts of the San Joaquin Valley. Seepage-induced waterlogging of farm land has historically occurred due to the movement of water from streams into adjacent shallow groundwater aquifers. Land subsidence may be caused by one or a combination of the following mechanisms: compaction of aquifer sediments, resulting from groundwater overdrafting and lowering of the hydraulic head in the aquifer system; compaction of sediments in petroleum reservoir rocks caused by oil and gas exploration and extraction; hydrocompaction (the compaction of moisture-deficient sediments following the first application of

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water); compaction of peat soils following land drainage; and tectonic subsidence (Bertoldi et al. 1991).

Historically, the greatest occurrence of land subsidence in the San Joaquin Valley has resulted from groundwater overdraft and lowering of the hydraulic head, and is the only type of land subsidence discussed in this section.

3.3.3 Overview of the Central Valley Regional Aquifer System

The Central Valley regional aquifer system of California is a 400-mile long, northwest-trending asymmetric trough averaging 50 miles in width. The location and geologic boundary of this aquifer system is shown in Figure 3.3-1.

The significant water-producing geologic units throughout the valley trough are the unconsolidated to semi-consolidated non-marine sediments that range from the Oligocene and Miocene ages (13 million to 25 million years old) to recent. The west side of the trough is bounded by pre-Tertiary and Tertiary semi-consolidated to consolidated marine sedimentary rocks of the Coast Ranges. These faulted and folded sediments extend eastward beneath most of the Central Valley; any water contained in the sediments is usually saline. The east side of the valley is underlain by pre-Tertiary igneous and metamorphic rocks of the Sierra Nevada. Only small quantities of water are extracted from the joints and cracks of these basement rocks.

3.3.4 Groundwater Resources of the San Joaquin River Region

The southern two-thirds of the Central Valley regional aquifer system extends from just south of the Delta to just south of Bakersfield, and is referred to as the San Joaquin Valley Basin (DWR 1975), covering over 13,500 square-miles. The Department of Water Resources (DWR) further divides this basin into subbasins. Subbasins in the northern half of the San Joaquin Valley basin, lying within the San Joaquin River Region, include the Tracy, Eastern San Joaquin County, Modesto, Turlock, Merced, Chowchilla, Madera, and Delta-Mendota subbasins (DWR 1994).

3.3.4.1 Hydrogeology of the San Joaquin River Region

The San Joaquin Valley Basin has accumulated up to 6 vertical miles of unconsolidated continental and marine sediment in the structural trough. The top 2,000 feet of these sediments consist of continental deposits that generally contain freshwater (Page 1986). As these sediments accumulated over the last 24 million years, large lakes periodically filled and drained, resulting in deposition of laterally extensive clay layers that formed significant barriers to the vertical movement of groundwater in the basin (USBR 1997d.). The most extensive of these is the Corcoran Clay (a member of the Tulare Formation which was deposited about 600,000 years ago), consisting of a clay layer zero to 160 feet thick, found at depths of 100 to 400 feet below the land surface in the San

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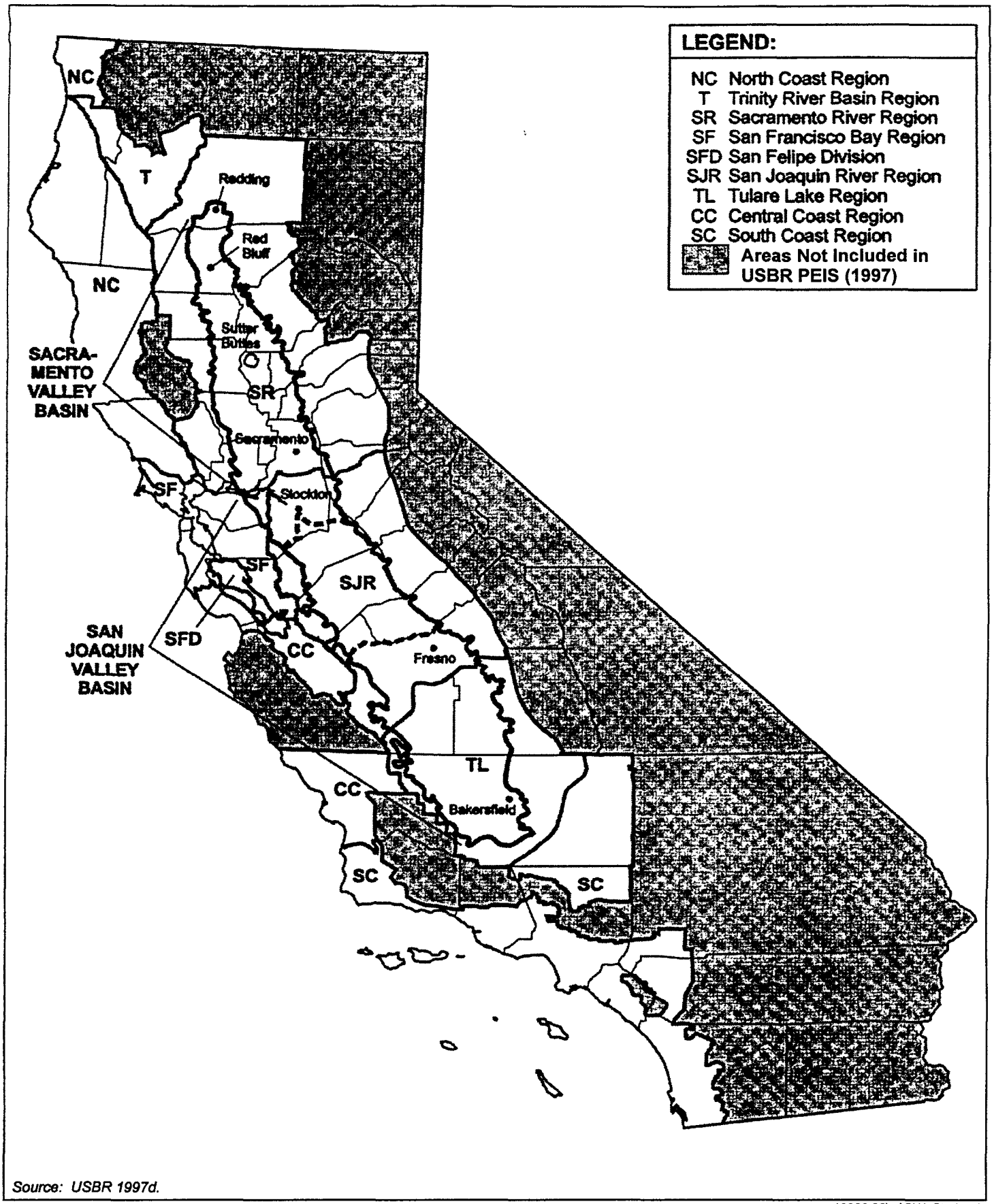

Source: USBR 1997d.

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Figure 3.3-1. Central Valley regional aquifer system.

Joaquin River Region. These hydrogeologic features are displayed in Figure 3.3-2, showing a generalized cross-sections for the San Joaquin River Region. Figure 3.3-2 shows the approximate distribution of the Corcoran Clay in the San Joaquin River Region and the location of the generalized cross section. Other clay layers are present above and below the Corcoran Clay and may have local impacts on groundwater conditions.

The Corcoran Clay divides the groundwater system into two major aquifers: a confined aquifer below the clay layer and a semi-confined aquifer above the layer (Williamson et al. 1989). Water recharge of the semi-confined upper aquifer generally occurs from stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. As agricultural practices expanded in the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems used to convey this water. Recharge of the lower confined aquifer consists of subsurface inflow from the valley floor and foothill areas to the east of the eastern boundary of the Corcoran Clay Member. Present information indicates that the clay layers, including the Corcoran Clay, are not continuous in some areas, and some seepage from the semi-confined aquifer above does occur through the confining layer.

Historically, the interaction of groundwater and surface water resulted in net gains to the streams. This condition existed on a regional basis through about the mid 1950s. Since that time groundwater level declines have resulted in some stream reaches losing flow through seepage to the groundwater systems below.

During pre-development conditions, groundwater in the San Joaquin River Region flowed from the valley flanks to the axis, then north toward the Delta. Large-scale groundwater development since the 1940s, combined with the introduction of imported surface water supplies, have modified the natural groundwater flow pattern. The groundwater pumping and recharge from imported irrigation water has resulted in a change in regional flow patterns. Flow largely occurs from areas of recharge towards areas of lower groundwater levels due to groundwater pumping (Bertoldi et at. 1991). The vertical movement of water in the aquifer has been altered in this region as a result of thousands of wells constructed with perforation above and below the confining unit (Corcoran Clay Member, where present), providing a direct hydraulic connection (Bertoldi et al. 1991). This may have been partially offset by a decrease in vertical flow resulting from the inelastic compaction of fine-grained materials within the aquifer system.

3.3.4.2 Groundwater Storage and Production

In DWR's Bulletin 160-93, usable storage capacity for the San Joaquin River Region was estimated to be approximately 24 million acre-feet (DWR 1994). The change in groundwater storage from 1970 to 1992 for the San Joaquin River and Tulare Lake Regions combined is shown in Figure 3.3-3. Relative to 1970, groundwater storage in the San Joaquin Valley Basin during the 1970s reached a low point in 1978, a result of the 1976 to 1977 drought period. By the early 1980s, groundwater

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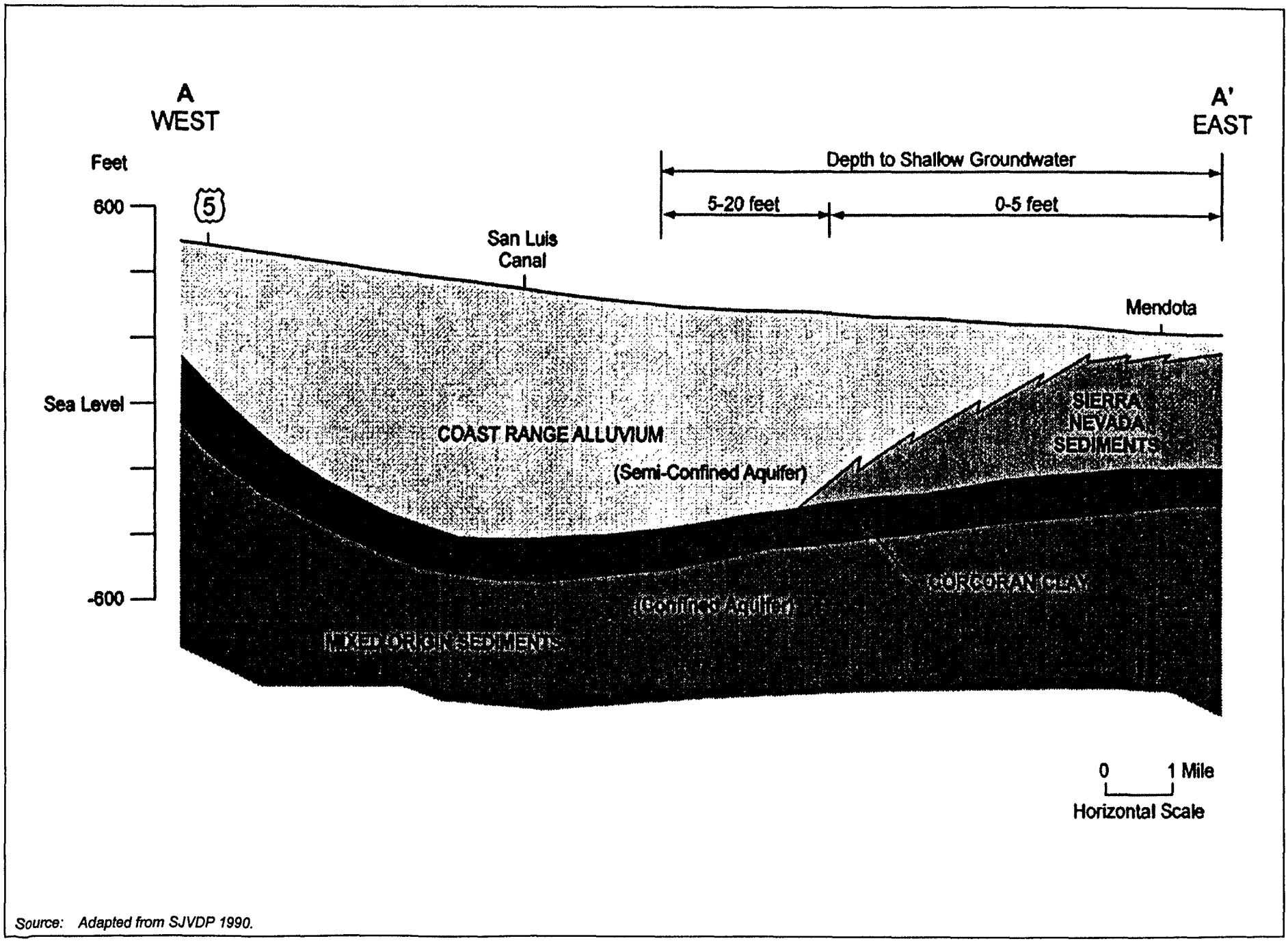

Source: Adapted from SJVDP 1990.

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Figure 3.3-2. Generalized cross-sections for the Central San Joaquin River Region.

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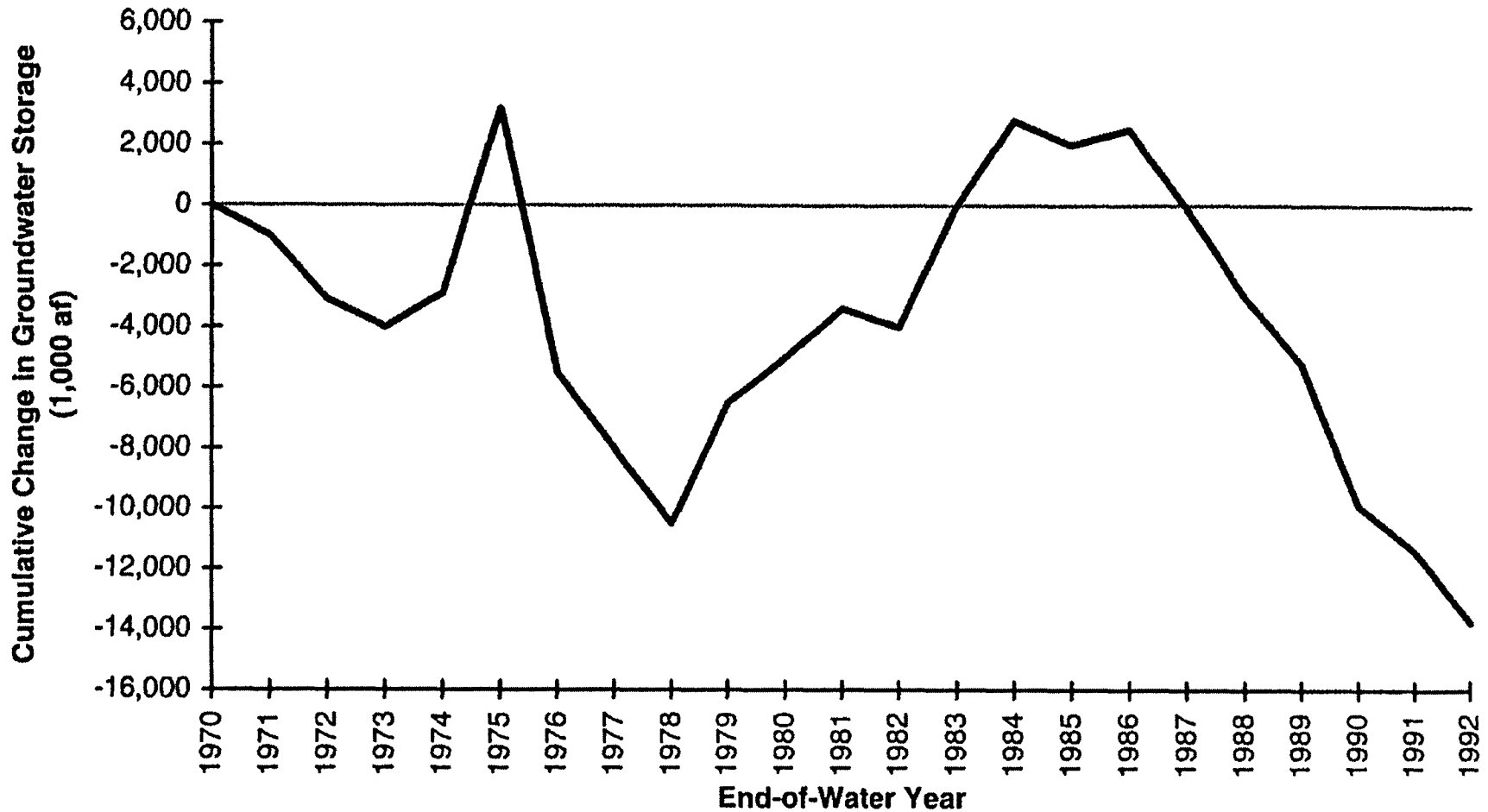

SOURCE:
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Figure 3.3-3. Change in groundwater storage for the San Joaquin River and Tulare Lake Regions, 1970-1992.

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storage returned to pre-drought conditions. Groundwater storage declines returned during the 1987-1992 drought, reaching a low for the 1970 to 1992 period at the end of the drought in 1992.

Groundwater pumping ranged from 1.6 million acre-feet in 1922 to 4.7 million acre-feet in 1977. Groundwater pumping has increased through the 1970s, and has varied greatly from year to year depending on hydrologic conditions and water user needs. Immediately following the 1976-1977 drought, hydrologic conditions for the years 1978, 1979, and 1980, characterized as wet, above normal, and wet, respectively, were largely responsible for the reduced pumping following the drought period.

There have been numerous attempts to estimate the safe yield of the San Joaquin River Region. The most recent estimate, made by DWR, is approximately 3.3 million acre-feet of perennial yield (DWR 1994). DWR estimated recent groundwater pumping for 1990 conditions (normalized) in the San Joaquin River Region to be 3.5 million acre-feet. This exceeds the estimated perennial yield by approximately 200 thousand acre-feet. All of the subbasins within the San Joaquin River Region experienced some overdraft (DWR 1994).

3.3.4.3 Groundwater Levels in the San Joaquin River Region

Expansion of agricultural practices between 1920 and 1950 caused declines in groundwater levels in many areas of the San Joaquin River Region. Along the east side of the region, declines have ranged between 40 and 80 feet since redevelopment conditions (1860) (Williamson et al. 1989).

With the exception of perched water tables, declines began occurring in the 1940s along the west side of the San Joaquin River Region, dropping more than 30 feet by 1960. By spring 1970, groundwater levels (reported by DWR) in this same area were recorded as ranging from 200 feet to 100 feet below sea level, a drop of as much as 100 feet. Groundwater levels in central San Joaquin County reached 50 feet below sea level by spring 1970, causing saline groundwater intrusion problems for the city of Stockton. By spring 1980, confined aquifer groundwater levels (reported by DWR) along northwestern Fresno County and western Merced County increased up to 100 feet. Groundwater levels in the semi-confined aquifer between spring 1970 and spring 1980 declined in response to 1976-1977 drought conditions and recovered to near pre-drought levels by 1980. The 1987-1992 drought resulted in substantial deficiencies in surface water deliveries and corresponding increases in groundwater pumping. Water levels declined by 20 to 30 feet throughout most of the central and eastern parts of the San Joaquin Valley (Westlands Water District 1995). Recent groundwater conditions, observed for spring 1993 following the drought, are shown in Figure 3.3-4.

Depression areas resulting from groundwater withdrawals are indicated along the east side of the San Joaquin River Region in Merced and Madera counties and are less than 50 feet above sea level. These groundwater levels are indicative of depleted conditions due to regional groundwater withdrawals resulting from the 1987-1992 drought period. This is consistent with observed storage

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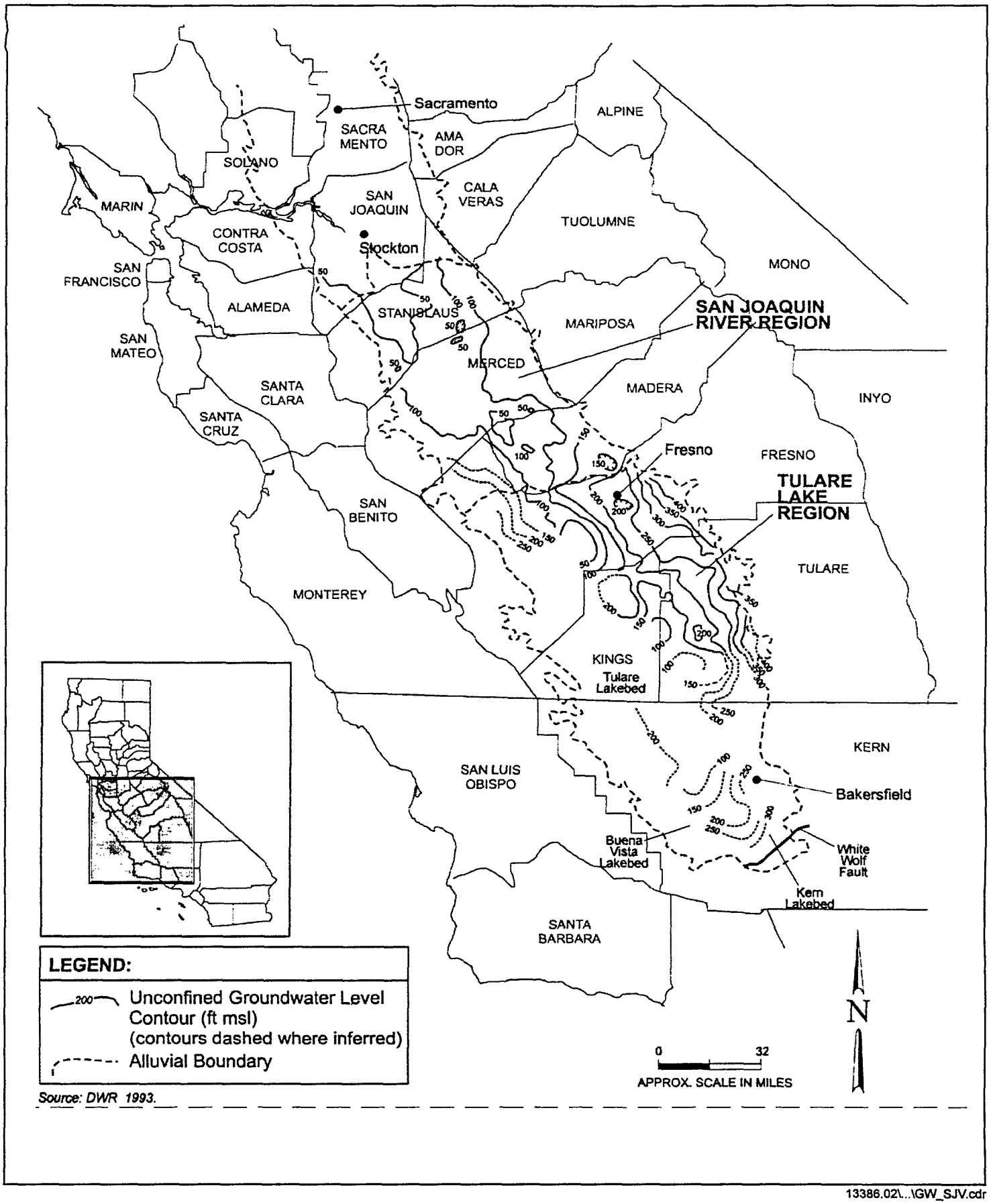

Source: DWR 1993.

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Figure 3.3-4. Groundwater conditions in the San Joaquin Valley.

recovery time which may span several years. For example, recovery to pre-drought storage conditions took more than five years following the 1976-1977 drought.

3.3.4.4 Groundwater Quality in the San Joaquin River Region

Groundwater quality conditions in the San Joaquin River Region vary throughout the area. Groundwater quality parameters are discussed below for the San Joaquin River Region, and sources and reasons for concerns associated with these parameters are listed. The discussion is limited to parameters that are associated with regional problems.

Total Dissolved Solids

TDS concentrations vary considerably in the San Joaquin River and Tulare Lake Regions, depending upon the groundwater zone. TDS concentrations in groundwater along the east side of the San Joaquin Valley are lower in comparison to concentrations in the west side of the San Joaquin River Region. This distribution reflects the low concentrations of dissolved solids in recharge water that originates in the Sierra Nevada and the predominant regional groundwater flow pattern. In the center and on the east side, TDS concentrations generally do not exceed 500 mg/l. On the west side, TDS concentrations are generally greater than 500 mg/l, and are in excess of 2,000 mg/l along portions of the western margin of the valley (Bertoldi et al. 1991). The concentrations in excess of 2,000 mg/l commonly occur above the Corcoran Clay layer. Impaired municipal use of groundwater for drinking water supply due to elevated TDS concentrations occurs at several locations throughout the San Joaquin River Region (SWRCB 1991).

Boron

High boron concentrations occur in the groundwater in the northwestern part of the San Joaquin River Region from the northernmost edge of the region to the southernmost edge of the region (Bertoldi et al. 1991). Agricultural use of groundwater is impaired due to elevated boron concentrations in western Stanislaus and Merced counties (SWRCB 1991) due to boron's excessive phytotoxicity.

Nitrates

In the San Joaquin River Region, a large area within the northern San Joaquin County (between Lodi and Stockton) contains NO_3-N concentrations in groundwater exceeding 5 mg/l (Bertoldi et al. 1991). Municipal use of groundwater as a drinking water supply is also impaired due to elevated nitrate concentrations in the Tracy, Modesto-Turlock, Merced, and Madera areas (SWRCB 1991).

Arsenic

In the San Joaquin River Region, municipal use of groundwater as a drinking water supply is impaired due to elevated arsenic concentrations in Stanislaus and Merced counties and western San Joaquin County (SWRCB 1991).

Selenium

High selenium concentrations occur naturally in soils and groundwater on the west side of the San Joaquin River Region. These concentrations have raised considerable concern because of their potential to leach from the soil by subsurface irrigation return flow into the groundwater and into receiving surface waters. Selenium concentrations in shallow groundwater have been highest in the central and southern area south of Los Banos and Mendota (median concentrations of 10,000 to 11,000 µg/l) (Bertoldi et al. 1991). Although selenium is currently regulated by federal primary drinking water standards at an MCL of 50 µg/l, USEPA recently established chronic and acute toxicity criteria of 5 and 20 µg/l, respectively, for the protection of wildlife and aquatic organisms. The SWRCB, Central Valley Region, has established monthly mean and daily maximum selenium objectives of 5 and 12 µg/l, respectively, for the San Joaquin River from the mouth of the Merced River to Vernalis and 10 and 26 µg/l from Sack Dam to the mouth of the Merced River (SWRCB Central Valley Region 1992).

Dibromochloropropane

DBCP has been detected in many groundwater wells in the San Joaquin River Region. Municipal use of groundwater as drinking water supply is impaired due to elevated DBCP concentrations in groundwater near several cities within the San Joaquin River Region, including Chowchilla, Madera, Merced, and the Modesto-Turlock area (SWRCB 1991).

3.3.4.5 Land Subsidence in the San Joaquin River Region

Beginning in the 1920s, the use of San Joaquin Valley groundwater for crop irrigation began to increase rapidly until the mid-1960s. As a result of this heavy pumping, groundwater level declines have caused land subsidence on areas of the valley. Land subsidence is a significant problem in the San Joaquin River and Tulare Lake Regions. From 1920 to 1970, almost 5,200 square miles of irrigated land in the San Joaquin River and Tulare Lake regions registered at least 1 foot of land subsidence (Ireland 1986). By the mid 1970s, the use of imported surface water in the western and southern portions of San Joaquin Valley essentially eliminated new land subsidence. During the 1976 to 1977 drought, land subsidence was again observed in areas previously affected due to renewed high groundwater pumping rates. After nearly two decades of little or no land subsidence, significant land subsidence has been recently detected in the San Joaquin Valley due to increased groundwater pumping during the 1987-1992 drought. Land subsidence occurring between 1984 and

1996 was reported along the Delta-Mendota Canal. Two locations of note are: (1) near Mendota Pool where 1.3 feet of land subsidence was measured, and (2) approximately 25 miles northeast of Mendota Pool where 2.0 feet of land subsidence was measured (Central California Irrigation District 1996). Measured land subsidence by DWR between 1990 and 1995 of up to 2.0 feet was reported along the California Aqueduct in Westlands Water District (Dudley 1995).

Land subsidence in the San Joaquin Valley has occurred mostly in areas that are confined by the Corcoran Clay, where pressure changes caused by groundwater pumping promote greater compressive stress than in the unconfined zone (DWR 1977). The maximum land subsidence levels recorded in the Central Valley occurred in the 2,600 square-mile Los Banos-Kettleman City area. Because of the slow drainage of the fine-grained deposits, subsidence at a particular time is more closely related to past water-level change than to current change. For example, in the San Joaquin Valley, groundwater withdrawals increased greatly until large imports of surface water through various canals occurred; but even though water levels in the area started to rise, the rate of subsidence began to decrease three years later.

3.3.4.6 Agricultural Subsurface Drainage in the San Joaquin River Region

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake Regions.

The soils on the west side of the region are derived from marine sediments and are naturally high in salts and trace elements. Irrigation of these soils has mobilized these compounds and facilitated their movement into the shallow groundwater. Since the early 1950s, much of this irrigation has been with imported water, resulting in rising groundwater and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainage water frequently contains high concentrations of salts and trace elements (SJVDP 1990). The area of subsurface drainage problems extends along the western side of the San Joaquin River and Tulare Lake Regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions, groundwater levels often encroach on the root zone of agricultural crops, and natural subsurface drainage must be supplemented by constructed drainage facilities for irrigation agriculture to be sustained.

Toxic and potentially toxic trace elements in some soil and shallow groundwater on the western side of the San Joaquin River and Tulare Lake Regions are also of concern. These trace elements greatly complicate the disposal of subsurface drainage waters. Elements of primary concern are selenium, boron, molybdenum, and arsenic. Selenium is of greatest concern due to the wide distribution and known toxicity of selenium to aquatic animals and waterfowl.

3.3.4.7 Seepage and Waterlogging in the San Joaquin River Region

In the lower reaches of the San Joaquin River and in the vicinity of its confluence with major tributaries, high periodic streamflows and local flooding combined with high groundwater levels have resulted in seepage-induced waterlogging damage to low-lying farm land. In the western portion of the Stanislaus River watershed, groundwater pumping has historically been used for control of high groundwater levels and seepage-induced waterlogging conditions. Along the San Joaquin River from the confluence with the Tuolumne River through the South Delta, flood control operation requirements have recently contributed to some seepage-induced waterlogging damage to low-lying farm land, a result of streamflow seepage into adjacent shallow groundwater aquifers (USBR 1997f). The seepage-induced waterlogging places neighboring crops and farm land at risk and prevents cultivation of the land until the summer months, placing the annual crop production at risk. Concern has been raised that San Joaquin River flows in excess of 16,000 cfs at Vernalis can result in seepage-induced waterlogging damage of adjacent low-lying farm land in the south Sacramento-San Joaquin Delta area (Hildebrand 1996).

3.3.5 Summary of Groundwater Conditions

Each of the basins and service areas within the San Joaquin River Region are summarized in Table 3.3-1. The areas include:

- Turlock Groundwater Basin
- Modesto Basin
- Merced Groundwater Basin
- Eastern San Joaquin County Basin
- San Joaquin River Exchange Contractors Service Area

The Oakdale Irrigation District Service Area is contained in parts of both the Modesto Basin and the Eastern San Joaquin County Basin, and the groundwater conditions are not separated out for purposes of this summary. A detailed description of the groundwater resources in each of the districts is contained in Appendix B.

Table 3.3-1. SUMMARY OF GROUNDWATER CONDITIONS IN THE SAN JOAQUIN RIVER REGION

Groundwater Conditions	GROUNDWATER BASIN OR SERVICE AREA				
	Turlock Groundwater Basin	Modesto Basin/Oakdale Irrigation District Service Area	Merced Groundwater Basin	Eastern San Joaquin County Basin	San Joaquin River Exchange Contractors Service Area
Elevation/Levels	Depth to groundwater ranges from 6 to over 100 feet bgs.	Depth to groundwater ranges from less than 5 feet to over 100 feet bgs. Water table declined 15' for period 1970-90.	Depth to groundwater ranges from less than 1 foot to over 100 feet bgs. Water table declined up to 40' for period 1980-92.	Water table declined 20' to 30' since 1964.	No data available
Water Quality	Water table declined approximately 5 feet. Water hardness moderate to very hard	Generally acceptable	Numerous constituents detected	Increasing levels of contaminants	Localized poor groundwater quality
• **TDS**	High TDS in wells deeper than 350 feet	Relatively low	High TDS in wells deeper than 350 feet	No data available	No data available
• **Nitrates**	Localized and some levels above MCL	Localized and some levels above MCL	Below current MCL	Localized levels above MCL - wells closed or replaced	No data available
• **Arsenic**	Below current MCL	Below current MCL	Below current MCL	No data available	No data available
• **Iron and Manganese**	Elevated naturally occurring concentrations	Elevated naturally occurring concentrations	Elevated naturally occurring concentrations	No data available	Elevated concentrations

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Table 3.3-1. SUMMARY OF GROUNDWATER CONDITIONS IN THE SAN JOAQUIN RIVER REGION (CONT.)

Groundwater Conditions	GROUNDWATER BASIN OR SERVICE AREA				
	Turlock Groundwater Basin	Modesto Basin/Oakdale Irrigation District Service Area	Merced Groundwater Basin	Eastern San Joaquin County Basin	San Joaquin River Exchange Contractors Service Area
• **Radionuclides**	High naturally occurring uranium	High naturally occurring uranium	No data available	No data available	No data available
• **Pesticides**	Localized and some levels above MCL.	Localized and some levels above MCL.	Levels detected at or below MCL.	Levels detected below MCL	No data available
• **Trace Organics/ Organics**	Isolated occurrences principally the result of leaking USTs - none in public water supply	Isolated occurrences principally the result of leaking USTs- some in public water supply	Localized and some levels above MCLs	No data available	No data available
Subsidence	Not a problem	Not a problem	Not a problem	Not a problem	Significant in western San Joaquin Valley
Agricultural Subsurface Drainage	Drainage pumping	Drainage pumping	Drainage pumping	Not a problem	Many subsurface drainage systems

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3.4 TERRESTRIAL RESOURCES

This section discusses existing vegetation and wildlife resources in the San Joaquin Valley with emphasis on biological communities where implementation of the instream flows for SJRA will have the greatest effect. Sensitive features, such as wetlands, and rare, threatened, endangered, and sensitive (RTES) species are specifically addressed. Information for this section was primarily derived from existing data. Site visits were conducted to assess vegetation resources.

3.4.1 Vegetation

This description of vegetation growing within the boundaries of the riparian corridors of the project area is based on the ecological relationships between vegetation, soils, and hydrology (which the fluvial system creates). This section, along with Appendix C, describes the current status of vegetation growing within the riparian corridor along the Stanislaus, Tuolumne, Merced, and San Joaquin rivers (the project area). This vegetation description is based on the ecological relationship between vegetation growing within the project area's riparian corridors and the fluvial system. Appendix C contains a description of vegetation resources in the San Joaquin River and the East San Joaquin Basin Ecological Zones.

3.4.1.1 Background

The term riparian describes a unique physical environment and associated plant vegetation that occurs along banks of freshwater bodies, watercourses, estuaries, and surface-emergent aquifers and adjacent areas. The groundwater in these areas provides soil moisture sufficiently in excess of that available through local precipitation, and is capable of supporting vegetation requiring moderate amounts of water (Warner et al. 1984). The extent of groundwater influence defines the riparian corridor width and the plant assemblages that grow there.

A riparian plant's life has four stages: initiation, establishment, maturity, and senescence (Figure 3.4-1). Initiation starts after a seed lands on exposed, moist substrate and germinates; this stage continues through the first growing season. The establishment stage begins after the first growing season and continues until the plant has enough resources to begin sexual reproduction. When a plant flowers and produces seed, maturity starts. Eventually seed production and reproductive capacity decline, and the mature plant enters senescence. Within the project area, riparian stands growing on what are now terraces (floodplains prior to flow regulation) are predominantly senescent with no younger age classes to replace them. Historically, large floods created gaps in the riparian vegetation where new sediments could be deposited, and younger age classes could regenerate. Because the magnitude and frequency of these floods have been virtually eliminated, remaining mature stands are in decline because there are no younger age classes to replace trees when they die.

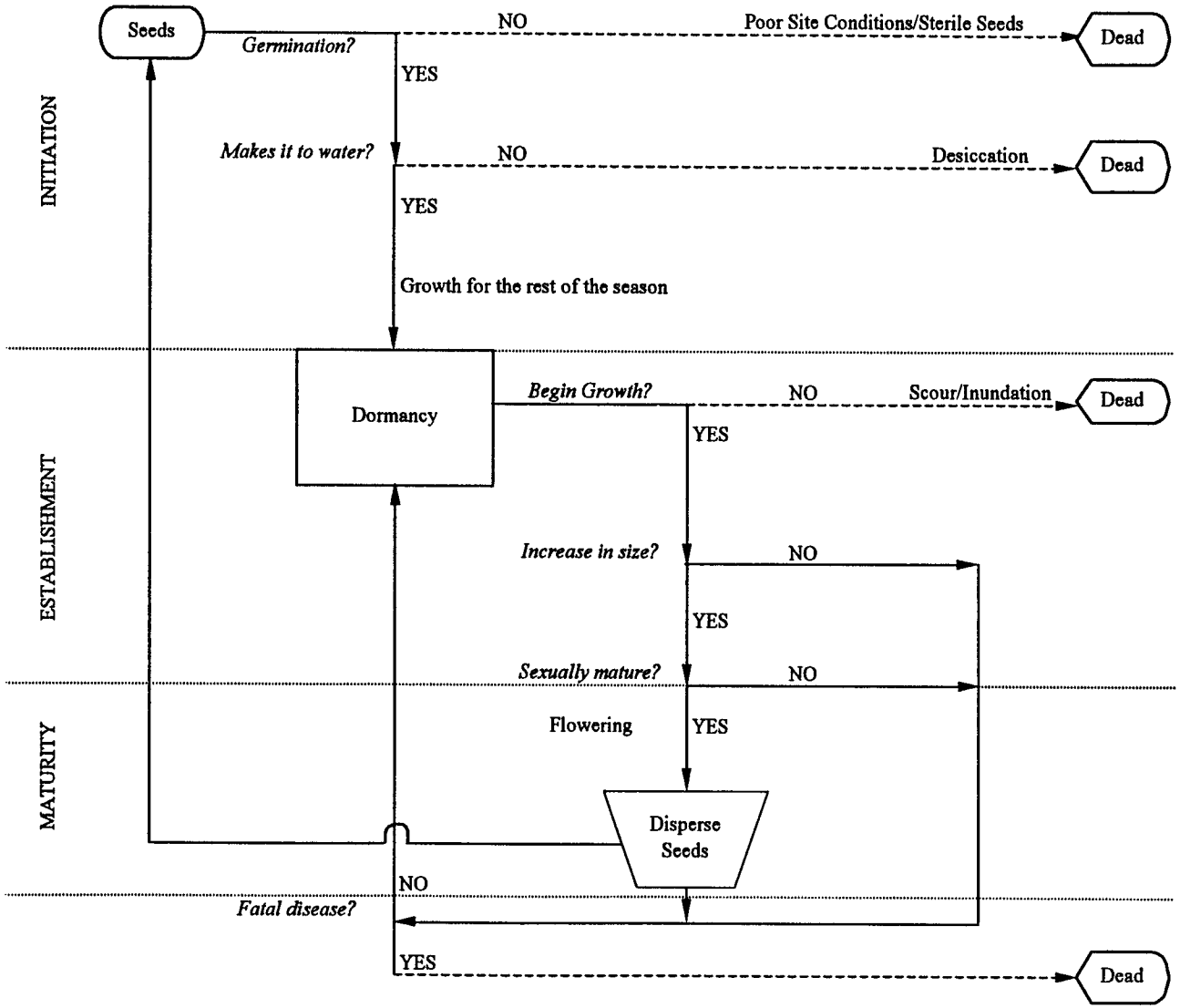

Figure 3.4-1. A generalized riparian hardwood life cycle showing life stages, and mortality agents that affect these life stages.

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Vegetation growing within the riparian corridor forms a mosaic of patches; individual patches are called stands. The list of plant species comprising the stand defines the composition of a particular plant series. Plant series are the latest classification term used to describe riparian vegetation (Sawyer and Keeler-Wolf 1995). Plant series consist of uniform patches of vegetation, usually comprised of multiple species, but always having one or two species that dominate. Series are stratified into a canopy, shrub and ground layer, with the series name determined by the species of greatest relative abundance within the highest strata (Sawyer and Keeler-Wolf 1995).

The types of riparian vegetation that would be affected by the project alternatives are divided into three groups: aquatic vegetation, emergent marshes, and terrestrial vegetation with plant series endemic to each group. Aquatic vegetation is commonly referred to as a lacustrine wetland because it grows in open, still water. Section 3.5 contains a more detailed discussion of aquatic resources. Cowardin et. al. (1979) referred to terrestrial and emergent vegetation within the riparian corridor as forested palustrine and palustrine wetlands. Holland (1986) classified riparian vegetation in further detail however his classification was never published for public use, and the scale of his descriptions are geographically broad (e.g., Valley, foothill, grasslands). The plant series classification remains as providing the greatest detail geographically and is generally consistent in species composition. The series classification is compared to Holland's system (see Table 3.4-1 on the following pages).

The proposed project would release different magnitudes of water into rivers within the project area. These releases would only affect vegetation within the immediate area of the rivers, and are not expected to have any significant effects on vegetation growing outside of the riparian corridor. Because the proposed project and alternative would only affect vegetation growing within the riparian corridor, a boundary limiting the evaluation scope was defined. Since it is difficult to detect the groundwater limits within the riparian corridor, another more practical boundary was used. The bankfull channel is well defined along each river, is the immediate area that may be potentially impacted by the pulse flows, and was established as the limit for evaluating project effects.

Vegetation patterns within each river's riparian corridor result from the interactions of fluvial geomorphology, hydrology, and a particular plant species' physiologic tolerances. Important hydrologic processes include magnitude and timing of flow inundation, and groundwater table fluctuation. Important fluvial geomorphic processes include channel migration and avulsion, fine sediment deposition on floodplains and terraces, point bar scour, and woody debris transport. Fluvial geomorphic processes are a product of variable discharges, which create and maintain an alternate bar morphology. The alternate bar morphology is a geomorphic template that structures the basic riparian vegetation patterns (Figure 3.4-2). The alternate bar morphology is divided into geomorphic units: riffles, pools, runs, point bars, floodplains, terraces, sloughs/oxbows, and backwaters. The channel region below the floodplain is called the bankfull channel.

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Table 3.4-1: POTENTIALLY OCCURRING PLANT SERIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

VEGETATION SERIES	NDDB/HOLLAND TYPE SYNONOMIES	NATURE CONSERVANCY STATUS
Arroyo willow series (RpScr)	Southern cottonwood-willow riparian forest (61330 *in part*)	G3 S3
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
	Southern willow scrub (63320 *in part*)	G3 S3.2
Black willow series (RpScr; RpWld)	Southern cottonwood-willow riparian forest (61330 *in part*)	G3 S3
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
	Southern willow scrub (63320 *in part*)	G3 S3.2
Blue elderberry series (RpScr;RpWld;VFGr)	Elderberry savanna (63430)	G2 S2.1
	Mexican elderberry series	
Box elder series (RpScr; RpWld)	Southern cottonwood-willow riparian forest (61330 *in part*)	G3 S3
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
	Southern willow scrub (63320 *in part*)	G3 S3.2
Bulrush series (MshSw)	Coast and Valley freshwater marsh (52410 *in part)*	G3 S2.1
Bulrush- cattail series (MshSw)	Coast and Valley freshwater marsh (52410 *in part*)	G3 S2.1
Buttonbush series (MshSw; RpScr)	Buttonbush scrub (63430)	G1 S1.1
California walnut series (CmWld; RpWld)	California walnut woodland (71210)	G2 S2.1
	Walnut forest (81600)	G1 S1.1
Cattail series (MshSw)	Coast and Valley freshwater marsh (52410 *in part*)	G3 S2.1
Common reed series (MshSw)		n/a

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Table 3.4-1: POTENTIALLY OCCURRING PLANT SERIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES (CONT.)

VEGETATION SERIES	NDDB/HOLLAND TYPE SYNONOMIES	NATURE CONSERVANCY STATUS
Ditch-grass series (MshSw)	Coastal brackish marsh (52200 *in part*)	G2 S2.1
	Cismontane alkali marsh (52310 *in part*)	G1 S1.1
	Alkali seep (45320 *in part*)	G3 S2.1
Duckweed series (MshSw)	Coast and Valley freshwater marsh (52410 in part)	G3 S2.1
Dusky willow series (MshSw)	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
	Great Valley willow scrub (63410 *in part*)	G3 S3.2
	Southern willow scrub (63320 *in part*)	G3 S3.2
Eucalyptus series EXOTIC		n/a
Edible fig series EXOTIC		n/a
Fremont cottonwood series (RpWld)	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
Hind's Walnut stands (RpWld; CmWld)	Hinds walnut woodland (71220)	G1 S1.2
Kentucky bluegrass series (VFGr)	Valley and foothill grasslands (42000)	n/a
Mixed willow series (RpScr; RpWld)	Freshwater swamp (52600 *in part*)	G1 S1.2
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley mixed riparian forest (61420 *in part*)	G2 S2.1
	Great Valley willow scrub (63410 *in part*)	G3 S3.2
	Southern willow scrub (63320 *in part*)	G3 S3.2
Mosquito fern series (MshSw)	Coast and Valley freshwater marsh (52410 *in part*)	G3 S2.2
Narrowleaf willow series (RpScr)	Southern cottonwood-willow riparian forest (61330 *in part*)	G3 S3
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley willow scrub (63410 *in part*)	G3 S3.2

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Table 3.4-1: POTENTIALLY OCCURRING PLANT SERIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES (CONT.)

VEGETATION SERIES	NDDB/HOLLAND TYPE SYNONOMIES	NATURE CONSERVANCY STATUS
Nodding needlegrass series (VFGr)	Valley needlegrass grassland (42110 *in part*)	G3 S3.1
Northern claypan vernal pools (VnPl)	Northern claypan vernal pool (44120)	G1 S1.2
Northern hardpan vernal pools (VnPl)	Northern hardpan vernal pool (44110)	G3 S4
Oregon ash series (RpScr; RpWld)	Southern cottonwood-willow riparian forest (61330 *in part*)	G3 S4
	Great Valley mixed riparian forest (61420 in part)	G2 S2.1
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
	Great Valley willow scrub (63410 *in part*)	G3 S3.2
Purple needlegrass series (VFGr)	Valley needlegrass grassland (42110 *in part*)	G3 S3.1
Shining willow series (RpScr; RpWld)	Freshwater swamp (52600 *in part*)	G1 S1.2
	Southern cottonwood-willow riparian forest (61330 *in part)*	G3 S3
	Great Valley mixed riparian forest (61420 in part)	G2 S2.1
	Great Valley cottonwood riparian forest (61410 *in part*)	G3 S2.1
Shining willow series (RpScr; RpWld)	Great Valley willow scrub (63410 *in part*)	G3 S3.2
	Pacific willow series	
Pondweeds with floating leaves series (MshSw)	Coast and Valley freshwater marsh (52410 *in part*)	G3 S2.2
Pondweeds with submerged leaves series (MshSw)	Coast and Valley freshwater marsh (52410 *in part*)	G3 S2.3
Quillwort series (MshSw)	Freshwater marsh (52400 *in part*)	G4 S4
Tree of heaven series EXOTIC		n/a
Valley oak series (RpWld)	Great Valley valley oak riparian forest (61430)	G1 S1.2
	Valley oak woodland (71130)	G2 S2.1

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Table 3.4-1: POTENTIALLY OCCURRING PLANT SERIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES (CONT.)

Nature Conservancy Heritage Program Status Ranks

Global ranks
G1= Fewer than 6 viable occurrences worldwide and/or 2000 acres
G2= 6-20 viable occurrences worldwide and/or 2,000-10,000 acres
G3= 21-100 viable occurrences worldwide and/or 10,000-50,000 acres
G4= Greater than 100 viable occurrences worldwide and/or greater than 50,000 acres
G5= vegetation type is demonstrably secure due to worldwide abundance

State ranks
S1= Fewer than 6 viable occurrences statewide and/or 2000 acres
S2= 6-20 viable occurrences statewide and/or 2,000-10,000 acres
S3= 21-100 viable occurrences statewide and/or 10,000-50,000 acres
S4= Greater than 100 viable occurrences statewide and/or greater than 50,000 acres
S5= vegetation type is demonstrably secure statewide

Threat Ranks
0.1 = Very threatened
0.2 = Threatened
0.3 = No current threats known

References:
Hickman J.C. (Ed.) 1993. *The Jepson Manual Higher Plants of California.* University of California Press, Berkeley.

Sawyer J.O. and Keeler-Wolf T. 1995. *A Manual of California Vegetation* California Native Plant Society.

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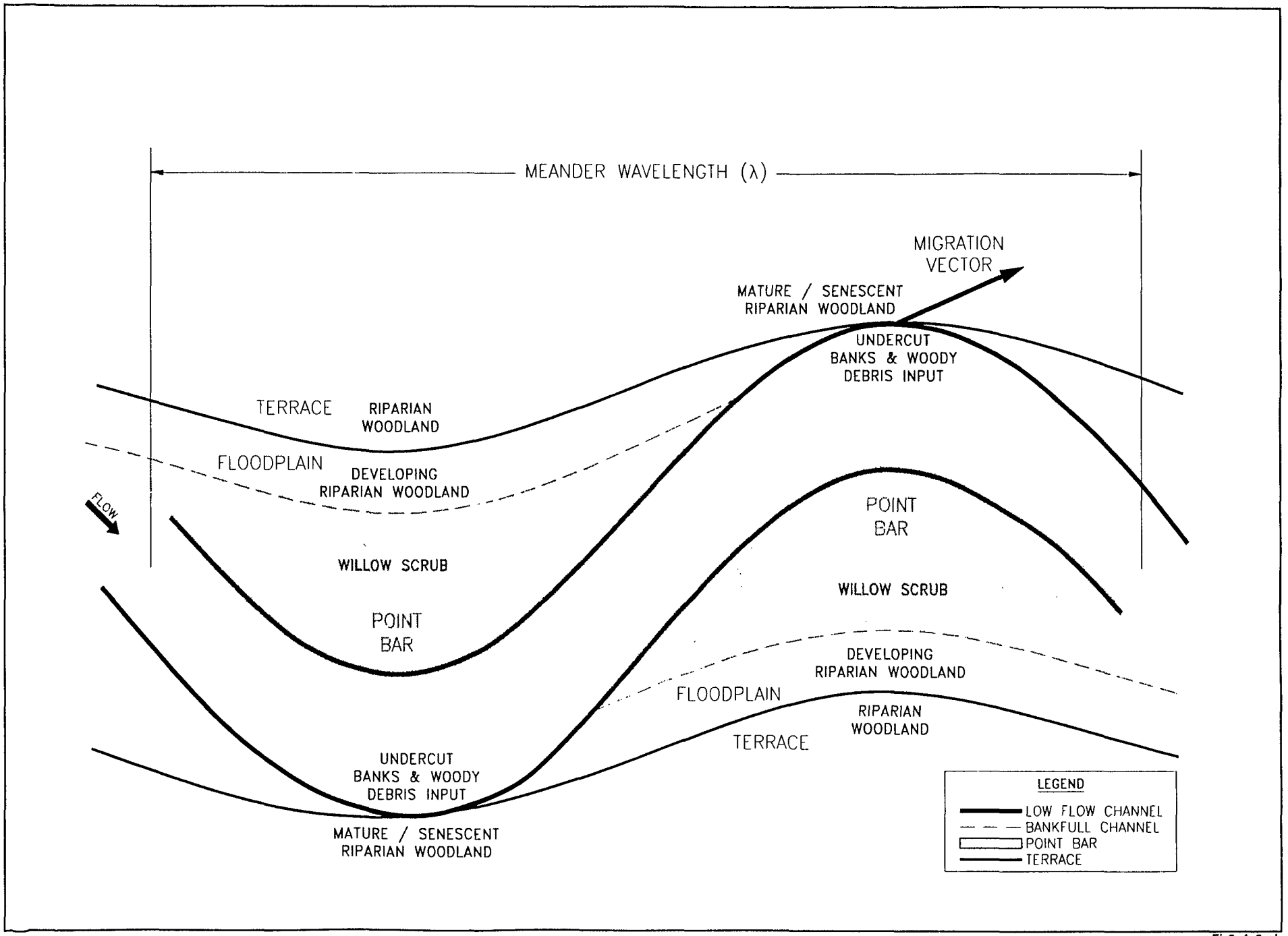

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Figure 3.4-2. Idealized alternate bar unit and associated vegetation.

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Annual hydraulic regimes are often illustrated with an annual hydrograph (Figure 3.4-3). The annual hydrograph is broken into components to illustrate certain trends in timing, magnitude and duration of discharge during portion of the water year. Individual hydrograph components affect riparian vegetation growing on geomorphic units differently, and the cumulative effects are summarized in Table 3.4-2 on the following pages.

Historically, spring snowmelt floods rose and fell gradually; and after the peak, river water levels declined gradually through summer months (Figure 3.4-3). This annual trend in discharge affected initiating and establishing vegetation, creating observable patterns in established vegetation. Some plant species evolved rapidly growing roots, which "follow" dwindling sub-surface soil moisture created by flow recession (Segelquist et al. 1993). Falling groundwater tables during summer months created soil moisture gradients, which placed strong selective pressures on vegetation. Plants whose roots could not keep up with the groundwater drawdown died. These gradients, combined with local soil differences, caused distinctive "zonation" patterns in riparian vegetation. In many locations, plants germinated but were later unable to survive because of insufficient soil moisture. Desiccation mortality may prevent a plant's transition into the establishment stage for many successive years, causing distinct age classes between successful cohorts. Before flow regulation, inundation discouraged seed germination in the bankfull channel. Spring snowmelt floods would inundate substrate on which seeds could potentially land and germinate. Riparian hardwoods disperse most of their annual seeds during the spring snowmelt, resulting in a sparsely vegetated bankfull channel.

Each woody riparian species (and life stage) responds differently to hydrologic and fluvial processes. Particular plant life stages are more vulnerable to the effects of flow variation and fluvial processes. Initiating and early establishing plants are especially susceptible to mortality created by inadequate substrate and water availability. If initiating plants survive the summer, they are still susceptible to inundation or scour-induced mortality during winter and spring flood events. Once plants escape a two- to four-year window and develop deeper and more extensive root systems, the risk of scour induced mortality decreases. Ultimately, mortality of maturing plants depends on channel migration, being pushed over by flood debris, or disease. These periodic and spatially variable disturbance patterns and mortality agents perpetuated the plant series diversity that was once found along the rivers within the project area.

Prior to human intervention, the riparian corridor was several miles wide in places where the rivers lacked confinement, creating true riparian "forests". The dynamic interaction between initiation and maturation on one hand, and mortality on the other, maintained riparian stand species and structural diversity. The struggle between plants' physiological tolerances and fluvial and hydrologic processes resulted in noticeable patterns in species location on specific geomorphic surfaces. Riparian plants initiate and establish after floods of specific recurrence intervals (Auble et al 1994, Bradley and Smith 1984, Osterkamp and Hupp 1984). A study by McBain and Trush (1998) suggests that these

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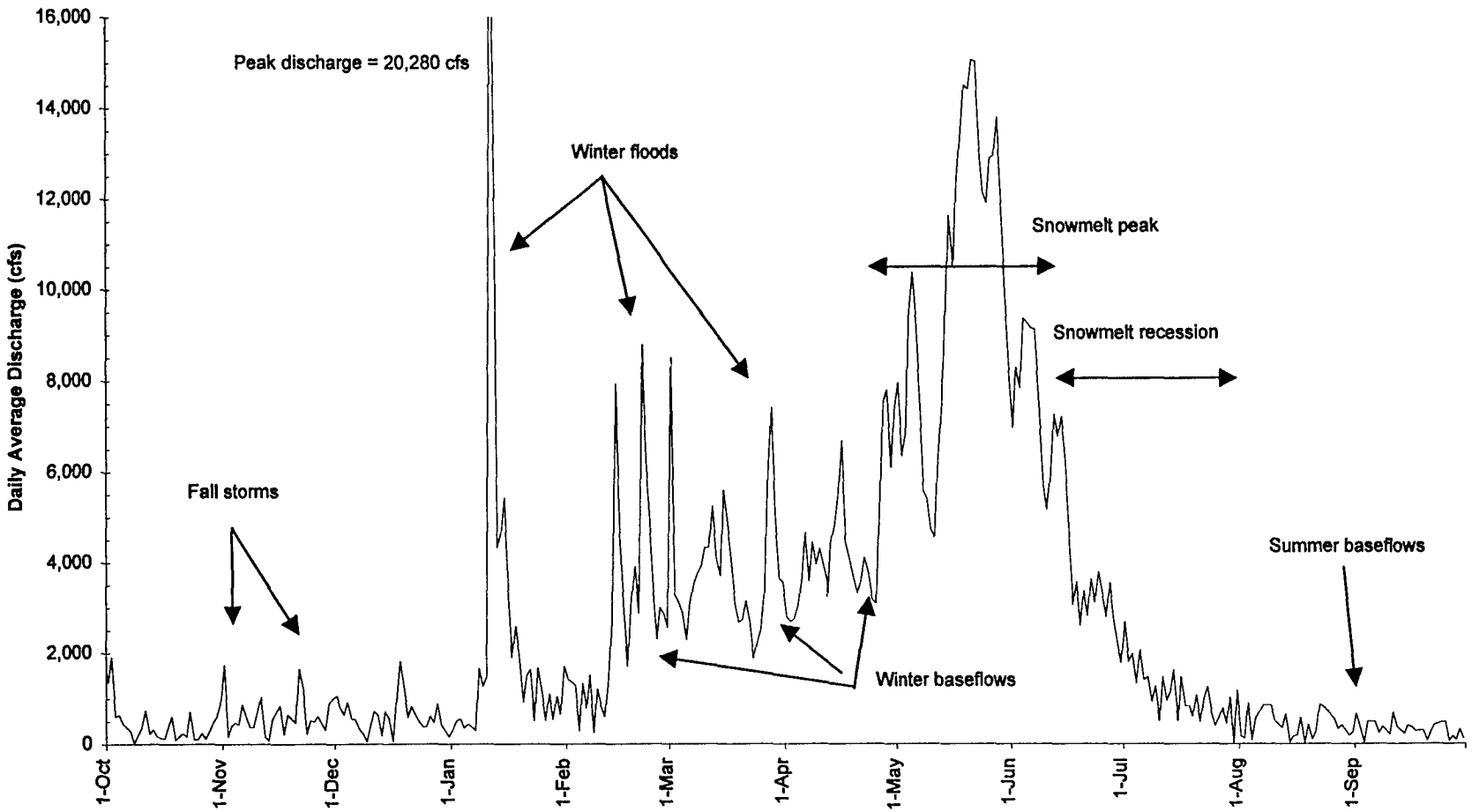

Figure 3.4-3. Toulumne River at La Grange annual hydrograph for water year 1979 to illustrate important hydrograph components.

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Table 3.4-2: THE COMBINED INTERACTIVE EFFECTS OF INDIVIDUAL HYDROGRAPH COMPONENTS AND FLUVIAL GEOMORPHOLOGY ON RIPARIAN VEGETATION

Hydrograph Component	Geomorphic Feature				
	Point Bar	Floodplains	Terraces	Outside of Meander Bends	Oxbows
Winter/Spring baseflow	**Promote inundation mortality of seedlings** **Prevent germination by inundating the active channel margins**	Recharges ground water promoting late fall/early winter growth and maximum growth after plants break dormancy	Recharges ground water in excess of precipitation facilitating maximum growth in establishing mature and senescent vegetation	Sustains ground water promoting late fall/early winter season growth	Recharges and maintains ground water tables sustaining off-channel wetlands
Winter floods	**Significantly mobilize channel bed scouring previous years seedlings**	Builds and fertilizes floodplain by fine sediment and detrital deposition Promotes inundation mortality in physiologically sensitive plant species Deposits seeds, establishing a short term seed bank waiting for suitable germination conditions	Deposits seeds, establishing a short term seed bank waiting for suitable germination conditions	Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris	Over bank flow can refill sloughs and oxbows potentially introducing more plant species
Extreme winter floods **(during normal or above normal water years)**	**Move and reorganize inchannel woody debris** **Realign channel by jumping channel or cutting off sharp meander bends creating wetlands**	Significantly scour around mature, and senescent vegetation, creating new seed beds Mobilize woody debris jams; locally removing or pushing over establishing, mature, and scenescent vegetation Fine sediment deposition promotes root suffocation	Builds and fertilizes terrace through fine sediment and detrital deposition Promotes inundation mortality in physiologically sensitive plant species Fine sediment deposition promotes root suffocation	Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris	Oxbow may be recaptured by the channel and the wetland reoccupied by the main channel Fine sediment and detrital deposition creates greater topographic variation and increases nutrient availability

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Table 3.4-2: THE COMBINED INTERACTIVE EFFECTS OF INDIVIDUAL HYDROGRAPH COMPONENTS AND FLUVIAL GEOMORPHOLOGY ON RIPARIAN VEGETATION (CONT.)

Hydrograph Component	Geomorphic Feature				
	Point Bar	Floodplains	Terraces	Outside of Meander Bends	Oxbows
Snowmelt peak	**Prevents germination by inundation of point bar** **Scour establishing seedlings** **Promote inundation related mortality**	Encourages seed germination by providing high soil moisture Discourages germination near the active channel by inundation	Encourages seed germination by providing high soil moisture	Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris	Surface and ground water recharges creating the specialized environmental conditions required by ephemeral herbaceous plant species
Snowmelt recession	**Prevent plant germination by inundation**	Facilitates seed germination over a wide elevation range Drops in river stage causes desiccation mortality to plants that had germinated earlier in the spring	Drops in river stage causes desiccation mortality to plants that had germinated	Recharges ground water promoting maximum growth after breaking dormancy	Water table draw down causes desiccation related mortality
Summer baseflows	**Plant germination on point bar occurs too late in the growing season to permit survival through next year's flow regime** **Sustains herbaceous perennials surviving along the summer baseflow water surface elevation**	Desiccate seedling germinated through the late winter and spring	Low water tables create drought stress among plants leading to desiccation related mortality Sustaines herbaceous perennials surviving among the summer baseflow water surface elevation	Desiccate seedlings that germinated through the late winter and spring	In below normal water years, some portions could dry up causing widespread mortality to aquatic and emergent vegetation

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relationships historically existed on the Tuolumne River and presumably existed along the other rivers in the project area as well (Table 3.4-3).

Table 3.4-3: COMMON PLANT SERIES FOUND ALONG THE TUOLUMNE RIVER, THE ASSOCIATED RANGE OF DISCHARGES THAT THE SERIES FALLS WITHIN AND THE RECURRENCE INTERVALS OF THE DISCHARGES PRE- AND POST-NEW DON PEDRO DAM (NDPP).

Plant Series	Recurrence Interval Range	Pre-NDPP Magnitudes (cfs)	Post-NDPP Magnitudes (cfs)
Narrow-leaf willow	summer baseflow to 1.5 year flood	150 to 8,500	150 to 3,020
White alder/Box elder	1.5 to 5 year flood	8,500 to 25,000	3,020 to 7,500
Fremont Cottonwood	5 year to 20 year flood	25,000 to 51,000	7,500 to 12,800
Valley oak	20 year to the 100 year flood	51,000 to 89,000	12,800 to 18,000

Source: McBain and Trush, 1998.

Over the years intensive land management has reduced riparian vegetation in the San Joaquin Valley to less than two percent of its historic coverage (CALFED 1998). Where riparian stands have persisted, older senescent Fremont cottonwood and valley oaks stands have been infiltrated by exotic plants and younger willow, alder and box elder stands are encroaching into the bankfull channel. Flow regulation, combined with human disturbance, has simplified channel morphology and eliminated the extent and diversity of historic riparian vegetation. Senescent stands are relics of pre-flow regulation flow regime vegetation, while in most locations the once extensive native riparian forests have been reduced to a narrow band often no more than one tree wide along the river's bankfull channel.

Relic stands have canopy parasites (e.g., mistletoe) and liana (vine) development between the ground and canopy. Parasite loads in the canopy increase with age, and liana development is indicative of a low frequency disturbance regime. If a stand has a no liana development, but a large parasite load in the canopy, it is an old stand with a high frequency of disturbance. Where relic stands are present in the project area there is often visible mistletoe, but lianas have been removed by humans or are not well developed. This is because the old trees are valued for esthetic and shade value but not the habitat complex that they create. Intensive land management by mowing or clearing has kept the older trees, but removed all the vegetation on the ground and shrub layers around them; the canopy remains, but the other habitat created by the associated liana and shrubs is removed.

The combination of contemporary hydrologic and geomorphic processes, human disturbance, and each riparian plant's specific physiologic tolerances interactions has resulted in a narrow riparian corridor with low species diversity. Periodic and spatially variable disturbance patterns perpetuated the plant diversity that was once found along the rivers within the project area. Human induced

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changes to hydrology and fluvial geomorphology have resulted in some plant species to increase cover and dominate the riparian corridor (narrowleaf willow) and others to decrease in cover and eventually disappear (western sycamore, Fremont cottonwood and valley oak).

3.4.1.2 Current Conditions

Common, Exotic, and Rare Plant Stands

Both native and exotic plants comprise riparian vegetation growing on terraces, floodplains, and within the active channel. General riparian vegetation types within the project area consists of riparian woodland, riparian scrub, vernal pools, valley/foothill grasslands, marches/swamps, wet meadows, and cismontane woodland. These general vegetation types are further subdivided into individual stands composed of a plant series. Table 3.4-4 on the following pages lists the plant series that are potentially found within riparian corridors in the project area, other common habitat type synonymies, and the relative abundance of each series in the Central Valley. Along all of the rivers in the study area, the riparian scrub type vegetation series are the most prevalent, and often grow within the active channel.

Human impacts have reduced the riparian vegetation in the Central Valley to a fraction of its previous extent; however, it is difficult to say that this vegetation type is threatened when plants that comprise it are common. The Nature Conservancy has characterized California's general vegetation types in terms of relative abundance. Where there is only between 2,000 and 10,000 acres of the specific vegetation type left in the state, the vegetation type has been identified as "threatened". Using their classification, all native terrestrial vegetation within the riparian corridor is very threatened to threatened (Table 3.4-4). Some aquatic and emergent vegetation is very threatened (e.g., ditch grass series), while others are common with no threat of extinction (e.g., pondweeds with floating leaves series).

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

	Scientific Name	Common Name	Habit	USFWS Hydric Code	Found in These General Vegetation Types	Status Fed	State	CNPS
1	Acer negundo var. californicum	box elder	Tree	FACW	RpScr;RpWld			
2	Acer saccharinum	silver maple	Tree	-	CmWld;RpScr;RpWld			
3	Adiantum jordanii	California maidenhair fern	Fern	FACW	CmWld;RpScr;RpWld			
4	Aesculus californica	California buckeye	Tree	-	CmWld;RpScr;RpWld			
5	Ailanthus altissma	tree of heaven	Tree	FACU	CmWld;RpWld;RpScr			
6	Alisma plantago-aquatica	water plantain	Em Herb	OBL	MshSw;Medws;RpWld;RpScr			
7	Alnus rhombifolia	white alder	Tree	FACW	RpWld; RpScr			
8	Amsinckia douglasiana	common fiddleneck	Herb	-	VFGr; RpWld;RpScr			
9	Anemopsis californica	yerba mansa	Em Herb	OBL	MshSw;Medws;RpWld;RpScr			
10	Artemisia douglasiana	mugwort	Herb	FACW	RpWld; RpScr;Medws			
11	Arundo donax	giant reed	Grass	FACW	RpWld; RpScr			
12	Astragulus tener var. tener	alkali milkvetch	Herb	FACW	VGFr; Vnpl			1b
13	Atriplex vallicola	Lost Hills crownscale	Herb	FACW	VGFr; Vnpl	C2	-	1b
14	Avena fatua	wild oat	Grass	-	VFGr;CmWld;RpWld;RpScr			
15	Azolla filiculoides	mosquito fern	Fern	OBL	MshSw			
16	Azolla mexicana	mexican mosquito fern	Fern	OBL	MshSw			
17	Baccharis pilularis ssp. consanguiea	coyote brush	Shrub	-	CmWld;VFGr			
18	Baccharis salicifolia	mule fat, seep willow, water wally	Herb	FACW	RpWld; RpScr			
19	Blennosperma nanum var. nanum	dwarf blennosperma	Herb	OBL	VFGr;Medws;RpScr;CmWld			
20	Brassica nigra	black mustard	Herb	-	VFGr;CmWld;RpWld;RpScr			
21	Brassica sp.		Herb	-	VFGr;CmWld;RpWld;RpScr			
22	Briza minor	rattlesnake grass, quaking grass	Grass	FACU	CmWld; VFGr			
23	Brodiaea minor	dwarf brodiaea	Herb	-	CmWld; VFGr			
24	Bromus sp.		Grass	-	CmWld; VFGr			
25	Bromus tectorum	cheat grass	Grass	-	CmWld; VFGr			
26	Calycadenia hooveri	Hoover's calycadenia	Herb	-	CmWld; VFGr	C2	-	1b
27	Calycanthus occidentalis	spice bush	Shurb		CmWld;RpScr;RpWld			
28	Carex sp.	sedges	Em Herb	OBL-FACW	MshSw;Medws			
29	Castilleja campestris	owl clover	Herb	OBL	MshSw;Medws			
30	Castilleja campestris ssp. succelenta	succulent owl's clover	Em Herb	OBL	VnPl	PT	CE	1b
31	Catalpa bignoniodes	catalpa	Tree	-	RpWld; RpScr			

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

				USFWS		Status		
	Scientific Name	Common Name	Habit	Hydric Code	Found in These General Vegetation Types	Fed	State	CNPS
32	Centaurea solstitialis	yellow star thistle	Herb	-	VFGr;CmWld;RpWld;RpScr			
33	Cephalanthus occidentalis var. californicus	buttonbush, buttonwillow	Shrub	OBL	MshSw;RpWld;RpScr			
34	Ceratophyllum demersum	hornwort, common coon's tail	Em Herb	OBL	MshSw			
35	Chamaesyce albomarginata	rattlesnake spurge	Herb	-	VFGr;CmWld;RpWld;RpScr			
36	Chamaesyce hooveri	Hoover's spurge	Herb	OBL	VnPl	PT	-	1b
37	Chenopodium album	pig weed, lambs quarters	Herb	FAC	VFGr;CmWld;RpWld;RpScr			
38	Clarkia rostrata	beaked clarkia	Herb	-	CmWld; VFGr	C2	-	1b
39	Clematis lingusticifolia	virgin's bowers, yerba de chiva	Vine	-	CmWld;RpWld; RpScr			
40	Conium maculatum	poison hemlock	Herb	FACW	MshSw;RpWld;RpScr			
41	Convolvulus arvensis	bindweed, orchard morning glory	Vine	-	VFGr;CmWld;RpWld;RpScr			
42	Convolvulus simulans	small flowered morning glory	Herb	-	VFGr	-	-	4
43	Cryptantha hooveri	Hoover's cryptantha	Herb	-	VFGr	-	-	4
44	Cucurbita palmata	coyote melon	Vine	-	VFGr;CmWld;RpWld;RpScr			
45	Cuscuta sp	dodder	Parasite	-	VFGr;CmWld;RpWld;RpScr			
46	Cynodon dactylon	Bermuda grass	Grass	FAC	VFGr;MshSw;RpWld;RpScr			
47	Cyperus eragrostis	umbrella flat sedge	Grass	FACW	MshSw;RpWld;RpScr			
48	Datura wrightii	Jimson weed	Herb	-	VFGr			
49	Delphinium gypsophilum ssp. gypsophilum	gypsum loving larkspur	Herb	-	CmWld; VFGr	-	-	4
50	Distichlis spicata	saltgrass	Grass	FACW	MshSw;Medws			
51	Downingia pusilla	dwarf downingia	Herb	OBL	VFGr; VnPls	C3c	-	2
52	Echinochloa crus-galli	barnyard grass	Grass	FACW	VFGr;RpWld;RpScr;Medws			
53	Egeria densa	brazilian waterweed	Em Herb	OBL	MshSw			
54	Eichhornia crassipes	water hyacinth	Em Herb	OBL	MshSw;Medws			
55	Eleocharis sp.	spike rush	Em Herb	OBL-FACW	MshSw;RpWld;RpScr;VnPl			
56	Elodea canadensis	common waterweed	Em Herb	OBL	MshSw			
57	Epilobium sp.	willow herb	Herb	OBL-FACU	VFGr;CmWld;RpWld;RpScr			
58	Equisetum arvense	common horsetail	Em Fern	FAC	MshSw;RpWld;RpScr			
59	Eremocarpus setigerus	turkey mullien	Herb	-	CmWld;RpWld;RpScr			
60	Eriodictyon californicum	yerba santa	Herb	-	CmWld;VFGr			
61	Eryngium castrense	coyote thistle	Herb	FACW	MshSw;VnPl			
62	Eryngium racemosum	delta button celery	Herb	OBL	RpScr	C2	CE	1b

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

	Scientific Name	Common Name	Habit	USFWS Hydric Code	Found in These General Vegetation Types	Status Fed	State	CNPS
63	Eryngium vaseyi	Vasey's coyote thistle	Herb	FACW	VFGr; VnPls			
64	Eryngium spinosepalum	spiny sepaled button celery	Herb	FACW	VFGr; VnPls	C2	-	1b
65	Eschscholzia californica	California poppy	Herb	-	VFGr			
66	Eschscholzia rhombipetala	diamond petaled California poppy	Herb	-	VFGr	C2	-	1a
67	Eucalyptus camaldulensis	red gum, river red gum	Tree	-	RpWld; RpScr			
68	Eucalyptus globulus	blue gum	Tree	-	RpWld; RpScr			
69	Eucalyptus polyanthemos	silver dollar gum	Tree	-	RpWld; RpScr			
70	Eucalyptus tereticornis	forest red gum	Tree	-	RpWld; RpScr			
71	Ficus carica	edible fig	Shrub	-	RpWld; RpScr			
72	Fraxinus dipetela	ash	Tree	FACW	RpWld; RpScr			
73	Fraxinus latifolia	Oregon ash	Tree	FACW	RpWld; RpScr			
74	Fritillaria agrestis	stinkbells	Herb	-	CmWld; VFGr	C3c		4
75	Gallium aparine	goose grass	Herb	FACU	CmWld;RpWld;RpScr			
76	Gnaphalium sp.	everlasting	Herb	-	VFGr; RpWld;RpScr			
77	Gratioa heterosepala	Boggs Lake hedge hyssop	Em Herb	OBL	MshSw	C3c	CE	1b
78	Helianthus annuus	sunflower	Herb	FAC	VFGr; RpWld;RpScr			
79	Hemizonia fitchii	Fitch tarweed	Herb	-	CmWld;VFGr			
80	Hibiscus lasiocarpus	rose-mallow, California hibiscus	Herb	FACW	MshSw	-	-	2
81	Hippuris vulgaris	mare's tail	Em Herb	OBL	MshSw			
82	Hydrocotyle verticillata	pennywort	Em Herb	OBL	MshSw			
83	Iris pseudacorus	yellow flag iris	Herb	OBL	MshSw			
84	Isoetes sp.	quillwort	Fern	OBL	MshSw;VnPl			
85	Juglans californica var. californica	Southern California walnut	Tree	FAC	CmWld	-	-	4
86	Juglans californica var. hindsii	Northern California walnut	Tree	FAC	RpFrs; RpWld	C2	-	1b
87	Juglans regia	Persian or English Walnut	Tree	FAC	RpFrs; RpWld			
88	Juncus balticus	baltic rush	Em Herb	OBL	MshSw;RpWld;RpScr			
89	Juncus effusus	common rush	Em Herb	OBL	MshSw;RpWld;RpScr			
90	Juncus lieospermus var. ahartii	ahart dwarf rush	Em Herb	OBL	VnPl			
91	Juncus sp.	rushes	Em Herb	OBL-FAC	MshSw;Medws;RpScr;VnPl			
92	Lasthenia californica	California goldfields	Herb	FACU	VFGr;MshSw;VnPl			
93	Lasthenia fremontii	Fremont goldfields	Herb	OBL	MshSw;VnPl			

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

	Scientific Name	Common Name	Habit	USFWS Hydric Code	Found in These General Vegetation Types	Status Fed	State	CNPS
94	Lasthenia glabrata ssp. glabrata	smooth goldfields	Herb	OBL	MshSw;VnPl			
95	Layia chrysanthemoides	smooth tidylips	Herb	FACW	CmWld;VGFr			
96	Layia fremontia	Fremont tidylips	Herb	FACW	CmWld;VGFr			
97	Legenere limosa	venus-looking-glass, mudbank	Herb	OBL	VnPl	C2		1b
98	Lemna gibba	inflated duckweed	Em Herb	OBL	MshSw			
99	Lemna minor	lesser duckweed	Em Herb	OBL	MshSw			
100	Lemna sp.	duckweeds	Em Herb	OBL	MshSw			
101	Lilaeopsis masonii	Mason's lilaeopsis	Herb	OBL	MshSw; RpScr	C2	CR	1b
102	Lolium perenne	perennial ryegrass	Grass	FAC	VGFr;RpWld;RpScr			
103	Lotus rubriflorus	red-flowered lotus	Herb	-	CmWld; VFGr	C2		1b
104	Ludwigia repens	water primrose	Em Herb	OBL	MshSw			
105	Lupinus sp.	bush lupine	Shrub	UPL	CmWld;VGFr;RpWld			
106	Marsilea vestita ssp. vestita	pepperwort	Fern	OBL	MshSw;RpScr;VnPl			
107	Melilotus alba	white sweet clover	Herb	FACU	VGFr;RpWld;RpScr			
108	Melilotus officinalis	yellow sweet clover	Herb	FACU	VGFr;RpWld;RpScr			
109	Mentzelia sp.	blazing star	Herb	-	VGFr;RpWld;RpScr			
110	Mimulus guttatus	monkey flower	Herb	OBL	MshSw;RpWld;RpScr			
111	Monardella candicans	Sierra monardella	Herb	-	CmWld; LCFr	-	-	4
112	Monardella leucocephala	Merced monardella	Herb	-	VFGr	C2	-	1a
113	Morus alba	white mulberry	Tree	FAC	RpWld; RpScr			
114	Myosurus minimus ssp. apus	little mousetail	Herb	OBL	VnPls	C2	-	1b
115	Myriophyllum aquaticum	parrots feather	Em Herb	OBL	MshSw			
116	Myriophyllum hippuroides	western milfoil	Em Herb	OBL	MshSw			
117	Myriophyllum sibiricum	water milfoil	Em Herb	OBL	MshSw			
118	Myriophyllum spicatum	Eurasian milfoil	Em Herb	OBL	MshSw			
119	Najas guadalupensis	common water-nymph	Em Herb	OBL	MshSw			
120	Navarretia leucocephala ssp. plieantha	many-flowered navarretia	Herb	OBL	VnPls	C1	CE	1b
121	Navarretia myersii	pincushion navarretia	Herb	-	VnPl	-	-	1b
122	Navarretia nigelliformis ssp. radians	shining navarretia	Herb	-	CMWld; VFGr; VnPl	-	-	1b
123	Neostapfia colusana	Colusa grass	Grass	-	VnPl	PT	CE	1b
124	Nicotiana glauca	tree tobacco	Shrub	FAC	VGFr;RpWld;RpScr			

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

				USFWS		Status		
	Scientific Name	Common Name	Habit	Hydric Code	Found in These General Vegetation Types	Fed	State	CNPS
125	Oenothera elata ssp hirsutissima	evening primrose	Herb	FACW	VGFr;RpWld;RpScr			
126	Ophiglossum californicum	California adders tongue	Fern	FACW	VGfr; VnPl	C3c	-	4
127	Orcutta inaequalis	San Joaquin orcutt grass	Grass	OBL	VnPl	PE	CE	1b
128	Orcuttia pilosa	hairy orcutt grass	Grass	OBL	VnPl	PE	CE	1b
129	Osmorhiza brachypoda	California sweetcicely	Herb	FAC	MshSw;RpWld;RpScr			
130	Oxalis corniculata	oxallis	Herb	FACU	VGFr;RpWld;RpScr			
131	Paspalum dilatatum	dallis grass	Grass	FAC	MshSw;RpWld;RpScr			
132	Pentagramma triangularis	golden backed fern	Fern	-	CmWld			
133	Phorodendron macrophyllum	poplar mistletoe	Parasite	-	RpWld; RpScr			
134	Phragmites australis	common reed	Grass	FACW	MshSw;RpWld;RpScr			
135	Phytolacca americana	pokeweed, pigeon berry	Herb	FAC	CmWld;RpWld;RpScr			
136	Pilularia americana	American pilwort	Fern	OBL	MshSw;VnPl			
137	Pinus sabiniana	grey pine, foothill pine	Tree	-	CmWld			
138	Plantago major	common plantain	Herb	FACW	MshSw;RpWld;RpScr			
139	Plantago sp.	plantain	Herb	FACW	MshSw;RpWld;RpScr			
140	Platanus racemosa	western sycamore	Tree	FACW	RpWld; RpScr			
141	Polygonum hydropiperoides	waterpepper	Herb	OBL	MshSw;RpWld;RpScr			
142	Polypogon maritimus	beard grass	Grass	FACW	MshSw;RpWld;RpScr			
143	Populus fremontii	Fremont cottonwood	Tree	FACW	RpWld; RpScr			
144	Potamogeton crispus	crispate-leaved pondweed	Em Herb	OBL	MshSw			
145	Potamogeton diversifolius	diverse leaf pondweed	Em Herb	OBL	MshSw			
146	Potamogeton filiformis	slenderleaf pondweed	Em Herb	OBL	MshSw			
147	Potamogeton foliosus var. foliosus	leafy pondweed	Em Herb	OBL	MshSw			
148	Potamogeton illinoensis	shining pondweed	Em Herb	OBL	MshSw			
149	Potamogeton latifolius	Nevada pondweed	Em Herb	OBL	MshSw			
150	Potamogeton natans	floatingleaf pondweed	Em Herb	OBL	MshSw			
151	Potamogeton nodosus	longleaf pondweed	Em Herb	OBL	MshSw			
152	Potamogeton pectinatus	fennelleaf pondweed	Em Herb	OBL	MshSw			
153	Potamogeton pusillus	small pondweed	Em Herb	OBL	MshSw			
154	Pseudobahia bahiifolia	Hartweg's golden sunburst	Herb	-	CmWld; VFGr	PE	CE	1b
155	Psilocarpus brevissimus var. multiflorus	delta woolly marbles	Herb	OBL	VnPls	-	-	4

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

	Scientific Name	Common Name	Habit	USFWS Hydric Code	Found in These General Vegetation Types	Status Fed	State	CNPS
156	Quercus douglasii	blue oak	Tree	-	CmWld			
157	Quercus lobata	valley oak, roble oak	Tree	FAC	RpWld; RpScr			
158	Quercus lobata x douglasii		Tree	-	RpWld; RpScr			
159	Quercus wislizenii var. wislizenii	interior live oak tree form	Tree	-	CmWld			
160	Raphnus sativus	radish	Herb	-	VGFr;RpWld;RpScr			
161	Rhamnus californica ssp. californica	California coffeeberry	Shrub	-	CmWld			
162	Ribes aureum var. aureum	golden currant	Shrub		CmWld; RpWld			
163	Ricinus communis	castor bean	Herb	-	CmWld;RpWld;RpScr			
164	Robinia pseudoacacia	black locust	Tree	FAC	RpWld; RpScr			
165	Rosa californicum	wild rose	Shrub	FAC	CmWld;RpWld;RpScr			
166	Rubus discolor	himalayan berry	Vine	FACW	CmWld;RpWld;RpScr			
167	Rubus leucodermis	black cap raspberry	Vine	-	CmWld;RpWld;RpScr			
168	Rubus ursinus	California blackberry	Vine	FACW	CmWld;RpWld;RpScr			
169	Rumex crispus	curly dock	Herb	FACW	RpWld; RpScr;MshSw			
170	Ruppia cirrhosa	ditch-grass	Em Herb	OBL	MshSw			
171	Sagittaria latifolia	arrowhead	Em Herb	OBL	MshSw			
172	Sagittaria sanfordii	Sanford arrowhead	Em Herb	OBL	MshSw	C2	-	1b
173	Salix babylonica	weeping willow	Tree	FACW	RpWld; RpScr			
174	Salix exigua	narrowleaf willow	Shrub	OBL	RpWld; RpScr			
175	Salix gooddingii	Goodding's black willow	Tree	OBL	RpWld; RpScr			
176	Salix laevigata	red willow	Tree	OBL	RpWld; RpScr			
177	Salix lasiolepis	arroyo willow	Shrub	FACW	RpWld; RpScr			
178	Salix lucida ssp. lasiandra	pacific willow, shining willow	Tree	OBL	RpWld; RpScr			
179	Salix melanopsis	dusky willow	Shrub	FACW	RpWld; RpScr			
180	Sambucus mexicana	blue elderberry	Shrub	FAC	VGFr;RpWld;RpScr			
181	Scirpus acutus var. occidentalis	common tule	Em Herb	OBL	MshSw			
182	Scirpus americanus	common three square	Em Herb	OBL	MshSw			
183	Scirpus californicus	California bulrush	Em Herb	OBL	MshSw			
184	Scirpus maritimus	saltmarsh bulrush	Em Herb	OBL	MshSw			
185	Selaginella hansenii	Spike Moss	Fern	-	CmWld			
186	Setaria pumila	yellow bristlegrass	Grass	-	VGFr;RpWld;RpScr			

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TABLE 3.4-4. POTENTIALLY OCCURRING PLANT SPECIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES

	Scientific Name	Common Name	Habit	USFWS Hydric Code	Found in These General Vegetation Types	Status Fed	State	CNPS
187	Solanum americanum	nightshade	Herb	FAC	CmWld;VGFr;RpWld			
188	Sorghum halepense	Johnson grass	Herb		VFGr; CmWld;VGFr;RpWld			
189	Spirodela polyrrhiza	greater duckweed	Em Herb	OBL	MshSw			
190	Spirodela punctata	duckmeat	Em Herb	OBL	MshSw			
191	Tamarix sp.	tamarisk	Tree	FACW	RpWld; RpScr			
192	Toxicodendron diversilobum	poison oak	Shrub	-	CmWld;RpWld;RpScr			
193	Trifolium depauperatum	bladder clover	Herb	FAC	CmWld;VFGr;MshSw;			
194	Tuctoria greenei	Greene tuctoria	Herb	-	VnPl	PE	CR	1b
195	Typha angustifolia	narrowleaf cattail	Em Herb	OBL	MshSw			
196	Typha domingensis	southern cattail	Em Herb	OBL	MshSw			
197	Typha latifolia	broadleaf cattail	Em Herb	OBL	MshSw			
198	Ulmus americana	american elm	Tree	-	RpWld; RpScr			
199	Urtica dioica ssp. holosericea	hoary nettle	Herb	FACW	RpWld; RpScr			
200	Utricularia vulgaris	bladderwort	Em Herb	OBL	MshSw			
201	Verbascum blattaria	moth mullien	Herb	FACW	RpWld; RpScr			
202	Verbascum thapsus	mullien	Herb	-	VFGr; RpWld; RpScr			
203	Vicia americana	american vetch	Herb	FACU	VFGr; RpWld; RpScr			
204	Vitis californica	California grape	Vine	FACW	RpWld; RpScr			
205	Wolffia sp.	mud-midgets	Em Herb	OBL	MshSw			
206	Wolffiella sp.	water-meals	Em Herb	OBL	MshSw			
207	Woodwardia fimbrata	giant chain fern	Fern	FACW	MshSw			
208	Xanthium strumarium	common cocklebur	Herb	FAC	RpWld; RpScr			
209	Zannichellia palustris	horned pondweed	Em Herb	OBL	MshSw			

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No plant series is unique to a specific river. Fremont cottonwood, valley oak and black willow series are the most impacted by human disturbance because they grow on terraces and floodplains. Terraces and floodplains typically have Class 1 soils, making them extremely productive and economically valuable. Agricultural development has reduced riparian vegetation in many locations to one tree width along the river as a buffer. This one tree width buffer is not connected with or contiguous with any other trees or shrubs along the channel, causing further fragmentation of the remaining vegetation and migration corridors.

Exotic plant series are proliferating throughout the riparian corridor, displacing native plants and preventing native plant regeneration. Exotic plants are effective interspecific competitors, and often grow in pure stands that exclude other plant species from growing. Four exotic plant species represent 67 percent of all mapped exotic plants in the Tuolumne River riparian corridor: Eucalyptus, edible fig, common reed, and tree of heaven. These species form large stands and interfere with native hardwood recruitment and regeneration.

Most remaining large tracts of relic riparian vegetation are associated with state, federal or county parks. Large relic stands (>5 acres) preserved by parks are subjected to different types of human activities, which often conflict with riparian vegetation use by wildlife. Roads and campgrounds create openings and clear the dense understory. The presence of dogs, trails, and noise also impacts relic stands. Dogs are prey-driven animals, and most will readily pursue anything that flees. Non-burrowing wildlife species may be driven out of the riparian vegetation within parks where there is no refuge from dogs. Planned and un-planned trails sub-divide habitat, and small animals may find this a barrier. The management of these relic stands prohibits their temporal evolution and disturbance by the river; this strategy prevents a change to the relic stand's current condition. Although the parks represent most of the largest tracts of relic riparian vegetation, they are riparian vegetation museums where stand evolution is incompatible with long term park management activities.

Vernal pools and great valley grass lands both fall within the project area (the San Joaquin River north of Bear Slough and including the confluence areas with backwater effects). However, they do not rely solely on the fluvial system for survival. Vernal pools are not subject to the changes in groundwater created by the rising and falling of the river stage, and rely solely on rainfall for the moisture to sustain them. Great valley grasslands and vernal pools have the highest number of rare, threatened or endangered plants of any vegetation type within the project area; however, the pulse flows of various project alternatives are not anticipated to affect them (see Section 4.4.1).

Common, Exotic, Rare, Threatened, or Endangered Plant Species

Common riparian plant species make up the majority of canopy structure and understory; there are no endangered plants associated with it. Valley grasslands and vernal pools have a very high species diversity and several endangered plants; however, they are not further evaluated because the proposed project alternatives will not affect them. See Appendix D for a complete listing of threatened and endangered plant species evaluated for the proposed and alternative actions. Fremont cottonwood, white alder, box elder, valley oak, black willow, and narrowleaf willow are the primary riparian vegetation constituents throughout the project area's riparian corridors.

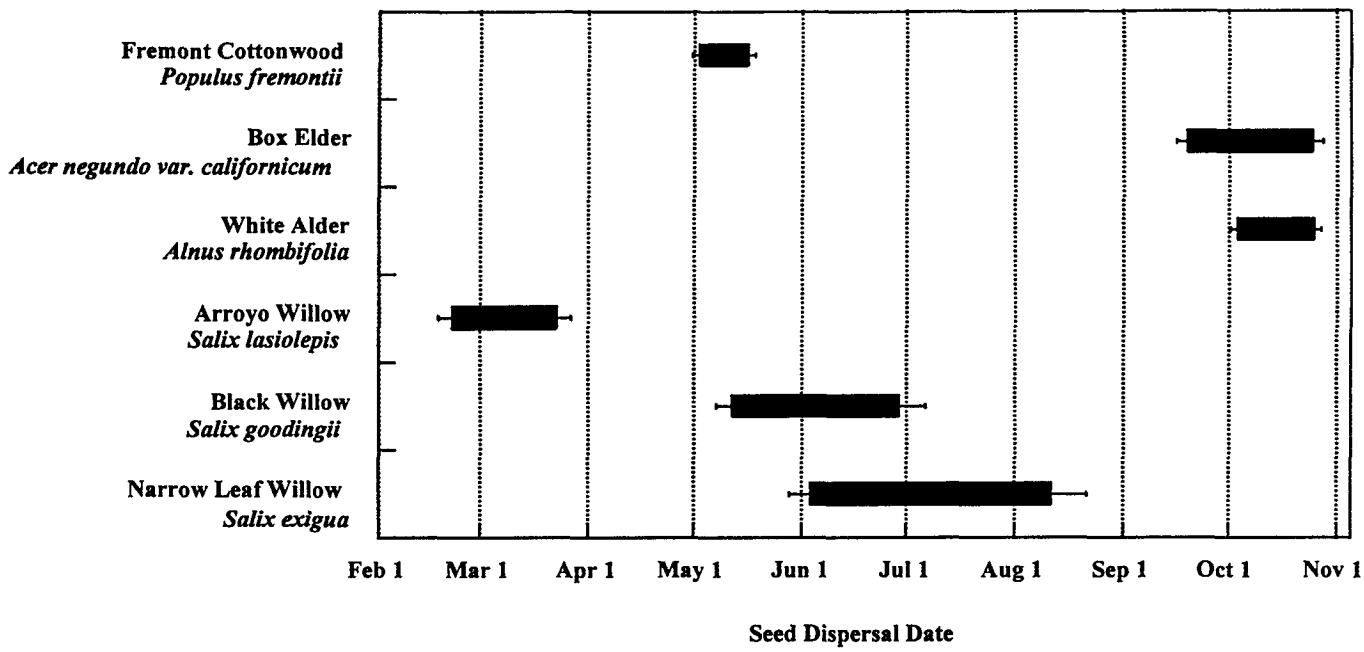
Exotic plants are widespread throughout the project area and are affecting native plant regeneration, and canopy and understory structure. Aquatic exotic plants brought from tropical countries have been favored by higher water temperature created by flow regulation and low gradient river reaches. Eucalyptus, edible fig, common reed (*Arundo donax*), and tree of heaven already form large stands and are interfering with native hardwood recruitment and regeneration. White mulberry, yellow flag iris, and weeping willow are just beginning to proliferate and will soon out-compete indigenous riparian plant species.

Aspects of Common Species Annual Life History

Riparian plants have adapted to survive within the fluvial environment by timing different stages of their annual life history to coincide with changes in discharge associated with different hydrograph components. Dormancy and seed dispersal are the two annual life history stages that are most likely to occur during the different fall and spring pulse flow alternatives associated with this project. These will affect each species differently because of the timing of individual seed dispersal periods (Figure 3.4-4).

Plant dormancy along the San Joaquin River and its tributaries is correlated with the onset of late fall and early winter storms. These storms are colder and cause a rise in river stage, and also coincide with a shorter photoperiod. Drought stress, a change in temperature, or flooding can induce plant dormancy. Plants are the most vulnerable to mortality agents during the growing season, and dormancy is a way for the plant to protect its resources from environmental stresses created during drought, in-climate temperatures, or flooding. Plant physiologic processes such as respiration and photosynthesis are reduced during dormancy, and their need for oxygen and mineral nutrients is negligible. Many riparian plants will only go dormant if exposed to environmental stress, such as a storm or flood. Otherwise, they maximize their photosynthetic potential each year by continuing growth as long as possible. If fall pulse flows occur before dormancy, it is conceivable, however improbable, that inundation could cause stress and mortality.

Spring pulse flow timing, magnitude, and duration may provide the conditions necessary for hardwood regeneration in certain locations along the San Joaquin River and its tributaries.



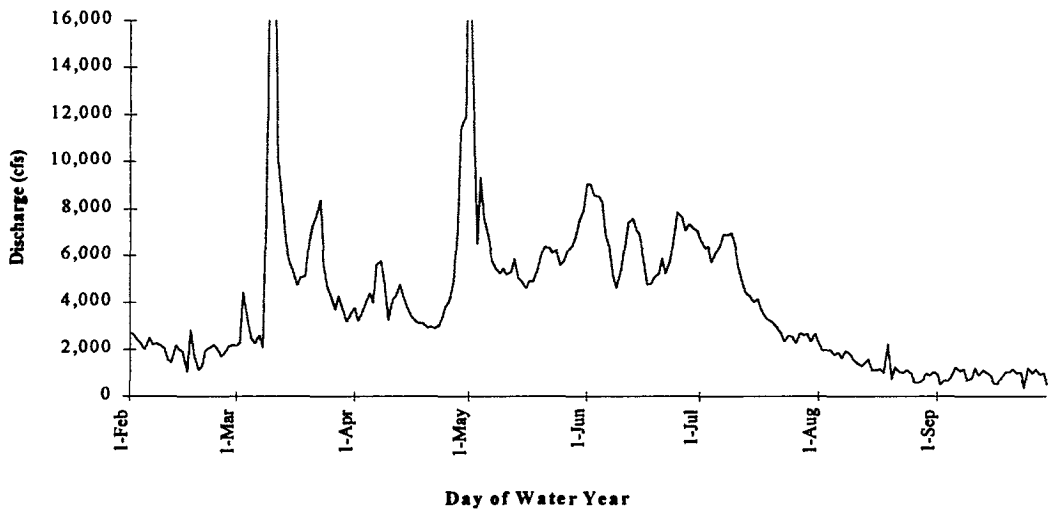


Figure 3.4-4. Upper figure-Riparian hardwood seed dispersal periods for six common species, each box displays the length of time by which 90% of the seeds are dispersed. Median seed dispersal dates are represented with a vertical line through the box. Whiskers at either end of the box indicate the earliest and latest 5% of seed dispersal. Lower figure- Stanislaus River unregulated flow (modeled) below Goodwin Dam annual hydrograph for water year 1995 between February 1 and September 1. Seed dispersal timing for willows and cottonwood corresponds to the snowmelt peak in May and the subsequent receding limb.

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Historically, the timing of seed dispersal for the dominant species on the floodplain coincided with each river's snowmelt peak and the subsequent receding line. For example, Fremont cottonwood drops its seeds during the first two weeks of May, and narrowleaf willow drops it seeds during late May and early June; their seeds have a short life span of seven to ten days (Young and Young 1992). In contrast, box elder and white alder drop their seeds in the late summer and fall, and the seeds are viable for a minimum of a year (Young and Young 1992).

Different seed dispersal strategies lead to unique germination and establishment patterns along the bankfull channel, floodplains, and terraces. For example, because white alder and box elder disperse seeds in the fall, the pattern of alder and box elder stand establishment is a function of flows that raft seeds to a place where they can germinate and establish. Fremont cottonwood seed dispersal takes place in the late spring when floodplain soils are moist; the soil moisture being fed subsurface by high ground water tables recharged by the snowmelt peak, and sustained by the slow flow recession into the summer. Spring pulse flows could potentially affect the quantities, size, distribution, and species composition of regenerating riparian vegetation.

3.4.2 Wildlife

In the context of the proposed actions of this project, wildlife in the San Joaquin Valley are a less important feature than the aquatic resources (discussed in Section 3.5). This is because the proposed project involves the potential redistribution of water in the San Joaquin River Basin. Since none of the proposed project alternatives involve transport of water away from existing upland areas, this section addresses wildlife in the context of habitats that depend upon water to support wildlife.

The diversity and types of wildlife within the San Joaquin River Basin are related to the quality and areal extent of terrestrial habitat. Many of the wildlife species that formerly dominated the landscape (elk, bison, and other large mammals) required extensive desert scrub, large seasonal wetlands, extensive grasslands, and broad riparian corridors. Mountain meadows typically had less than 20 percent shrub canopy, with trees widely scattered around the perimeter. Wet meadows supported rushes, grasses, and perennial sedges. The soil remained wet late into the summer while in some places it remained permanently wet. The dry meadows were dominated by perennial grasses and forbs with some sedges. The riparian deciduous corridors were located along streams or ponds. These areas provided a narrow band of deciduous trees and shrubs along the margins.

Consequently, in the proposed project, the chief habitat used by wildlife species is riparian. Based on the interaction of a unique physical environment and the associated vegetation that occurs along the banks of the San Joaquin River tributaries, riparian corridors include surface and groundwater (sufficiently in excess of local precipitation) capable of supporting vegetation requiring moderate amounts of water. Plants in these areas undergo ecological succession from: 1) initiation (when the seeds fall on exposed, moist substrate and starts germination); to 2) establishment (from the end of the first growing season until the plant begins sexual reproduction); to 3) maturation (the active

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production of flowers and seeds); to 4) senescence (from when seed/flower production declines until plant death).

Historically, large floods (during wet years) created gaps in the riparian vegetation. Due to excessive erosion associated with flooding, open areas were created where new sediments associated with the flood events could be deposited. During normal years riparian vegetation was established, and seral stages of ecological succession followed. With the occurrence of dry years, seed production was limited, no new areas were opened for deposition, no sediments were transported, and no new plants could start their life cycle.

The plants growing in the riparian corridor formed a patchwork distribution responding to the availability of adequate water. The patterning of vegetation within the riparian corridor resulted from not only plant specific physiologic tolerances but also interactions of fluvial geomorphology, and hydrology. As a result of naturally occurring spring snowmelt floods, water levels rose and fell gradually. Following peak water levels, there was a gradual decline during summer months which created patterns in the vegetation along the waterway's riparian corridor. Each riparian plant species (and each life stage) respond differently to hydrologic and fluvial processes. Initiation and establishing stage plants were susceptible to mortality due to inadequate substrate and water availability. Establishing plants were susceptible to inundation or scour-induced mortality from subsequent year flooding. The longevity of maturation plants depends on channel migration and damage from debris from major floods as well as disease. The dynamic interactions between the four life stages and mortality results in structural diversity of riparian habitat. The interactions of contemporary hydrologic and geomorphic processes, anthropogenic management of water resources, and each riparian plant's specific physiologic tolerances resulted in a "narrow window" for survival of the riparian plants.

With development in the Valley, the natural processes of ecological succession (time, human activities, and natural changes) all resulted in changes in the structure and composition of the plant community. Superimposed on these changes are the ecological successional patterns from a grass forb stage, to a shrub/seedling/sapling stage, to a pole/medium tree stage, to a mature large tree stage (all with associated changes in the soils). As a result of the natural ecological succession and the anthropogenic influences of development, vegetation and wildlife now associated with natural terrestrial, agricultural, urban, riparian, and wetlands habitats exists.

As a result of habitat disruption or elimination, common wildlife species today include foxes, coyote, badgers, skunks, and opossums (an introduced species) which feed on insects, reptiles, rabbits and rodents. Their utilization of the habitat is inextricably linked to three major life history activities of the wildlife: breeding, feeding, and resting.

While the CALFED (1997) ecological zone classification system (fully described in Section 3.5.1) has been used to subdivide the project area, the wide distribution of wildlife does not facilitate such

description within the same zones. Consequently, this section highlights common wildlife species of the San Joaquin Valley, and draws particular attention to wildlife species associated with riparian habitat. Representative avifauna include waterfowl (associated with the Pacific Flyway) which overwinter in valley wetlands. In addition, upland game birds (doves, pheasant, quail, and chukar) and shorebirds (terns, plovers, sandpipers, egrets, and gulls) inhabit the study area. Raptors (bald eagles, prairie falcons, and owls) feed in the riparian and wetlands habitats of the valley. Passerines, including warblers, blackbirds, sparrows, flycatchers, and swallows, utilize the diverse habitats of the San Joaquin River Basin for nesting and overwintering.

Riparian habitat includes areas in or adjacent to drainageways and flood plains which are characterized by species and/or life forms significantly different from those of the surrounding non-riparian habitats. Nutrients, water, and detrital materials are transported into riparian areas from surrounding upland areas. The importance of riparian habitat is demonstrated in that some of the highest densities of breeding birds are found in riparian habitats, and more than 60 percent of all vertebrates spend some portion of their life cycle in riparian habitat (Ohmart and Anderson 1982). Some of the riparian habitat has a lush canopy with associated shade and cover which provides habitat for a myriad of insects. Rough, ever-sloughing bark of common riparian trees attracts wood-boring larvae and provides forage for bark-gleaning and trunk-scaling birds. Woodpeckers, warblers, flycatchers, and owls are common inhabitants of this habitat. The tall trees also attract wintering and breeding raptors.

In addition to birds, riparian habitat is important to large mammals because it affords food, water, and cover. Herpatofauna (turtles, snakes, and amphibians such as salamanders) are dependent on riparian habitat for at least some stages of their life cycle. Many of these species are aquatic or semi-aquatic and lay open eggs (nonshelled) in water or very moist areas. Many also prefer rotting logs or dense ground cover (provided by leaf litter from the riparian vegetation). Many of these species are insectivorous or carnivorous. Herptiles also depend on this habitat for dispersal and genetic continuity between populations.

A number of mammals make use of the diverse habitats afforded by the San Joaquin River Basin (Table 3.4-5). Many of these are transients between the upland and riparian habitats. The San Joaquin pocket mouse prefers dry, open grasslands or scrub areas of fine textured soils. Feeding on seeds and some green vegetation and insects, this nocturnal mouse digs burrows for cover and may become torpid during extreme heat or cold. Heermann's kangaroo rat is found in the foothills and valley. It is common to the grasslands, scrub, mixed and montane chaparral, and early successional stages of valley hardwood and hardwood-conifer habitats. Feeding mostly on grains but also eating some forbs and green grass, this rat prefers food from red brome, foxtail, fescue, mouse barley, wild oats, lupine, lotus, and clover. It burrows in fine, deep, well drained soils. Muskrats are abundant in riparian areas, especially in fresh emergent wetlands as well as valley foothill and montane riparian habitats, aspen, and lacustrine riverine habitats. Muskrats are mainly herbivorous and prefer roots and basal stems of plants but also consume crayfish, molluscs, turtles, and fish

Table 3.4-5: MAMMALS COMMONLY OCCURRING IN THE SAN JOAQUIN VALLEY

COMMON NAME	NATIVE	INTRODUCED
Virginia Opossum		*
Ornate Shrew	*	
Broad-footed mole	*	
Yuma myotis	*	
Western pipstrelle	*	
Big brown bat	*	
Red bat	*	
Hoary bat	*	
Townsend's big-eared bat	*	
Pallid bat	*	
Brazilian free-tailed bat	*	
Desert cottontail	*	
Black-tailed hare	*	
California ground squirrel	*	
Botta's pocket gopher	*	
San Joaquin pocket mouse	*	
Heermann's kangaroo rat	*	
Beaver	*	
Western harvest mouse	*	
Deer mouse	*	
California vole	*	
Muskrat	*	
Black rat		*
Norway rat		*
House mouse		*
Coyote	*	
Gray fox	*	
Ringtail	*	
Raccoon	*	
Long-tailed weasel	*	
Badger	*	
Western spotted skunk	*	
Striped skunk	*	
Bobcat	*	
Mule deer	*	

Source: Zeiner et al, 1990.

opportunistically. Coyote are common in brush, scrub, shrub, and herbaceous habitats. They also frequent younger stands of deciduous and conifer forests with low to intermediate canopy. An omnivorous opportunist, coyote eat primarily rats, mice, ground squirrels, gophers, and carrion.

A number of anthropogenic activities including livestock grazing, mining, intensive recreational activities, impoundment construction, logging (and associated road construction) have had dramatic impacts on the diversity of wildlife found in these riparian habitats. Although extensive efforts have been taken to slow habitat alteration, a number of species have declined in abundance, some to near extinction (Table 3.4-6). Species included in this list are those associated with habitat types that may potentially be affected by project alternatives. Species that were considered for this list are contained in Appendix D.

Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA.

Species	Status[a] Federal/ State	Habitats
		Invertebrates
Conservancy fairy shrimp *Branchinecta conservatio*	E/--	Large, deep vernal pools in annual grasslands
Longhorn fairy shrimp *Branchinecta longiantenna*	E/--	Small, clear pools in sandstone rock outcrops of clear to moderately turbid clay- or grass-bottomed pools
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/--	Riparian and oak savanna habitats with elderberry shrubs; below 2,000 feet elevation
Vernal pool fairy shrimp *Branchinecta lynchi*	T/--	Vernal pools; sandstone rock outcrop pools
Vernal pool tadpole shrimp *Lepidurus packardi*	E/--	Vernal pools; ephemeral stock ponds
		Amphibians and Reptiles
California tiger salamander *Ambystoma tigrinum californiense*	C1/SSC	Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy
California red-legged frog *Rana aurora draytonii*	T/SSC	Permanent and semipermanent aquatic habitats such as creeks and coldwater ponds with emergent and submergent vegetation and riparian species along the edges; may estivate in rodent burrows or cracks during dry periods

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Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

Species	Status[a] Federal/ State	Habitats
Giant garter snake *Thamnophis couchi gigas*	T/T	Sloughs, canals, and other small waterways, where there is a prey base of small fish and amphibians; requires grassy banks and emergent vegetation for basking, and areas of high ground protected from flooding during winter
Western pond turtle *Clemmys marmorata*	--/SSC	Permanent ponds, lakes, streams, and irrigation ditches; basking sites, such as logs, rocks, mud banks, or mats of floating vegetation required; nests constructed in sandy banks or on hillsides up to 325 feet from water
		Birds
Aleutian Canada goose *Branta canadensis leucopareia*	T/--	Winters in the San Joaquin Valley; forage on pastures, harvested fields, and wetlands; roost on flooded fields and ponds at night
Bald eagle *Haliaeetus leucocephalus*	T/E	Requires large, old-growth trees or snags in mixed stands near large bodies of water or free-flowing rivers with abundant fish. Roosts communally in winter in dense, sheltered, remote conifer stands in proximity to feeding areas.
American peregrine falcon *Falco peregrinus anatum*	E/E	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large populations of other bird species
Bank swallow *Riparia riparia*	--/T	Nests in bluffs or banks adjacent to water where the soil consists of sand or sandy loam to allow digging; the state's largest breeding populations are along the Sacramento River, and along the Feather and Lower American Rivers, in the Owens Valley
California yellow warbler *Dendroica petechia brewsteri*	--/SSC	Nests and feeds in riparian deciduous habitats; preferred species include cottonwoods, willows, and alders
Cooper's hawk *Accipiter cooperii*	--/SSC	Dense stands of live oak, riparian deciduous, or other forest habitats near water used most frequently
Greater sandhill crane *Grus canadensis tabida*	--/T	Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water
Loggerhead shrike *Lanius ludovicianus*	--/SSC	Found in a wide variety of lowland habitats including valley foothill hardwood, hardwood-conifer, valley foothill riparian, and pinyon-juniper
Long-billed curlew *Numenius americanus*	--/SSC	Breeds on grazed, mixed-grass and short grass prairies, and wetlands; feeds in a variety of wetlands, and flooded or wet fields
Mountain plover *Charadrius montanus*	C/SSC	Frequents open plains below 3,200 feet elevation with low herbaceous or scattered shrub vegetation; plowed fields with little vegetation; avoids high and dense cover

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Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

Species	Status[a] Federal/ State	Habitats
Northern harrier *Circus cyaneus*	--/SSC	Frequents meadows, grasslands, open rangelands, and wetlands; nests in emergent wetland or along rivers or lakes; less frequently nests in grasslands and grain fields
Prairie falcon *Falco mexicanus*	--/SSC	Associated primarily with perennial grasslands, savannas, rangelands, and some agricultural fields; uses open terrain for foraging and nests in adjacent canyons, cliffs, or rock outcrops
Sharp-shinned hawk *Accipiter striatus*	--/SSC	Prefers, but not restricted to, riparian habitats; forages in openings at edges of woodlands, brushy pastres, and shorelines where there is an abundance of migrating birds
Short-eared owl *Agio flammeus*	--/SSC	Winters in the Central Valley; usually found in open areas with few trees, such as grasslands, prairies, irrigated lands meadows, and wetlands
Swainson's hawk *Buteo swainsoni*	--/T	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields
Western least bittern *Ixobrychus exilis hesperis*	--/SSC	Nests in fresh emergent wetlands in the Central Valley; rests, roosts, and hides in dense emergent vegetation; often feeds along the edge of emergent vegetation on the open-water side
White-tailed kite *Elanus leucurus*	--/P	Forages in agricultural areas and grasslands; uses trees with dense canopies for cover; nests in dense oak, willow, or other tree stand
Willow flycatcher *Empidonax traillii brewsteri*	--/E	Riparian areas and large, wet meadows with abundant willows for breeding; usually occurs in riparian habitats during migration
		Mammals
Giant kangaroo rat *Dipodomys ingens*	E/E	Restricted to flat, sparsely vegetated areas with native annual grassland and shrubland habitats; requires uncultivated soils consisting of dry, fine, sandy loams for burrowing
Tipton kangaroo rat *Dipodomys nitratoides nitratoides*	E/E	Construct burrows in alkali marshes and on plains. Unable to use cultivated lands. Prefer areas with scattered woody shrubs such as saltbush, and a sparse covering of grasses and forbs. A critical element of their habitat is slightly elevated terrain where they can build burrows above the winter and spring floods.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	E/E	Use sandy loam soils for excavation of burrows in gently undulating to level terrain in mildly to moderately alkaline areas. Herbaceous vegetation with scattered shrubs preferred.

Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

Species	Status[a] Federal/ State	Habitats
Riparian woodrat *Neotoma fuscipes riparia*	C/SSC	Prefers areas with a mixture of trees and shrubs with moderate canopy and brushy understory. Requires cavities in trees, snags, or logs for nesting. In the San Joaquin Valley, suitable habitat restricted primarily to riparian areas where trees and brush are found. Only known from along the San Joaquin, Stanislaus, and Tuolumne rivers.
Riparian brush rabbit *Sylvilagus bachmani riparius*	C/SSC	Occupy dense thickets of riparian shrubs including wild rose (*Rosa* sp.), willows (*Salix* sp.), and blackberries (*Rubus* sp.). Also uses weedy fields adjacent to shrubs. Currently only known on the lower Stanislaus River and possibly in the vicinity of the confluence of the Stanislaus and San Joaquin rivers.
San Joaquin kit fox *Vulpes macrotis mutica*	E/T	Saltbush scrub, valley grassland, oak woodlands, and freshwater scrub. Principally occurs in the San Joaquin Valley.

Status[a]
Federal
- E = Listed as endangered under the federal Endangered Species Act
- T = Listed as threatened under the federal Endangered Species Act
- PE = Proposed for federal listing as endangered under the federal Endangered Species Act
- C1 = Category 1 candidate for federal listing. Category 1 includes species for which U.S. Fish and Wildlife Service has on file enough substantial information on biological vulnerability and threat to support proposals to list them.

Status[a]
Federal
- -- = No status

State
- E = Listed as endangered under the California Endangered Species Act
- T = Listed as threatened under the California Endangered Species Act
- SSC= Species of special concern
- P = Fully protected in California
- -- = No status

3.4.2.1 Natural Terrestrial Habitats

Annual grassland and valley foothill hardwood are the dominant natural terrestrial habitat types in the San Joaquin River region constituting approximately 58 percent of these habitats (USBR 1997d). Many wildlife species use annual grasslands for foraging, but some require special habitat features such as cliffs, caves, ponds, or habitats with woody plants for breeding, resting, and escape cover.

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Annual grasslands in the San Joaquin region are found in the lower foothills and often comprise the understory in oak savannas. Annual grasslands are largely used for livestock grazing but also provide habitat for wildlife. Reptiles that breed in annual grasslands include the western fence lizard, common garter snake, and western rattlesnake. Mammals commonly found in this habitat include black-tailed jackrabbit, California ground squirrel, western harvest mouse, California vole, badger, and coyote. Common birds that breed in annual grasslands include horned lark, and western meadowlark. Numerous threatened, endangered, or sensitive species use annual grasslands for breeding and foraging including burrowing owl, short-eared owl, white-tailed kite, prairie falcon, and San Joaquin kit fox.

Valley foothill hardwood habitat varies from savanna-like to forest-like stands with partially closed canopies dominated by valley oaks (Conard et al. 1977). Denser hardwood stands are associated with valley soils along natural drainages (Mayer and Laudenslayer 1988). Valley foothill hardwood stands are often associated with riparian habitat along the Stanislaus, Merced, and Tuolumne rivers. Hardwood stands provide food and cover for a variety of wildlife, with oaks supplying an important food resource to some birds and mammals. TES species that may be found in this habitat include white-tailed kite, short-eared owl, and riparian woodrat.

3.4.2.2 Agricultural Lands

Agricultural habitats are generally of lower value to wildlife than are natural habitats. The major agricultural habitats in the San Joaquin River region are irrigated pasture, orchards, vineyards, grain, grasslands, and cotton (USBR 1997d). Agricultural areas interrupt riparian vegetation along the Stanislaus, Merced, and Tuolumne rivers (see Section 3.4.1) resulting in the fragmentation of natural habitats. Fragmentation greatly reduces the potential of riparian and valley hardwood stands to fulfill habitat requirements and act as corridors for many wildlife species. In addition, agricultural areas create abrupt edges with natural habitats creating conditions less-preferable by native species. Nonetheless, wildlife species have adapted to these intensively managed areas and use them for foraging and occasionally for breeding. Irrigated pasture provides the highest quality habitat for wildlife and may be used by RTES species. Irrigated pasture, grain, and grasslands used for hay production offer foraging opportunities for black-bellied plover, killdeer, long-billed curlew, white-faced ibis, red-tailed hawk, white-tailed kite, and prairie falcon (USBR 1997b). Small mammals occupying pasture habitat include California vole, Botta's pocket gopher, and California ground squirrel (USBR 1997b). Ground-nesting birds, including ring-necked pheasant, waterfowl, and western meadowlark, occupy pasture habitat if adequate residual vegetation is present (USBR 1997b).

Orchard and vineyard habitat includes intensively managed cultivated fruit or nut-bearing trees, and grape vines planted in rows (USBR 1997b). Understory vegetation is usually absent, but in some areas grasses and other herbaceous plants are allowed to grow along tree rows and between vineyard rows to reduce erosion (Mayer and Laudenslayer 1988). Some wildlife species have adapted to

orchard and vineyard habitats. Deer and rabbits browse on the trees or vines, and squirrels and numerous birds feed on fruits or nuts (Mayer and Laudenslayer 1988). Other wildlife species associated with vineyards include deer mouse, mourning dove, and black-tailed hare. In addition, nuts and fruits from orchards provides food for a variety of animals including American crow, scrub jay, yellow-billed magpie, northern mockingbird, black-headed grosbeak, California ground squirrel, western gray squirrel, coyote, and raccoon (Mayer and Laudenslayer 1988). Orchard and vineyard habitat provides little habitat value for RTES species.

Cotton is an annual crop which is planted in spring and harvested during the fall. Crop rotation, usually between annual and perennial plants, is a common practice applied to conserve soil nutrients in order to maintain soil productivity. Cropland vegetation is grown as a monoculture, using tillage or herbicides to eliminate unwanted vegetation (Mayer and Laudenslayer 1988). Today, many species of rodents and birds have adapted to croplands but are controlled by fencing, trapping, and poisoning to prevent excessive crop losses (CA Dept. Food and Agri. 1975). Croplands flooded for weed control, leaching, irrigation, or waterfowl hunting serve as freshwater wetlands for a variety of wetland wildlife such as shorebirds, wading birds, and gulls (Mayer and Laudenslayer 1988).

3.5 AQUATIC RESOURCES

From an ecosystem and historic perspective, this chapter describes the aquatic resources of the proposed project study area to provide a baseline by which potential impacts of the project can be evaluated. This description of existing aquatic resources elaborates on information contained in Chapter V of the *Environmental Report, Appendix 1* of the 1995 WQCP (SWRCB 1995b), and Chapter III of the 1997 Administrative Draft SWRCB EIR (SWRCB 1997), for the implementation of the 1995 Water Quality Control Plan for the Bay/Delta. This chapter is patterned on the CALFED Bay/Delta program characterization of aquatic ecological habitat elements and stressors (CALFED 1997) and the Central Valley Project Improvement Act review of factors affecting the recovery of aquatic resources in the San Joaquin River system (USBR 1997d).

During the past century, the aquatic resources of the San Joaquin River study area have undergone very significant changes due to human related activities. Virtually all native species have declined in abundance, and many introduced species have become excessively abundant. The decline of native species has become a matter of considerable public concern and has resulted in the proposed actions being considered in this document. These actions are intended to help stem the decline and actively promote the restoration of the chinook salmon, as well as the general ecological health of the San Joaquin River Basin and the Bay/Delta Estuary. The characterization of the baseline abundance and distribution of aquatic resources in this chapter emphasizes manageable factors that contribute to the restoration of selected fish species by the proposed actions of this project. The characterization places into context the impacts that will be described in Section 4.4 of this EIS/EIR.

3.5.1 Habitats and Ecological Zones

The project area encompasses unique Ecological Zones (Figure 3.5-1) characterized by their predominant physical habitats and species assemblages as defined by the Ecosystem Restoration Program Plan (CALFED 1997). These ecological zones relate directly to the rivers, tributaries, and reservoirs of San Joaquin River Basin and include:

- San Joaquin River Ecological Zone
- East San Joaquin Basin Ecological Zone
- West San Joaquin Basin Ecological Zone
- Sacramento-San Joaquin Delta Ecological Zone (Delta)

The following sections describe the demarcation lines of each ecological zone, the salient ecological features, major tributaries and species assemblages.

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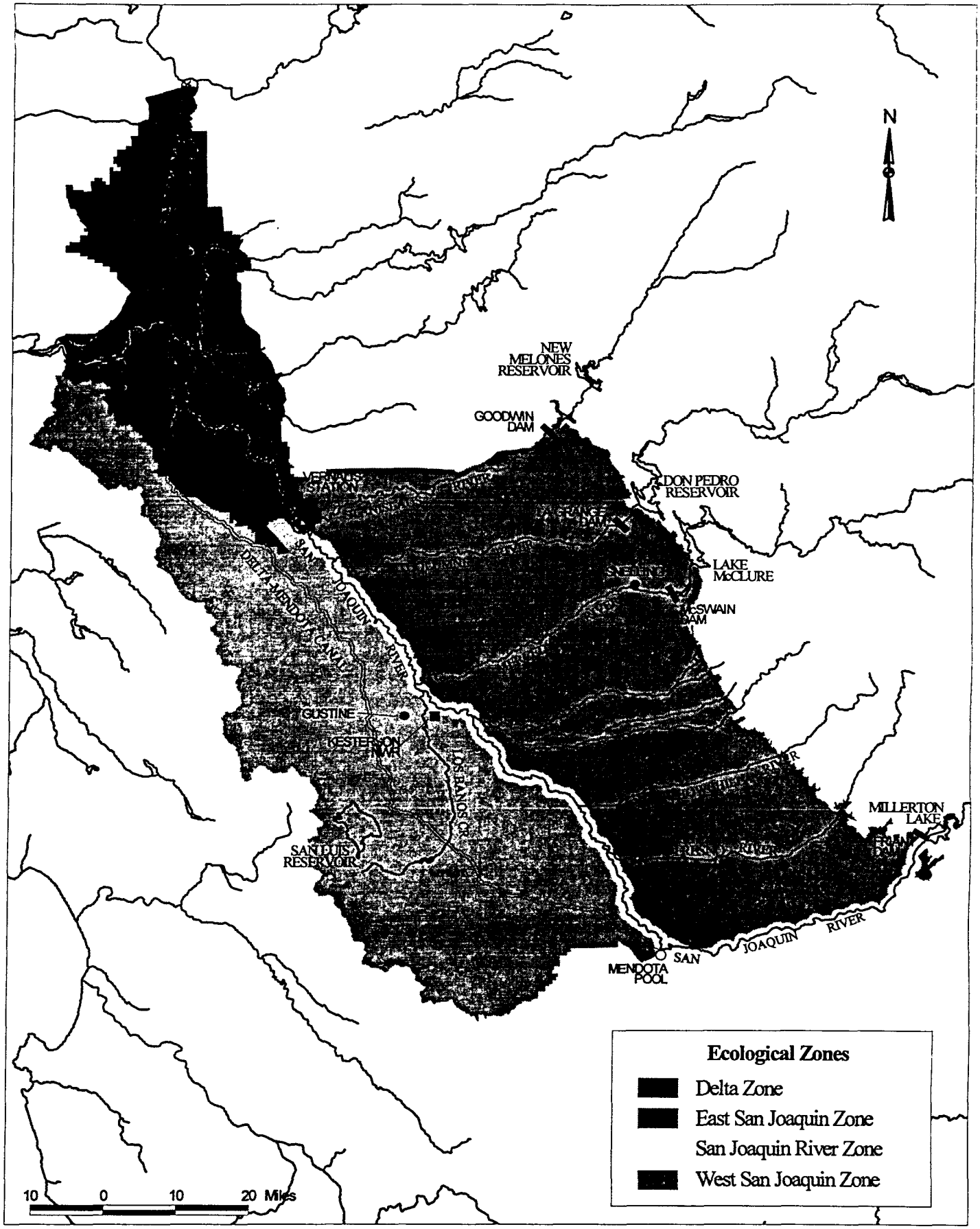

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Figure 3.5-1 Ecological Zones within the project area.

3.5.1.1 San Joaquin River Ecological Zone

The San Joaquin Valley, the southern half of the great California Central Valley, extends some 290 miles from the Sacramento-San Joaquin Delta in the north, to the Tehachapi Mountains in the south. It is bordered on the east by the high mountains of the Sierra Nevada and to the west by the Coast Ranges. The San Joaquin Valley is divided into two distinct hydrologic zones: the Tulare Lake Basin in the south, and the San Joaquin River Basin in the north. The Tulare Lake Basin is separated from the San Joaquin River except in wet years by a low geological divide and, consequently, is not considered part of the San Joaquin River Ecological Zone (Figure 3.5-1). The San Joaquin River traverses the approximate center of the San Joaquin Valley emptying into the Sacramento-San Joaquin Delta at Vernalis. The San Joaquin River Ecological Zone (Figure 3.5-1) includes all of the 185-mile length of the San Joaquin River below Friant Dam, its confluence with other rivers, and drainage from adjacent wetlands.

Snowmelt from the Sierra Nevada mountain range is the primary source of water entering tributaries of the San Joaquin River Basin. Unimpaired flows in normal water years characteristically peak in May, June, and July as the snowpack melts in the spring and summer. Unimpaired flows the rest of the year are typically very low. The overall effect of water development in the San Joaquin River Basin is that water is stored in large reservoirs and then released more evenly throughout the year with generally highest flows in the early spring (CALED 1997, SWRCB 1997).

Water quality in the San Joaquin River varies seasonally, but in periods of low flow is generally degraded due to high temperatures, heavy metals, and pesticides from drainage (Saiki et al. 1992; Kuivila and Foe 1995). During the irrigation season (March - October) and occasionally following the flushing of the drainage water from duck clubs (January and February), degraded quality drainage water makes up a significant portion of the total San Joaquin River flow.

Within the project area, the San Joaquin River Ecological Zone is further subdivided into two ecological units that include:

- Vernalis Station to Merced River Ecological Unit
- Merced River to Mendota Pool Ecological Unit

The first unit, Vernalis to the mouth of the Merced River, is the most significant from the standpoint of the proposed project and from the perspective of the anadromous fish (salmon, steelhead, and striped bass) that use the San Joaquin River for migration or spawning. This 43-mile reach includes the confluence of the Merced, Tuolumne, and Stanislaus rivers, the main tributaries to the San Joaquin River, entering on the east side of the drainage (Figure 3.5-1). Levees confine the river on both sides and have limited the extent of available floodplain, wetland, or shaded riverine habitat (CALFED 1997). On the west side, broad alluvial river channels and floodplains connect to the San

Joaquin, but water from these rivers rarely reaches the San Joaquin. Virtually all land adjacent to the river is under intensive agricultural development.

The Merced River to Mendota Pool Ecological Unit is 87 miles long and includes Salt and Mud sloughs, the Chowchilla River, and the Fresno River. It receives some flow from the Delta-Mendota Canal into the Mendota Pool (CALFED 1997). A significant amount of flow also comes from agricultural drainage via Salt and Mud sloughs. This reach is also used as a conduit for deliveries of irrigation water.

The reach of the San Joaquin River from Mendota Pool to Friant Dam contains two additional ecological units. Flows in this reach are governed under CVPIA Section 3406(c)(1) and are precluded from the project area and this document.

Shad and striped bass migrate from the Pacific Ocean via the Delta into the San Joaquin River to spawn in the spring. Splittail, squawfish, and other native species (Table 3.5-1) are also found in the San Joaquin River. However, this ecological zone is dominated by introduced species such as largemouth bass, silversides, green sunfish and brown bullhead (Brown and Moyle 1992). Introduced species dominate in terms of total numbers and biomass.

Table 3.5-1: SAN JOAQUIN RIVER BASIN AND DELTA NATIVE AND NON-NATIVE FISH SPECIES

Common Name	Scientific Name	Native	Status	Delta[1]	Rivers[2]	Reservoir[3]
yellowfin goby	*Acanthogobius flavimanus*			X		X[4]
white sturgeon	*Acipenser transmontanus*	X		X	X	
green sturgeon	*Acipenser medirostris*	X		X	X	
American shad	*Alosa sapidissima*			X	X	X
goldfish	*Carassius auratus*			X	X	X
Sacramento sucker	*Catostomus occidentalis*	X		X	X	X
Pacific herring	*Clupea harengus pallasi*	X		X		
prickly sculpin	*Cottus asper*	X		X	X	X
riffle sculpin	*Cottus gulosus*	X		X		
carp	*Cyprinus carpio*			X	X	X
threadfin shad	*Dorosoma petenense*			X	X	X
mosquitofish	*Gambusia affinis*			X	X	X
threespine stickleback	*Gasterosteus aculeatus*	X		X	X	X
California roach	*Hesperoleucus symmetricus*	X			X	
Delta smelt	*Hypomesus transpacificus*	X	FT, ST	X		
wakasagi	*Hypomesus nipponensis*			X	X	
surf smelt	*Hypomesus pretiosus*			X		
tule perch	*Hysterocarpus traski*	X		X	X	

Table 3.5-1: SAN JOAQUIN RIVER BASIN AND DELTA NATIVE AND NON-NATIVE FISH SPECIES (CONT.)

Common Name	Scientific Name	Native	Status	Delta[1]	Rivers[2]	Reservoir[3]
yellow bullhead	*Ictalurus natalis*			X		
channel catfish	*Ictalurus punctatus*			X	X	
black bullhead	*Ictalurus melas*			X		
brown bullhead	*Ictalurus nebulosus*			X	X	X
white catfish	*Ictalurus catus*			X	X	X
blue catfish	*Ictalurus furcatus*			X		
Pacific brook lamprey	*Lampetra pacifica*	X		X	X	
Pacific lamprey	*Lampetra tridentata*	X		X	X	
river lamprey	*Lampetra ayresi*	X		X	X	
hitch	*Lavinia exilicauda*	X		X	X	X
pumpkinseed	*Lepomis gibbosus*			X		
green sunfish	*Lepomis cyanellus*			X	X	X
warmouth	*Lepomis gulosus*			X	X	
redear sunfish	*Lepomis microlophus*			X		X
bluegill	*Lepomis macrochirus*			X	X	
staghorn sculpin	*Leptocottus armatus*	X		X		
inland silverside	*Menidia beryllina*			X	X	X[4]
spotted bass	*Micropterus punctulatus*					X
smallmouth bass	*Micropterus dolomieui*			X	X	X
largemouth bass	*Micropterus salmoides*			X		X
striped bass	*Morone saxatilis*			X	X	X
hardhead	*Mylopharodon conocephalus*	X		X	X	X
golden shiner	*Notemigonus crysoleucas*			X	X	X
red shiner	*Notropis lutrensis*			X		X
steelhead rainbow trout	*Oncorhincus mykiss*	X	FT	X	X	
chinook salmon	*Oncorhynchus tshawytscha*	X	FPT	X	X	
kokanee salmon	*Oncorhynchus nerka*	X				X
Sacramento blackfish	*Orthodon microlepidotus*	X		X		X
yellow perch	*Perca flavescens*			X		
bigscale logperch	*Percina macrolepida*			X	X	
fathead minnow	*Pimephales promelas*			X		
starry flounder	*Platichthys stellatus*	X		X		X[4]
Sacramento splittail	*Pogonichthys macrolepidotus*	X	FPT	X	X	
black crappie	*Pomoxis nigromaculatus*			X		X
white crappie	*Pomoxis annularis*			X		
Sacramento pikeminnow formerly Sacramento squawfish	*Ptychocheilus grandis*	X		X	X	X
brown trout	*Salmo trutta*					X
brook trout	*Salvelinus fontinalis*					X

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Table 3.5-1: SAN JOAQUIN RIVER BASIN AND DELTA NATIVE AND NON-NATIVE FISH SPECIES (CONT.)

Common Name	Scientific Name	Native	Status	Delta[1]	Rivers[2]	Reservoir[3]
longfin smelt	*Spirinchus thaleichthys*	X		X		
shimofuri goby	*Tridentiger bifasciatus*			X		
chameleon goby	*Tridentiger trigonocephalus*			X		

Notes:

FT = Federally listed Threatened, FPT = Federally Proposed Threatened, ST = State listed Threatened

1. Delta is the legal delta from Vernalis to Chipps Island.
2. Rivers is from Vernalis up to the first major dam.
3. See Table 3.5-3 for a compete list of reservoirs.
4. San Luis Reservoir only.

References:

DFG. 1997. Endangered and Threatened Animals of California. April.

McGinnis, S.M. 1984. Freshwater Fishes of California. University of California Press, Berkeley, California.

USFWS. 1997a. Federal Register, 50 CFR Part 17, Endangered and Threatened Species; Review of Plant and Animal Taxa; Proposed Rule. 19 September.

USFWS. 1997b. Federal Register, 50 CFR Part 17, Endangered and Threatened Wildlife and Plants. 31 August.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California Guide to the Early Life Histories. Technical Report 9. Interagency Ecological Study Program.

3.5.1.2 West San Joaquin Basin Ecological Zone

This area comprises the west side of the San Joaquin Valley from the Delta in the north and Panoche Creek in the south (CALFED 1997). It is bounded by the interior coast range on the west side, which supports a few naturally flowing, small streams that flow into the San Joaquin River. The eastern slopes of the coast range mountains are arid, while the few remaining wet land areas adjacent to the San Joaquin River are remnants of a once vast floodplain. Most of the remaining wetlands lie in a topographic trough between the Mendota Pool and the Community of Gustine. These important wetlands are an intregal part of the Pacific Flyway for millions of waterfowl which migrate through the Central Valley each spring and fall. The wetland sloughs scattered along the San Joaquin River in this zone are valuable resources for threatened and endangered wildlife. Many native species of fish no longer inhabit this area and introduced species such as striped bass, crappie, and catfish are now established in the San Luis Reservoir, O'Neill Forebay, and Los Banos Reservoir.

The San Luis Reservoir, the largest west side aquatic ecosystem, does not drain into the San Joaquin River. The San Luis Drain was designed to carry agricultural subsurface drainage from collectors

along the west side of the San Joaquin River to the Sacramento-San Joaquin Delta for ultimate discharge to the ocean. However, only a portion of the drain was constructed, and it presently terminates in Mud Slough at the north end of Kesterson National Wildlife Refuge and carries drainage from the Westlands Water District only. Accumulations of selenium in the drainage water and sediments at Kesterson resulted in the closure of the refuge and the drain after 1985 (SWRCB 1987). The drain now serves as a conveyance facility for subsurface drainage water that would otherwise flow through the wetlands areas and then to the San Joaquin River.

3.5.1.3 East San Joaquin Basin Ecological Zone

This ecological zone (Figure 3.5-1) includes all the major east side tributaries of the San Joaquin River. The hydrographic elements of this zone include major rivers and many reservoirs of varying size in the upper parts of the watershed. The largest reservoirs are New Melones, New Don Pedro, and Lake McClure. The East San Joaquin River Ecological Zone has been divided into three riverine ecological units, representing the three major tributaries of the San Joaquin River:

- Stanislaus River Ecological Unit
- Tuolumne River Ecological Unit
- Merced River Ecological Unit

Stanislaus River Ecological Unit. The Stanislaus is the northern most major tributary to the San Joaquin River. Average monthly unimpaired flows at New Melones are approximately 96,000 acre-feet. These flows are reduced to approximately 57,000 acre-feet at Ripon, near the confluence with the San Joaquin River, due to flow diversion and regulation at Goodwin Dam.

New Melones Dam is located 60 miles upstream from the confluence of the Stanislaus and San Joaquin Rivers, and is operated by Reclamation as a key element of the CVP. New Melones Reservoir has a capacity of 2,420,000 acre-feet and is currently operated under the New Melones Interim Plan of Operation (USBR 1997c). Releases from New Melones are used for agricultural irrigation and water supply purposes, to meet water quality control standards at Vernalis, provide beneficial fishery flows, and for the positioning of the freshwater/saltwater interface in the Delta.

Goodwin Dam is located approximately 15 miles below New Melones. It serves as the terminus for the upstream migration of chinook salmon. Salmon spawn below the dam and the early life stages grow and develop in the river between the dam and the San Joaquin River before emigrating. There are approximately forty small, unscreened pump diversions (for agricultural purposes) along the river. The channelization of the river below Goodwin Dam has resulted in impaired rearing habitat for juvenile salmon.

Water temperatures in the Stanislaus River are related to seasonal air temperatures and flow releases. Reclamation has developed a stream temperature model for the Stanislaus River that can be used to predict water temperatures given various flow and climate conditions.

The Stanislaus River, as well as the Tuolumne and Merced rivers, may have suitable habitat conditions to support steelhead even if steelhead are not present.

Tuolumne River Ecological Unit. The Tuolumne River is the largest of the San Joaquin River tributaries and has an average annual unimpaired flow of approximately 1.8 million acre-feet. The Tuolumne has a series of dams diverting water for municipal and irrigation uses as well as the generation of electric power. The City of San Francisco constructed the O'Shaughnessy Dam forming the Hetch-Hetchy Reservoir and another smaller dam to form Lake Eleanor in the 1920s. Cherry Dam, forming Lake Lloyd, was completed in 1956. Flow down the lower Tuolumne is regulated at the New Don Pedro Dam operated by the Turlock and Modesto Irrigation Districts. Don Pedro Reservoir has a maximum storage of approximately 2 million acre-feet.

La Grange Dam (built in 1893) is the upstream barrier to salmon migration. Spawning now takes place in the 25-mile reach below the dam, and juvenile rearing takes place throughout the lower river. The quantity and quality of habitat for salmon in the Tuolumne River has been degraded over the years by many factors including loss of riparian habitat due to cattle grazing, instream gravel mining, reduced instream flows, and elimination of upstream sources of gravel recruitment.

In 1995, a settlement agreement was signed by federal and state agencies, local irrigation districts, the City and County of San Francisco, and local environmental groups as part of an amendment to Article 37 of the FERC license for the operation of the New Don Pedro Project (TID/MID 1996). One of the results of this agreement is increased flow releases from New Don Pedro as part of a strategy for recovery of Tuolumne River chinook salmon.

Merced River Ecological Unit. The Merced River drains over 1, 200 square miles of Sierra Nevada range including the southern part of Yosemite National Park and has an annual average, unimpaired runoff of approximately 1 million acre-feet per year (CALFED 1997). The unimpaired monthly flow peaks in April, May and June and then abruptly drops to flows of less than 100 cfs from August through November. Flow is regulated by a series of dams that allow for flood control, irrigation and power production. The New Exchequer Dam, operated by the Merced Irrigation District, blocks off the higher elevations of the Merced River creating Lake McClure with over one million acre-feet of storage capacity. Further downstream the McSwain Dam acts as an afterbay for New Exchequer Dam.

Habitat quantity and quality within the lower reaches of the Merced River are extensively degraded due to cattle grazing, removal of bank side vegetation, gravel mining in the river bed, agricultural return flows into the reaches used by juvenile salmon and trout, low flows resulting in siltation of

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the spawning gravel, and lack of recruitment of new spawning gravel. Low flows in the lower reaches of the Merced River result in significantly degraded fish rearing habitat. The Merced Falls and Crocker-Huffman agricultural diversion dams divert approximately 500,000 acre-feet a year. Six major diversions in the salmon spawning reach from Crocker-Huffman to Snelling deplete virtually all available flow (CALFED 1997).

Reservoirs of the East San Joaquin River Ecological Zone. Reservoirs have become a major type of fish habitat in the east side tributaries since the development of the region's surface water projects. The nature of each reservoir and its fish fauna is determined by its elevation, size, water management regime, water quality and fisheries management practices. Many of the reservoirs lie at mid-level elevations in the Sierra Nevada foothills and have characteristics of both warm-water and cold-water ecosystems. Reservoir ecosystems include: 1) littoral, or edge habitats down to the lower limit of the penetration of light; 2) the epilimnetic, or open water zone; 3) the hypolimnetic zone of cold water below the warmer surface water; and 4) benthic, or bottom zone. The east side reservoirs provide considerable recreational fishing diversity, although extensive drawdowns tend to limit species that are dependent on relatively stable shallow-water habitat for some component of their life cycle.

3.5.1.4 Sacramento-San Joaquin River Delta Ecological Zone

The Sacramento-San Joaquin Delta Ecological Zone (Figure 3.5-1) includes all of the legal delta from the Carquinez Straights, to the mouth of the American River in the north, to Vernalis on the San Joaquin River in the south. The proposed project alternatives primarily affect the southern and central portions of the Delta through changes in the magnitude and timing of flows at Vernalis. The Sacramento-San Joaquin Delta Ecological Zone is characterized by a mosaic of habitat types that support a diverse community of aquatic organisms (CALFED 1997; SWRCB 1997). This zone is also a key element linking the Pacific Ocean with the tributary rivers in the watershed on the east side of the coast range and the western side of the Sierra Nevada Mountains. Based on the aquatic habitat nomenclature of CALFED (1997), the main types of aquatic habitat found in the Delta include:

- shaded riverine aquatic (SRA)
- vegetated and non-vegetated shallow shoal areas
- open-ended sloughs
- dead-end sloughs
- large, open river channels

Inflow to the Delta primarily comes from the large, open river channels of the Sacramento River with lesser amounts coming from the San Joaquin and Mokelumne rivers. The Sacramento River contributes approximately 75–80 percent of the water entering the Delta; the San Joaquin River contributes 10–15 percent of total inflows (SWRCB 1997). The cumulative flows of the Mokelumne

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and other east side rivers make up the balance of Delta inflows. Flows into the Delta vary greatly by water year type but on the average approximately 21 million acre-feet of water drains into the Delta each year (SWRCB 1997). Unimpaired monthly Delta outflows peak in March and drop off to their lowest levels in September. Development of water resources has greatly altered flow, resulting in significantly reduced spring peaks and higher flows in the late summer months. Flows are now regulated to maintain the 2 parts per thousand (ppt) isohaline (commonly referred to as X2) in Suisun Bay to prevent saltwater intrusion and benefit aquatic species.

The Delta is home to numerous species of aquatic plants and animals. Some of the fish species found in the Delta are migratory, using the Delta as a passage through which they move back and forth between Central Valley rivers and the ocean, while others spend their entire life there. Chinook salmon and striped bass are examples of anadromous, migratory species, while delta and longfin smelt are resident species.

3.5.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

The aquatic resources of the San Joaquin River Basin and Delta are greatly reduced from their former status. The decline in distribution and abundance, and the causes of decline, have been documented extensively (SWRCB 1995b). This section will summarize the factors associated with the decline in fishery resources. These factors include: natural environmental variability; water development; introduction of non-native aquatic organisms; food supply limitations; harvest; pollution; and reservoir issues (DFG 1994; SFEP 1992a).

3.5.2.1 Natural Environmental Variability

The flow of fresh water to the San Joaquin River Basin and ultimately the Bay/Delta Estuary is primarily determined by the amount and timing of precipitation in the Central Valley watershed along with the rate of runoff generated by snowmelt. Just as total precipitation varies each year, the volume of water annually flowing through the basin will also vary. Inflows to the southern Delta from the San Joaquin River basin are measured at the USGS Vernalis gauging station. For planning and regulatory purposes, the SWRCB has developed a water year classification system that provides a relative estimate of the amount of water originating in the San Joaquin hydrologic basins from seasonal runoff and reservoir storage. The system has five types of water years: wet, above normal, below normal, dry, and critical. Table 3.5-2 shows the water year types for the San Joaquin River system for the period 1930–1997.

Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997

Water Year	Type	Comments
1930	C	Lyons Reservoir on the Stanislaus River operational
1931	C	
1932	AN	
1933	D	
1934	C	
1935	AN	
1936	AN	
1937	W	
1938	W	Hetch Hetchy Reservoir on the Tuolumne River operational
1939	D	Friant Dam construction begins
1940	AN	
1941	W	
1942	W	
1943	W	
1944	BN	Friant Dam is allowed to regulate San Joaquin River flow
1945	AB	
1946	AB	
1947	D	Friant Dam construction completed, Millerton Reservoir on the San Joaquin River operational
1948	BN	
1949	BN	
1950	BN	Redinger Reservoir on the San Joaquin River operational
1951	AN	Friant Dam begins full operation, USBR Tracy Pumping Plant
1952	W	
1953	BN	
1954	BN	Thomas Edison Reservoir on the San Joaquin River operational
1955	D	
W = Wet, AN = Above normal, BN = Below normal, D = Dry, C = Critical		

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Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997 (CONT.)

Water Year	Type	Comments
1956	W	Cherry Reservoir on the Tuolumne River operational
1957	BN	Beardsley, Tulloch, and Donnells reservoirs on the Stanislaus River operational
1958	W	
1959	D	Mammoth Pool Reservoir on the San Joaquin River operational, drought year
1960	C	Drought year
1961	C	State Water Rights Board adopted Water Rights Decision 990 approving water rights for the CVP
1962	BN	
1963	AN	
1964	D	
1965	W	
1966	BN	New Exchequer Dam on Merced operational
1967	W	Water Rights Decision 1275 approving water rights for the SWP including agricultural salinity standards. McSwain and McClure reservoirs on the Merced River operational
1968	D	Banks Pumping Plant operational
1969	W	
1970	AN	Merced River Fish Facility
1971	BN	D-1379 requiring SWP and CVP comment fish and wildlife use in additional to agricultural, municipal, and industry. Don Pedro Reservoir on the Tuolumne River operational
1972	D	
1973	AN	
1974	W	
1975	W	
1976	C	Drought year
W = Wet, AN = Above normal, BN = Below normal, D = Dry, C = Critical		

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Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997 (CONT.)

Water Year	Type	Comments
1977	C	Drought year
1978	W	D-1485 requires DWR and USBR to meet Bay/Delta standards. New Melones Reservoir on the Stanislaus River operational.
1979	AN	
1980	W	
1981	D	
1982	W	
1983	W	
1984	AN	
1985	D	
1986	W	Federal/State Coordinated Operation Agreement for operation/export pumps is signed
1987	C	drought year
1988	C	drought year
1989	C	drought year
1990	C	Formation of San Joaquin River Management Plan Advisory Council, Spicer Meadows Reservoir on the Stanislaus River operational, drought year
1991	C	drought year
1992	C	drought year, CVPIA enacted, electric barrier on San Joaquin River
1993	W	NMFS Biological Opinion on winter run chinook salmon
1994	C	Bay/Delta Accord and the creation of CALFED Delta Smelt Biological Opinion by USFWS
1995	W	May 1995 SWRCB Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
1996	W	
1997	W	January flood, very dry spring
1998	W	El Niño
W = Wet, AN = Above normal, BN = Below normal, D = Dry, C = Critical		

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Variation in the amount of flow to the Bay/Delta Estuary is the most commonly cited factor controlling abundance, distribution, and reproductive success of many aquatic species in the project area (SWRCB 1995a; USBR 1997d). Drought and low flow conditions can have wide-ranging impacts on aquatic resources, depending on the species and life stage requirements. For many fish species, drought conditions can reduce the amount of habitat available, elevate water temperatures, reduce the food supply, increase susceptibility to predation, and degrade spawning and rearing habitats. Impaired habitat conditions result in reduced egg and young survivals for that year and a diminished year class in the adult population. The combination of floods and severe drought in the 1980s and 1990s contributed to, and accelerated the declines in populations of aquatic resources in the San Joaquin River Basin and the Bay/Delta Estuary (SWRCB 1995b).

Natural variability in the cycle of Pacific oceanic currents also may have contributed to the decline of some of the anadromous species. El Niño conditions disrupt the natural upwelling that occurs off the coast, reducing the amount of nutrients brought up from deep, nutrient rich strata of the ocean. Fewer nutrients result in greatly reduced plankton blooms and, therefore, less food for juvenile salmon and striped bass. While such natural variation is beyond the control of resource managers, these events accentuate and focus attention on the need to create robust aquatic ecological habitat so that essential species can survive the natural range of irregular geoclimatic conditions.

3.5.2.2 Water Development

Land reclamation projects and waterway modifications have caused major ecological changes throughout the San Joaquin River Basin and in the Delta. These practices have removed most of the seasonally-flooded wetlands on the valley floor and the tidal marshes in the Delta. The loss of wetland habitat greatly reduced the critical habitats for many riverine and delta species at all trophic levels, and has resulted in a significant reduction in population sizes, especially of those species that utilize shallow, back-water habitats, sloughs, or intertidal zones during all or part of their life cycle. Species that utilize flooded vegetation for spawning habitat, have either become extinct or greatly declined in abundance (CUWA 1994).

The progressive losses of habitat that have occurred throughout the Central Valley have reduced the ability of certain populations to rebound from natural and man-induced environmental changes. The following changes associated with water development have affected aquatic resources: alteration of seasonal flow regimes, diminished flow, modification of the entrapment zone location, export of water from the Delta, and modification and use of the Delta as a water conveyance facility.

The use of the Delta to convey water to South Delta export facilities (see Section 3.2) has played a particularly large role in modifying natural flow patterns. When export rates are high and Delta inflows are low, water from the central Delta and San Joaquin River is drawn into the channels that feed the CVP and SWP pumping plants. This net upstream flow of water toward the export pump

is known as reverse flow. Reverse flows occur primarily in the south and central delta. The magnitude, duration, and extent of reverse flows varies with season, water year type, and stream inflow to the Delta. Reverse flows reportedly disorient anadromous fish as they migrate either upstream or downstream following the salinity gradient (SWRCB 1997). Reverse flows carry young fish into the central or southern Delta, where habitat may not be as good or where they may be more susceptible to entrainment (DWR 1992). Entertainment losses also occur as a result of pumps used at many of the agricultural diversions found throughout the San Joaquin River Basin and Delta.

3.5.2.3 Introduced Species

The San Joaquin River Basin and the Bay/Delta Estuary is home to more than 150 introduced aquatic species of plants and animals. About 28 of these introduced species are non-native fish, and over 100 are non-native invertebrates (BDOC 1994). A list of the native and non-native fish species is presented in Table 3.5-1. Introduced species affect native species through a wide variety of mechanisms including competition for food and space, predation, habitat alteration, disturbance, hybridization, and acting as pathways for and sources of diseases (BDOC 1994).

3.5.2.4 Food Supply

Food supply can affect the abundances of aquatic organisms at all trophic levels. Food may be limited in various ways, including decreased availability of nutrients and decreased abundance and availability of food items. Orsi et al. (1996) reported a strong correlation between changes in the Delta food web base and the decline in the aquatic resources of the Bay/Delta Estuary. Dams, levees, enlarged river channels, and filling tidal wetlands have all reduced the loadings of land-derived detritus and dissolved organic carbon, which are primary nutrient sources for the lowest members of the food web (DWR 1994). These changes may affect the foraging success of fish species using the San Joaquin River Basin and Delta during all of parts of their life cycle.

3.5.2.5 Harvest

The legal harvest of various fish decreases the number of spawning adults and the average age of adults. The possibility of overharvesting is greatest for game species (e.g., striped bass, white sturgeon, chinook salmon). While current federal and state fisheries management regulations should prevent over fishing, even with full enforcement of these statutes, some species may be over harvested.

Management of salmon fisheries is complicated because of sport, commercial, and illegal fishing in the ocean, the presence of several regulatory agencies, and the support of populations by hatchery production. While ocean harvests of salmon substantially reduce spawning escapement, resource agencies maintain that harvests (legal or illegal) are not the principal limiting factor for salmon abundance. Similar to many other fisheries in decline around the globe, increased fishing efforts

(despite hatchery production) would result in over harvesting of wild salmon stocks (DFG 1994), including those occurring within the San Joaquin Basin.

Over harvest of game species in reservoirs by sport fishing is controlled not only by regulations but also by stocking reservoirs on an annual basis or when fish populations begin to decline. Reservoirs rarely provide sufficient habitat quantity or quality for game fish species, and most game fish species in reservoirs are not considered to be part of self-sustaining populations.

3.5.2.6 Pollution

As urban, industrial, and agricultural activities expanded throughout the Central Valley watershed, pollutant loads and associated impacts on aquatic resources increased. By the early 1900s, pollution contributed to the decline in salmon, sturgeon, and striped bass commercial fisheries (SFEP 1992b). There is growing concern about non-urban runoff in the San Joaquin Basin watersheds, particularly the agricultural component (SFEP 1992b). Agricultural return flows, which contain pesticides, trace elements, and solvents, may contribute most of the flow of the San Joaquin River in the summer (SFEP 1991).

Recently, the dormant spray pesticide diazinon, which is applied to orchards in the winter, has been identified in the San Joaquin River at levels that are acutely toxic to some aquatic organisms. The elevated concentrations of pesticides in the river immediately followed rainfall events, when runoff from agricultural and urban areas is most pronounced (DWR 1994; SFEP 1992b). The pesticides can also result in chronic toxicity to aquatic fauna in the river. Secondary adverse impacts also can occur due to pesticide toxicity to zooplankton, resulting in malnutrition of the fish.

In addition to being a source of pesticides, agricultural return flows can increase the salinity of receiving waters to levels which adversely affect some aquatic species. This occurs in the lower San Joaquin River where striped bass spawning habitat is impacted as the result of a combination of saline agricultural return flows and reduced freshwater flows.

It is unlikely that pollution is the principal cause of the widespread declines in fishery resources over the last 20 years because of the major pollutant abatement actions that have occurred during that period (DFG 1994). But it is still reasonable to conclude that toxic pollutants have been, and continue to be, among the factors which contribute to the decline of many species, in spite of an increased awareness of pollution and its impact on the aquatic resources of the San Joaquin River Basin.

3.5.2.7 Reservoir Issues

The project area and vicinity include 36 reservoirs of various size. Table 3.5-3 summarizes the reservoirs by name, watershed, and principal species. The three major reservoirs in the project area

Table 3.5-3: SAN JOAQUIN BASIN RESERVOIRS BY NAME, WATERSHED, AND PRINCIPAL SPECIES

Reservoir Name/Date	Watershed	Principal Species
Beardsley Lake (1957)	Stanislaus River	rainbow trout, brown trout, and brook trout
Donnells Reservoir (1957)	Stanislaus River	rainbow trout, brown trout, and brook trout
Goodwin Reservoir (1912)	Stanislaus River	not known
Lake Alpine (1908)	Stanislaus River	rainbow trout
Lake Tulloch (1957)	Stanislaus River	rainbow trout, smallmouth bass, largemouth bass, bluegill, catfish, and crappie
Lyons Reservoir (1930)	Stanislaus River	not known
New Melones (1979)	Stanislaus River	rainbow trout, brown trout, largemouth bass, smallmouth bass, bluegill, catfish, and crappie
Pinecrest Lake (1916)	Stanislaus River	rainbow trout, brown trout, and brook trout
Relief (1910)	Stanislaus River	not known
Spicer Meadows Reservoir (1990)	Stanislaus River	rainbow trout, brook trout, brown trout, black bass, and channel catfish
Union Reservoir (1902)	Stanislaus River	rainbow trout, brook trout, brown trout, black bass, and channel catfish
Utica Reservoir (1910)	Stanislaus River	rainbow trout, brook trout, brown trout, black bass, and channel catfish
Eleanor Lake (1918)	Tuolumne River	not known
Hetchy Hetchy (1938)	Tuolumne River	not known
LaGrange (1893)	Tuolumne River	not known
Lloyd Lake (1956)	Tuolumne River	rainbow trout, brown trout, and brook trout
New Don Pedro (1971)	Tuolumne River	trout, catfish, bluegill, crappie, sunfishes, silver salmon, and black bass
Crocker-Huffman Dam (1910)	Merced River	not known
Lake McClure (1967)	Merced River	trout, salmon, catfish, bluegill, crappie, sunfishes, and black bass
Lake McSwain (1967)	Merced River	trout, salmon, catfish, bluegill, crappie, sunfishes, and black bass
Merced Falls (1910)	Merced River	not known
Bass Lake (1901)	San Joaquin River	rainbow trout, brown trout, catfish, bluegill, sunfishes, crappie, black bass, and kokanee salmon
Florence Lake (1925)	San Joaquin River	rainbow trout, brown trout, and brook trout

Table 3.5-3: SAN JOAQUIN BASIN RESERVOIRS BY NAME, WATERSHED, AND PRINCIPAL SPECIES (CONT.)

Reservoir Name/Date	Watershed	Principal Species
Huntington Lake (1913)	San Joaquin River	rainbow trout, brown trout, brook trout, kokanee salmon
Kerckhoff Reservoir (1920)	San Joaquin River	striped bass
Mammoth Pool Reservoir (1954)	San Joaquin River	rainbow trout, brown trout, and brook trout
Millerton Lake (1947)	San Joaquin River	spotted bass, largemouth bass, smallmouth bass, and catfish
Redinger Lake (1950)	San Joaquin River	striped bass
Salt Springs Reservoir (1882)	San Joaquin River	rainbow trout, brown trout, and brook trout
Shaver Lake (1927)	San Joaquin River	rainbow trout, brown trout, brook trout, largemouth bass, smallmouth bass, catfish, and redear sunfish
Thomas Edison Lake (1954)	San Joaquin River/Mokelumne River	rainbow trout, brown trout, and brook trout
San Luis Reservoir (1967)	California Aqueduct	catfish, bluegill, crappie, striped bass, black bass, sturgeon, and shad

References:

DFG Exhibit 15 Bay/Delta Hearing, 1987.

Dirksen, D.J. and R.A. Reeves. 1990. Recreation Lakes of California. Ninth Edition. Recreation Sales Publishing, Inc., Burbank, California.

DWR. 1993b. Draft California water plan update. Volume 1. California Department of Water Resources. Sacramento, CA. Bulletin 160-93. 402pp. Volume 2. Bulletin 160-93. November 1993. 347 pp.

U.S. Geological Survey Water Data Report, CA-91-3.

that regulate flow in the Stanislaus, Tuolumne, and Merced rivers are New Melones, New Don Pedro, and Lake McClure, respectively. Factors limiting optimal sport fishery development in the project area reservoirs include periodicity and magnitude of water level fluctuation, quality and extent of riparian habitat, over fishing, and bank erosion (Leidy and Meyers 1984). Water-level fluctuation is a direct result of reservoir management operation decisions that are designed to meet water user needs. Reservoirs in the project area are operated to store water during winter and spring and to release water in summer and fall to meet agricultural and other requirements. Surface water elevation fluctuations may exceed 20 feet annually depending on the reservoir, precipitation, and demand.

Drawdowns directly affect reservoir productivity in several ways. As the reservoir surface elevation drops, the surface area decreases, reducing the areas of primary production and the living space of fish. The reduction in the extent of littoral area is the most adverse effect for nest building fish. Largemouth bass, crappie, and many other species tend to build nests and spawn in the littoral areas during the spring months, just as the reservoirs are being drawn down to provide water for other beneficial uses. The drawdown also affects temperature stratification, as well as mineral and gas distribution, thereby decreasing usable habitats for cold water fish such as trout. The drawdown also draws off plankton and small fish, and prevents stabilization of fish and invertebrate communities.

3.5.3 Indicator Species Population Trends

The San Joaquin River Basin, its associated tributaries and reservoirs, and the Delta contain approximately 58 species of native and non-native fish. Table 3.5-1 lists the species, the ecological zone(s) they inhabit, and any applicable designation of State or Federal status.

The fish species discussed in this report are considered indicator species because they are dominant within their habitat or have unique value to the ecosystem or regional economy due to their importance as a commercial or recreational target species. Three native species, the splittail, delta smelt, and longfin smelt, are included because of their decline over the last two decades. Sensitive fish species found in the San Joaquin River Basin are listed in Table 3.5-4. A complete listing of all Federal and State listed threatened and endangered species, including plants and animals, is found in Appendix D.

Table 3.5-4: SENSITIVE FISH SPECIES IN THE SAN JOAQUIN RIVER BASIN

		Status	
Scientific Name	Common Name	State	Federal
Acipenser medirostris	Green sturgeon	SSC	
Hesperoleucus symmetricus	California roach	SSC	
Hypomesus transpacificus	Delta smelt	ST	FT
Lampetra ayresi	River lamprey	SSC	
Lampetra hubsii	Kern brook lamprey	SSC	
Mylopharodon conocephalus	Hardhead	SSC	
Oncorhynchus tshawytscha	Fall-run chinook salmon	SSC	FPT
Oncorhynchus mykiss	Central Valley steelhead	SC	FT
Pogonichthys macrolepidotus	Splittail	SSC	FPT

STATE: ST=threatened; SC=candidate for listing; SSC=special concern.
FEDERAL: FT=threatened; FPT= proposed threatened.

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3.5.3.1 Chinook Salmon

Chinook salmon are an anadromous species that spend most of their adult life in open ocean waters and return to freshwater inland streams to spawn. As adult salmon migrate upstream, water must be cool enough and have sufficient dissolved oxygen to avoid stressing the fish. If these conditions are not met, adult fish may delay their migration (USFWS 1995b). Adult chinook salmon in the San Joaquin Basin typically spawn in upper reaches of the major tributaries. They select areas with gravel substrates and prefer loose, clean gravel about 1 to 4 inches in diameter, with preferred water depths ranging from 0.5 to 3.0 feet, and preferred water velocities of 1 to 3 feet per second (USFWS 1995b). For optimal development of embryos and survival of alevins (very young salmon with a yolk sac attached), water should contain high concentrations of dissolved oxygen and range in temperature from 41 to 55 degrees Fahrenheit (Vogel and Marine 1991 as cited in USFWS 1995b). Adult salmon typically do not feed while in freshwater, and all adult salmon die after spawning.

Fall-run chinook salmon in the San Joaquin Basin return to their natal streams to spawn from mid-October through December, with most spawning occurring in November. Eggs are fertilized and buried in gravels where they develop for a period of 40-60 days. After the eggs hatch, the alevins remain in the gravels for up to 30 days prior to emerging. Most salmon fry (young salmon with yolk sac absorbed) emerge from the gravels and rear in the streams from mid-January through March prior to emigrating back to the ocean as smolts from April through early June. In high flow years, fry may be displaced downstream or begin to migrate downstream earlier than in other years. For example, during the high flows of 1998, many fall-run fry emigrated from the San Joaquin tributaries to the lower San Joaquin River and Delta in January and February, according to the NMFS. Chinook salmon from the San Joaquin Basin spend two to four years maturing at sea before returning to spawn.

Four separate races of Central Valley chinook salmon have been identified: the fall, late-fall, winter, and spring runs, based on the timing of the upstream migration. Spring-run chinook salmon in the San Joaquin River Basin became extinct following the construction of impassible dams on major tributaries. Currently, the entire chinook salmon population in the San Joaquin River is made up of fall-run chinook salmon that spawn between October and December (USFWS 1995). Small numbers of spawners have been observed in the Tuolumne River as late as February. Although it has been suggested that these represent a distinct late-fall run, these late-fall salmon are more usually viewed as stragglers, or strays from other river systems (ORNL 1994; Yoshiyama and Moyle 1995).

San Joaquin fall-run chinook are usually regarded as forming a distinct stock, on the basis of geographical distribution and life-history timing. Evidence of genetic separation between Sacramento and San Joaquin fall chinook salmon is weak. Tag returns indicate straying from the Sacramento River system to the San Joaquin (USFWS 1996a). Mixing of genetic stocks has also occurred due to the initial use of Stanislaus River brood stock at the Merced River Fish Facility

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(MRFF), and the outplanting of MRFF-reared smolts and yearlings in the Stanislaus, Tuolumne, and San Joaquin rivers, and in the Delta (USFWS 1995a).

Population Trends

The annual spawning escapement of fall-run chinook salmon in the San Joaquin River basin has been estimated for most years since 1940, but early estimates are often incomplete and based on subjective methods (USBR 1986). Table 3.5-5 shows the estimated run sizes in each of the tributaries since 1940 (Ford 1997, personal communication). Methods for estimating the number of returning adults have improved over the last five decades, and the estimates show a pattern of cyclical returns, as indicated in Figure 3.5-2. Recent spawning escapement of chinook salmon in the Merced, Tuolumne, and Stanislaus rivers is highly variable. Higher returns are strongly correlated with above normal and wet water year types. Similarly, lower spawning escapements are correlated with normal, dry, and critically dry water years (USFWS 1995a). Very low spawning escapements since 1990 are related to recent drought conditions (1987–1992).

Low returns of fall-run chinook salmon to all three tributaries in the 1960s (Figure 3.5-2) were attributed to low San Joaquin River flows, flow reversals, and low dissolved oxygen levels in the lower San Joaquin River and south Delta channels. Nearly complete run failures occurred in 1962 and 1963. The failures appeared to be related to low spring flows in 1959, 1960, and 1961 rather than to fall migration conditions (Hallock et al. 1970). Similar run failures occurred in 1990 and 1991.

Causes of decline for chinook salmon populations have been attributed to: isolation from historical spawning areas; loss of habitat; impaired conditions for smolt emigration, including decreasing flows and increased water temperatures; legal and illegal harvest; introgression with hatchery stocks; presence of pesticides and agricultural chemicals; and entrainment of smolts in SWP/CVP water export system (USFWS 1995b). All the major rivers of the San Joaquin basin have dams at fairly low elevations which are impassable to salmon, preventing their migration into the tributary streams of the Sierra Nevada mountains.

In addition to physically blocking access to upstream habitat, the many dams and reservoirs in the basin have altered natural hydraulic regimes on the rivers, resulting in changes in river morphology, prevention of gravel recruitment, sedimentation of fines into the spawning gravels, and changes to seasonal patterns of flow and water temperatures (USFWS 1995).

Table 3.5-5: SAN JOAQUIN BASIN FALL-RUN CHINOOK SALMON ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996

	River System			
Year	Stanislaus	Tuolumne	Merced	Total
1940	3	122	1	126
1941	1	27	1	29
1942		44		44
1943				
1944		130		130
1945				
1946		61		61
1947	13	50		63
1948	15	40		55
1949	8	30		38
1950				
1951	4	3		7
1952	10	10		20
1953	35	45	0.5	81.5
1954	22	40	4	66
1955	7	20		27
1956	5	6	0	11
1957	4	8	0.4	12.4
1958	6	32	0.5	38.5
1959	4	46	0.4	50.4
1960	8	45	0.4	53.4
1961	2	0.5	0.1	2.6
1962	0.3	0.2	0.1	0.6
1963	0.2	0.1	0	0.3
1964	4	2.1	0	6.1
1965	2	3	0.1	5.1

Table 3.5-5: SAN JOAQUIN BASIN FALL-RUN CHINOOK SALMON ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996 (CONT.)

	River System			
Year	Stanislaus	Tuolumne	Merced	Total
1966	3	5	0	8
1967	12	7	0.6	19.6
1968	6	9	0.6	15.6
1969	12	32	0.6	44.6
1970	9	18	5	33
1971	14	22	4	39
1972	4	5	3	12
1973	1.2	2	1.2	4.4
1974	0.8	1.2	2	4
1975	1.2	1.6	2.4	5.2
1976	0.6	1.7	1.9	4.2
1977	0	0.5	0.4	0.9
1978	0.1	1.3	0.6	2
1979	0.1	1.2	2.1	3.4
1980	0.1	0.6	3	3.7
1981	1	14	10	25
1982		7	3	10
1983	0.5	15	18	33.5
1984	11	14	27	52
1985	13	40	16	70
1986	6	7	6	19
1987	6	15	4	25
1988	12	6	3	21
1989	2	1.3	0.2	3.5

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Table 3.5-5: SAN JOAQUIN BASIN FALL-RUN CHINOOK SALMON ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996 (CONT.)

	River System			
Year	Stanislaus	Tuolumne	Merced	Total
1990	0.5	0.1	0.1	0.7
1991	0.3	0.1	0.2	0.6
1993	0.4	0.4	1.8	2.6
1994	1.1	0.5	3	4.6
1995	0.6	1	2.6	4.2
1996	0.2	3	6	9.2

Source: T. Ford, Biologist, Turlock Irrigation District, personal communication, 19 August 1997.

Streamflow is an important factor affecting the productivity of the remaining habitat in the basin. Fall flows provide access to the spawning gravels and may be important in attracting returning spawners to the San Joaquin system. Spring flows may stimulate and transport migrating smolts out of the tributaries, provide suitable conditions for migrants in the San Joaquin River, and maintain acceptable water temperatures for juveniles (SWRCB 1995b). Increased flows for the benefit of salmon have been negotiated on the Stanislaus River, as part of the New Melones Interim Operation Plan, and on the Tuolumne River, as part of the re-evaluation of instream flows from the New Don Pedro Project by the Federal Energy Regulatory Commission (FERC). Increased flows are also being negotiated for the Merced River (CALFED 1997).

In-river gravel mining has left many large, deep pools in or adjacent to the tributaries. These pools provide habitat for salmon predators, particularly black bass, and are believed to be responsible for significant losses to out-migrating smolts (EA 1992). Some efforts are underway to isolate the pits or to restore the channel geometry (McBain and Trush 1998).

Additional factors leading to the decline of salmon populations include inadequate flow conditions during smolt emigration and adult immigration, and excessive water temperatures during spawning, incubation, and rearing life stages. Salmon migrating to and from the spawning tributaries must pass through the San Joaquin River upstream of the Delta. During the normal smolt emigration period, in low flow years, mean water temperatures in these reaches may exceed levels thought to be harmful to chinook salmon smolts. Stream temperatures are recorded at USGS and DWR gauging stations located in the San Joaquin Basin. In addition, the California Department of Fish and Game is compiling a database of stream temperatures from a series of thermographs (temperature recorders) located in each of the major tributaries (DFG 1995). TID and MID have compiled a database of their

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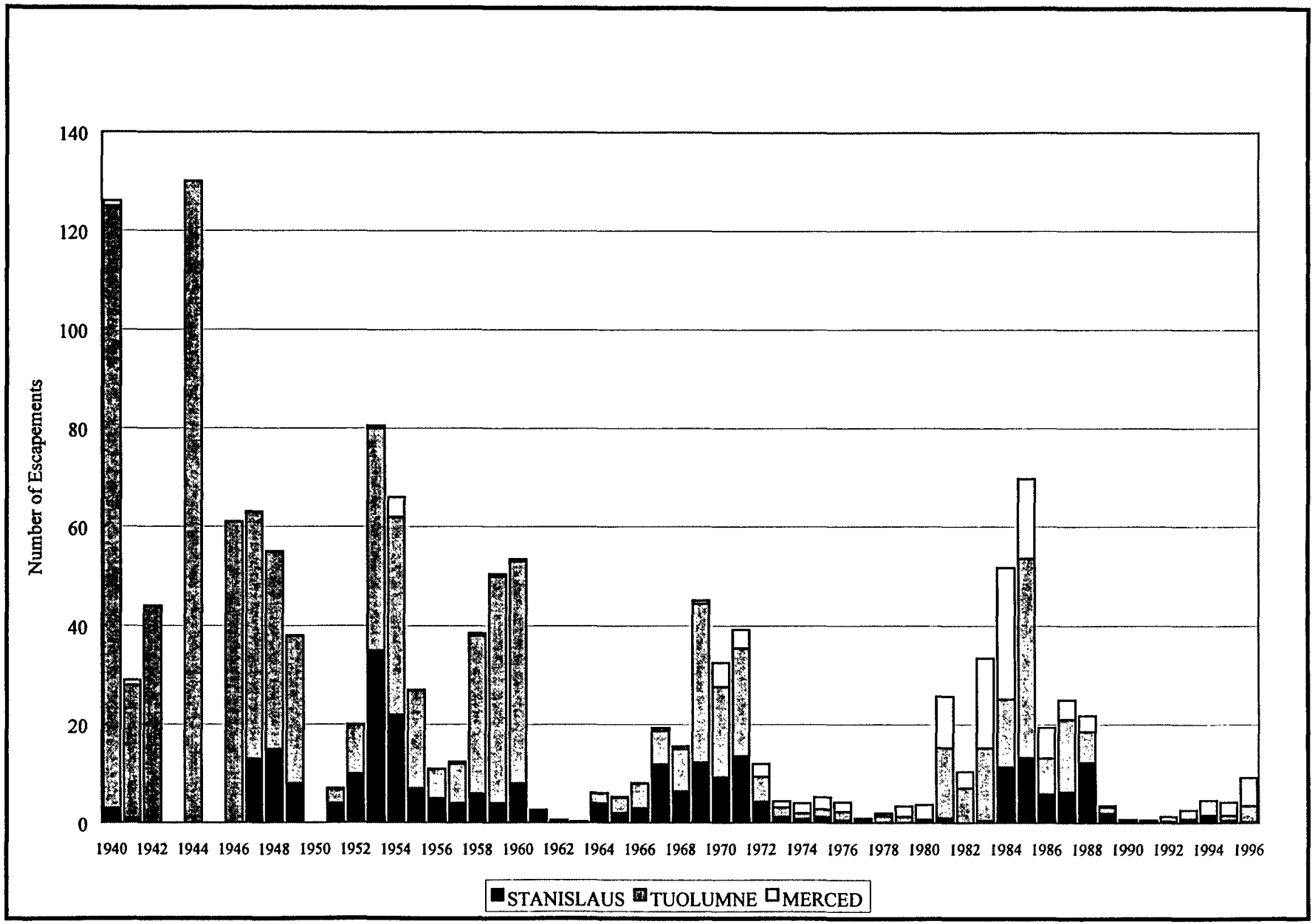

13386.02\..\Escape1.cdr

Figure 3.5-2. San Joaquin Basin Fall-run Chinook salmon escapement, 1940-1996.

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thermograph data for the Tuolumne River and San Joaquin River. Temperature models that show predicted water temperatures under various flow conditions have also been developed, or are being developed, for each major tributary.

Other water quality problems which are potentially of concern for salmon include high salinities and low dissolved oxygen in the San Joaqin River and Delta (USFWS 1995a). Dissolved oxygen levels less than 5 ppm (parts per million) and water temperatures higher than 66°F near Stockton have been identified as the cause of delays in the migration of adult chinook salmon (Hallock et al. 1970). Improved waste water treatment facilities at Stockton and the installation of a physical barrier at the head of Old River in dry years, which directs San Joaquin flows down the mainstem of the San Joaquin River, appear to have benefited the returning adult salmon to some extent.

At low river flow, high diversion rates at the CVP/SWP export facilities increase the proportion of San Joaquin River flow drawn toward the pumps via the Old River branch of the San Joaquin. Most chinook salmon reaching the CVP/SWP export facilities in the south Delta are from the San Joaquin River Basin (USBR 1986). Juvenile salmon, diverted towards the central Delta, experience reduced survival due to increased emigration time, high water temperatures, predation, entrainment in unscreened agricultural diversions, and Delta export pumping.

Mark-recapture studies since 1985 demonstrated that chinook salmon smolts released in the San Joaquin River downstream of the head of Old River survived better than those released into Old River (DFG 1992a). Maximum survival benefits are expected as a result of reduced exports, increased San Joaquin flows at Vernalis, and a barrier at the head of Old River during the spring emigration period (USFWS 1993). The barrier prevents salmon smolts from entering the south delta and avoids the influence of the export pumps at the spring.

Short-term increases in freshwater flows are termed pulsed flows. Pulsed flows in the tributaries are intended to benefit salmon by providing cues for salmon that stimulate migratory behavior. In spring, pulse flows can trigger the emigration of smolts from the tributaries to the ocean. In the fall, pulse flows signal the upstream migration of adults and may aid adults in identifying their natal systems. Pulsed flows also increase turbidity, thereby reducing visibility and predation losses during smolt emigration (EA 1992).

Since 1970, the Merced River run has been sustained in part by production of yearling fall-run salmon at the Merced River Fish Hatchery (DFG 1987). Because of low flows on the Merced, there has been a tendency for returning adult salmon to stray into agricultural drainage ditches, especially at Mud and Salt sloughs, and lose the opportunity to spawn. In the fall of 1991, an estimated 35 percent of the San Joaquin River salmon strayed into westside canals (DFG 1993). Since 1992, electrical and physical barriers have been installed to keep the migrating adults in the Merced River and out of the sloughs.

3.5.3.2 Steelhead/Rainbow Trout

Steelhead/rainbow trout have a broad range of life history strategies that include strains that always emigrate to the ocean and other strains that generally do not. Strains that do emigrate to the sea are called steelhead, and strains that remain resident in freshwater are termed rainbow trout. Both adult steelhead and rainbow trout typically survive after spawning, though it is rare that adults will spawn more than twice. Adult steelhead are generally larger than adult rainbow trout.

Steelhead have a life history similar to salmon. The primary difference is that juveniles will remain in the tributaries for at least one year before smolting. The majority of the spawning for winter-run steelhead generally occurs in December. Steelhead eggs are deposited in gravels and hatch in 30-60 days. Fry generally emerge during April and May, and juvenile steelhead will spend 1–3 years in freshwater before emigrating to the ocean, where they will spend 2–4 years before returning to spawn. Adults that survive spawning return to the ocean from April through June. Juveniles will usually emigrate from November through May.

Historically, winter-run steelhead are the only race found in the Central Valley and are native to the Sacramento and San Joaquin River Basins (USBR 1997g). In the San Joaquin River Basin, steelhead populations have been reduced to remnant levels. However, there is some evidence of a distinct anadromous run of steelhead in the Stanislaus River. Large rainbow trout are present in the upper reaches, and juvenile rainbow trout showing signs of smolting are trapped in the lower reach during studies designed to sample emigration of salmon smolts. Genetic studies are underway to determine whether these fish are part of a reproducing steelhead population within the Stanislaus River, strays from another basin, or resident rainbow trout (CALFED 1997). Past monitoring efforts have been inconclusive in determining the presence or absence of steelhead populations in the Tuolumne and Merced rivers, or the San Joaquin River upstream of the Stanislaus River. Recently, Central Valley steelhead were listed by the Federal government as a threatened species (USFWS 1998).

Resident rainbow trout can be found in the San Joaquin River, its tributaries, the Delta, and San Joaquin Basin reservoirs, but in numbers that are greatly reduced from their historical abundance in those areas (Yoshiyama et al. 1996).

Population Trends

There are a variety of indications that self sustaining stocks of rainbow trout continue to exist in the San Joaquin River system. Evidence is not as clear, however, concerning steelhead. DFG records contain reference to a small population characterized as emigrating steelhead smolts that are captured at the DFG Kodiak trawl survey station at Mossdale on the lower San Joaquin River each year. A few ripe rainbow trout which could be large enough to be small steelhead enter the fish traps at the Merced River Fish Hatchery every year.

There is some evidence of a distinct run of steelhead that may be using the Stanislaus river for spawning and rearing based on the presence of adult-sized rainbow trout in the upper part of the river and a small number of smolt-sized trout captured near the mouth of the river in 1996-1997 (Demko 1995).

3.5.3.3 Striped Bass

The striped bass (*Morone saxatilis*) is native to streams and bays of the Atlantic Coast. It was first introduced into the Bay/Delta Estuary in 1879. Within 10 years, this highly fecund and voracious predator was supporting a commercial fishery (SFEP 1992a).

California striped bass spend most of their life in the Bay/Delta Estuary and along the Pacific Coast, within a few miles north and south of the Golden Gate (DWR 1992). Landlocked populations of striped bass are also found in the Millerton and San Luis reservoirs.

Approximately one-half to two-thirds of bass spawning occurs in the Sacramento River system, while the remainder spawn in the Delta and the lower San Joaquin River below Vernalis (BDOC 1993). Important spawning areas include the area between Antioch Bridge and the mouth of Middle River in the San Joaquin River. Striped bass begin spawning in the Delta in spring, during April and May, when water temperatures reach about 60°F; most spawning occurs when water temperatures are between 61 and 69°F (BDOC 1993).

Striped bass spawn in fresh water where there is moderate to swift current. In slower currents, many eggs (which are slightly heavier than water) sink to the bottom and die (DFG 1993). The semi-buoyant striped bass eggs drift with river currents and are carried downstream. Larvae hatch two to three days after spawning. Initially, the larvae receive nourishment from the yolk sac, which is absorbed in five to ten days. As they move downstream toward the Delta, larvae begin feeding on small zooplankton. Upon reaching the western Delta, which is presently their primary rearing area, larvae are large enough to begin feeding on larger organisms such as the opossum shrimp (*Neomysis mercedis*). *Neomysis* remains the main food source until the striped bass reach their second year, when they become large enough to feed on bay shrimp and small forage fish. They reach maturity at 3–4 years of age and may live to 20–30 years of age. In recent years, most of the adult striped bass in the Bay/Delta system have been in the 4–7 year age classes. The older, more fecund fish, are no longer present in great numbers (DWR 1993c).

Population Trends

Beginning in 1982, the DFG stocked striped bass in the Estuary, largely as mitigation for various projects, in an effort to maintain the population. The stocking program was stopped in 1992 due to concerns that the effort was adding predators which might eat the endangered winter-run chinook salmon (BDOC 1994).

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The decline in young bass is predominately due to a decreased survival rate during the first year of life. Increased mortality of striped bass eggs and larvae is due to increased entrainment losses at the CVP and SWP export facilities and at agricultural pumps in the Delta (DFG 1992b; DWR 1992).

Losses to export and entrainment are affected by freshwater diversion, specifically by the proportion of water diverted for export and within-Delta use (Jassby et al. 1994). Higher outflows move a higher percentage of eggs and larvae away from potential entrainment, while diversions lead to higher percentages of entrainment of eggs and embryos (SFEP 1992a). Higher outflows may also shift the entrapment zone to a location downstream of the Delta, where larval striped bass appear to survive better (DWR 1992).

Measurements, dating back to 1959, indicate that young striped bass survival increases in proportion to Delta outflow during April through July. There is also evidence that Delta outflow continues to influence bass survival through December. The DFG's statistical model for striped bass indicates that the survival of striped bass during their first year is directly correlated with the magnitudes of Delta outflow and State and Federal exports in the southern Delta, and that these first year conditions could determine subsequent abundance of adult bass (BDOC 1993). Besides reducing the likelihood of entrainment at diversions, higher outflows provide additional benefits for striped bass by increasing low salinity nursery habitat in Suisun Bay, increasing primary productivity (food supply), increasing turbidity (reduces predation on young), and diluting pollutants (SFEP 1992a).

Other factors contributed to the decline in abundance of striped bass are; food supply, competition with other species, toxicity, and illegal harvest.

3.5.3.4 Splittail

The splittail *(Pogonichthys macrolepidotus)*, or Sacramento splittail as it was formerly named, is a large minnow endemic to the Bay/Delta Estuary and San Joaquin Basin. It is presently proposed for listing under the Federal Endangered Species Act as a threatened species. Once found throughout low elevation lakes and rivers of the Central Valley, from Redding to Fresno, this native species is now confined to the lower reaches of the Sacramento and San Joaquin rivers, the Delta, Suisun and Napa marshes, and tributaries of north San Pablo Bay. Although the splittail is generally considered a freshwater species, the adults and sub-adults have an unusually high tolerance for saline waters for a member of the minnow family. Therefore, the splittail is often considered an estuarine species.

The splittail, which has a high reproductive capacity, can live 5–7 years and generally begin spawning at 1–2 years of age. Spawning, which is triggered by increasing water temperatures and day length, occurs over beds of submerged vegetation in slow-moving stretches of water, such as flooded terrestrial areas and dead-end sloughs. Year class strength has been highly variable over the last decade, with particularly strong year classes associated with seasonally flooded wetlands that provide optimum spawning and larval rearing habitat. Adults spawn from March through May in

sloughs of the Delta, Napa Marsh, Suisun Marsh and on the inundated floodplains of large rivers during wet years. Hatched larvae remain in shallow, weedy areas until they move to deeper offshore habitat later in the summer. Young splittail may occur in shallow and open waters of the Delta and San Pablo Bay, but they are particularly abundant in the northern and western Delta (DFG 1992c; DWR 1992).

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*) and opportunistically on earthworms, clams, insect larvae, and other invertebrates. They are preyed upon primarily by striped bass.

Population Trends

Population levels appear to fluctuate widely from year to year, but since 1980 splittail numbers have declined steadily, reaching their lowest recorded numbers in 1994. The overall decline in splittail numbers can be attributed to a variety of factors including: modification of spawning habitat, changed estuarine hydraulics, climatic variation, toxic substances, introduced species, predation, and exploitation (NHI 1992b). Splittail have disappeared from much of their native range because dams, diversions, and agricultural development have eliminated or drastically altered much of the lowland habitat these fish once occupied. Splittail foraging and spawning habitat has been lost due to land reclamation activities (CUWA 1994; DFG 1992c). The construction of levees where flood waters formerly inundated low lands has prevented the splittail from moving into habitat critical for its spawning and early life history.

Successful reproduction is strongly associated with high outflows preceding, during, and following spawning, as demonstrated by high correlations between abundance of splittail in the fall mid-water trawl survey and various monthly combinations of Delta outflow from the previous winter through early summer (DFG 1992b). The strong correlation of the abundance of young Sacramento splittail with freshwater outflows during the late winter and spring accounts, in part, for the observed decline in juvenile production during the recent drought period (NHI 1992b; DFG 1992b; Hanson 1994).

3.5.3.5 Reservoir Species

The reservoirs of the San Joaquin Basin have a wide variety of fish species (Table 3.5-1). Reservoir communities of fish are highly stratified by preferred habitat. In general, reservoirs are less productive per surface acre than lakes because their typically deep, steep-sloped basins and fluctuating water levels greatly limit habitat diversity.

The exact species composition in any given reservoir varies. Commonly introduced species include game fish such as largemouth bass, bluegill, black crappie and brown bullhead. Native species present may include Sacramento sucker, hitch, and tui chub. Hatchery strains of rainbow trout along with hatchery strains of chinook and kokanee salmon are often introduced into larger reservoirs.

Population Trends

Extensive draw down of reservoirs and fluctuating water levels are the primary causes of declines in reservoir fish species populations. Habitat quantity and quality are affected by reservoir operational practices during seasonal periods of irrigation, power generation, or reservoir recharge. However, reservoirs represent a highly managed ecosystem where naturally reproducing populations rarely exist and where most reservoir species populations are sustained by artificial means.

3.5.3.6 Delta Smelt

The delta smelt (*Hypomesus transpacificus*) is a small, short-lived, native fish which is found only in the Bay/Delta. Typical adults are nearly transparent and generally only 2–3 inches long. They formerly were one of the most abundant species in the Delta. Delta smelt tend to school in open waters adjacent to areas with aquatic vegetation (DWR 1992; SFEP 1992a). Delta smelt have been found as far upstream as Mossdale, on the San Joaquin River. Their normal downstream limit appears to be western Suisun Bay. Although, during periods of high outflow, they can be washed into San Pablo and San Francisco bays, they do not establish permanent populations there (SFEP 1992a). They usually inhabit the upper portion of the water column near the interface between intruding water from San Francisco Bay and water flowing out of the estuary (entrapment zone), where salinities range from 2 to 10 ppt (DFG 1992d).

Delta smelt typically live only one year and have low fecundity (SFEP 1992a). The location of delta smelt spawning varies from year to year, ranging from the lower San Joaquin and Sacramento rivers out to Suisun Marsh (DFG 1992d; USFWS 1994a). Though delta smelt larvae may be found almost anywhere in the Delta, they generally do not spawn in abundance in the southern Delta. Based on ongoing sampling programs, it appears that a significant portion of delta smelt spawning takes place in the northern and western Delta (DWR 1992).

The spawning season also varies from year to year and may occur from late winter (December) to early summer (July). In 1989 and 1990, peak spawning occurred in late-April and early-May (USFWS 1994a). The adhesive eggs descend through the water column and attach to submerged substrates such as tree roots, vegetation, and gravel (DFG 1992d). After hatching, the planktonic larvae are transported downstream to the entrapment zone where they feed on zooplankton (USFWS 1994b).

Population Trends

Information from independent data sets have demonstrated a dramatic decline in the delta smelt population, with particularly low levels since 1983 (DFG 1994). The exact timing of the decline is different in most of the sampling programs but falls between 1982 and 1985 (SFEP 1992a). The

delta smelt was listed as a Federal threatened species by the USFWS in March 1993 and as a State threatened species by the DFG in December 1993.

Declines in delta smelt have been attributed primarily to restricted habitat and increased entrainment losses at Delta export facilities and diversions (DWR 1992; SFEP 1992a; USFWS 1994b). Reductions in available habitat occur when the entrapment zone moves out of the productive shallows of Suisun Bay and into the channels of the lower Sacramento and San Joaquin rivers as a result of low Delta outflow. The movement of the entrapment zone to the river channels potentially decreases the amount of area that can be occupied by smelt, and may also result in decreased production of phytoplankton and zooplankton (SFEP 1992a). When low flows result in movement of the entrapment zone into the central Delta, the delta smelt become more vulnerable to entrainment by the pumps of the SWP and the CVP, as well as by local agricultural riparian pumps (DWR 1992; NHI 1992a; SFEP 1992a).

The decline in delta smelt coincides with increases in the proportion of water diverted upstream of and within the Delta in recent years. Since 1984, the proportion of the water diverted at the export pumps from October through March has been higher, and has stayed higher for longer periods of time, than during any previous period, including the severe 1976–1977 drought. In order to avoid the effects of reversed flows, it is believed that higher Delta outflows are needed during February-June to transport larval and juvenile delta smelt into low salinity, productive rearing habitat in Suisun Bay and Suisun Marsh (USFWS 1994a).

Other contributing factors to the decline in the delta smelt population include: the presence of toxic compounds in the water, displacement of native copepods by introduced species, invasion of the Bay/Delta Estuary by the Asian clam (*Potamocorbula amurensis*), predation, very high floodflows, and low spawning stock (DFG 1992d, SFEP 1992a, USFWS 1994a).

The 1995 U.S. Fish and Wildlife Service (USFWS) Biological Opinion on the delta smelt called for a variety of measures to protect this species, including an intensified sampling program for all life stages. These surveys provide data on the distribution of eggs, larvae, and adults so that action can be taken to help move the smelt away from the zone of pump influence in the central and southern Delta. In addition, limits have been set for incidental take of delta smelt at the pumps and Federal/State sampling programs. When excessive numbers of delta smelt are taken, export and sampling operations must be reduced to conform to agreed limits, as occurred in 1997. Investigations of the delta smelt population have continued, and the species remains listed as threatened by state and federal agencies.

3.5.3.7 Longfin Smelt

The longfin smelt (*Spirinchus thaleichthys*) is a small, planktivorous fish that is found in several Pacific Coast estuaries from San Francisco Bay to Prince William Sound, Alaska. Within California,

longfin smelt have been reported in Humboldt Bay and the mouth of the Eel River, but the largest population inhabits the Bay/Delta Estuary. Longfin smelt can tolerate salinities ranging from fresh water to sea water. Spawning occurs in fresh to brackish water over sandy-gravel substrates, rocks, or aquatic vegetation. In the Bay/Delta Estuary, the longfin smelt life cycle begins with spawning in the lower Sacramento and San Joaquin rivers, the Delta, and freshwater portions of Suisun Bay. Spawning may take place as early as November and extend into June, with the peak spawning period occurring from February to April.

The eggs are adhesive and, after hatching, the larvae are carried downstream by freshwater outflow to nursery areas in the lower Delta, and Suisun and San Pablo bays (Wang 1991; DFG 1992b). Longfin smelt form a gas bladder shortly after hatching which keeps them near the surface as they migrate downstream past the entrapment zone, and into the more saline waters of San Pablo and San Francisco bays. This is in contrast to the delta smelt, which does not form a gas bladder until several months after hatching. The lack of a gas bladder keeps delta smelt near the bottom and on the freshwater side of the entrapment zone. Adult longfin smelt are found mainly in Suisun, San Pablo, and San Francisco bays, although their distribution shifts upstream during years of low outflow.

Although both longfin and delta smelt spawn adhesive eggs in river channels of the eastern Delta, and have larvae that are carried to nursery areas by freshwater outflow, the two species differ substantially. Consistently, a measurable portion of the longfin smelt population survives into a second year. During the second year of life, they inhabit San Francisco Bay and, occasionally, the Gulf of the Farallones; thus, longfin smelt are often considered anadromous. Longfin smelt are also more broadly distributed throughout the Estuary and are found at higher salinities than are delta smelt.

Because longfin smelt seldom occur in fresh water except to spawn, but are widely dispersed in brackish waters of the Bay, their range formerly extended as far up into the Delta as salt water intruded. The easternmost catch of longfin smelt in fall mid-water trawl samples has been at Medford Island in the central Delta. Utilization of different water depth is a pronounced difference between the two species in their region of overlap in Suisun Bay.

The main food of longfin smelt is the opossum shrimp, *Neomysis mercedis*, although copepods and other crustaceans are important at times, especially to small fish. Longfin smelt, in turn, are eaten by a variety of predatory fishes, birds, and marine mammals.

Population Trends

Longfin smelt were once one of the most common fish in the Sacramento-San Joaquin estuary. Their abundance has fluctuated widely in the past, reaching their lowest levels during drought years but quickly recovering when adequate winter and spring flows were available. Since 1982, longfin smelt abundance has plummeted and remained at record low numbers. Their numbers also have

declined in relative abundance to other fishes, dropping from first or second in abundance in most trawl surveys during the 1960s and 1970s, to being seventh or eighth in abundance.

The potential causes of decline are multiple and synergistic including: reduction in outflows, entrainment losses to water diversions, climatic variation, toxic substances, predation, and introduced species. Though longfin smelt have declined significantly in the last two decades, a petition to list them under the Federal Endangered Species Act was rejected by the USFWS in 1994 (USFWS 1994b). Currently the longfin smelt is listed as a Federal and State species of special concern.

3.5.4 Summary

Aquatic resources in the San Joaquin River Basin and Delta are varied and form complex interactions of species assemblages and habitats. Water development projects, the introduction of non-native species, and the creation of dams and large reservoirs over the past century have dramatically altered the habitats and reduced the abundance and distribution of many fish species.

By characterizing the ecological habitats and the factors affecting the recovery of these species within the project area, the potential impacts of the project can be evaluated. Specific habitats, such as spawning, rearing, and those used for migration of anadromous species have been identified as being vital to the species of prime importance and those which are considered indicators of a functional ecosystem. Factors identified as manageable and that contribute to the overall ability of a species to recover include habitat restoration, streamflow, and water quality.

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3.6 LAND USES

This chapter describes existing land uses and related socioeconomic conditions in the San Joaquin Valley project area and vicinity with comparisons to other geographic areas as appropriate. The affected environment is the socioeconomic context in which the alternative actions to provide additional water for instream flows occurs. The primary issue for the subsequent impact analyses in Section 4.6 is the potential for the alternative actions to affect agricultural activity and land use. In this section, population data are presented for the counties and cities comprising the project area, including population density. Employment in the agricultural industry spotlights the significance of agriculture to the regional economy. This is followed by a discussion of land uses in the project area focusing on agriculture, the primary land use.

3.6.1 Socioeconomic Environment

The boundaries of 14 counties are partially or wholly within the entire San Joaquin River basin. Of these, seven contain the major facilities and irrigation districts associated with the no action, proposed action, and other alternative action; these are used to represent the San Joaquin River project area and vicinity. An eighth county, Calaveras, contains part of the New Melones and Tulloch Reservoirs because the Calaveras/Tuolumne county boundary runs through the reservoirs. Calaveras County is not included in the tables in this section because it covers an extensive area unrelated to the alternatives. Tuloumne County covers portions of these reservoirs and all of New Don Pedro Reservoir, while all of Lake McClure is located in Mariposa County.

The districts who are willing sellers have service areas that are located in the following counties (see Figure 3.1-1):

- Exchange Contractors Water Authority: Fresno, Merced, Madera, Stanislaus counties
- Oakdale Irrigation District: San Joaquin and Stanislaus counties
- South San Joaquin Irrigation District: San Joaquin County
- Modesto Irrigation District: Stanislaus County
- Turlock Irrigation District: Stanislaus and Merced counties
- Merced Irrigation District: Merced County

Either these seven counties or other geographic approximations of the project area are used to describe the affected rural environment, depending on the availability of information. The other geographic areas used are:

- Reclamation's San Joaquin River Region comprised of eight counties and used in the 1997 Draft PEIS on the CVPIA (USBR 1997d), and
- San Joaquin River Region as described in the 1998 Draft PEIS/EIR (CALFED 1998).

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These two regions are explained further in the text the first time each is used. For information on poverty and ethnicity, see Section 3.11, Environmental Justice.

3.6.1.1 Population

The total county population and recent growth in the San Joaquin River project area and vicinity (Table 3.6-1) document that growth for the area since the 1990 Census was 106,162 people or 5.2 percent, which is close to the rate of growth in the state as a whole. Both Fresno and Madera counties have higher growth rates, 6.7 percent and 6.8 percent respectively, which reflect more rapid urbanization here than in many other counties in California.

Table 3.6-1: POPULATION GROWTH, 1990-1998

County	Total Population* January 1, 1998	Total Population** April 1, 1990	Numerical Increase 1990 - 1998	Percent Increase 1990-1998
Fresno	786,800	737,289	49,511	6.7
Madera	114,300	107,004	7,296	6.8
Mariposa	16,150	15,772	378	2.4
Merced	204,400	194,407	9,993	5.1
San Joaquin	545,200	523,969	21,231	4.1
Stanislaus	427,600	410,870	16,730	3.9
Tuolumne	52,800	51,777	1,023	2.0
San Joaquin River Area	2,147,250	2,041,088	106,162	5.2
State	33,252,000	31,589,153	1,662,847	5.3

Sources:
***California Department of Finance, Demographic Research Unit, *City/County Population Estimates*, May 1998.**
****Hall and Gaquin, 1997 *City and County Extra*, pp. 66-67.**

The centers of municipal and industrial land use in the San Joaquin River project area and vicinity include the cities of Fresno, Stockton, Modesto, and Merced. The cities of Stockton and Tracy have grown recently, largely in response to job development and housing constraints in the nearby San Francisco Bay Area. Fresno continues to be the major municipal and industrial center of the San Joaquin Valley (USBR 1997d), and it contains 19 percent of the San Joaquin River Area's 1998 population. Table 3.6-2 contains the 1998 population totals for the major cities located within the seven San Joaquin River project area counties.

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Table 3.6-2: CITY POPULATIONS, 1998

City	County	Total Population January 1, 1998
Fresno	Fresno	411,600
Clovis	Fresno	67,700
Madera	Madera	36,350
Merced	Merced	62,100
Lodi	San Joaquin	55,700
Los Banos	Merced	21,400
Manteca	San Joaquin	47,100
Stockton	San Joaquin	241,100
Tracy	San Joaquin	47,550
Modesto	Stanislaus	182,700
Turlock	Stanislaus	50,900

Source: California Department of Finance, Demographic Research Unit, *City/County Population Estimates*, May 1998.

3.6.1.2 Population Density

Although the project area contains major cities (Table 3.6-2), it also contains substantial nonurbanized or rural land which reduces overall population density. The San Joaquin River area's population density rounded to the nearest person is 50 persons per square kilometer (sq km), which is 39 percent less dense than the state as a whole with 82 persons per sq km (Table 3.6-3). San Joaquin County's population density is the highest in part because the land area excludes portions in the Delta usually covered by water.

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Table 3.6-3: POPULATION DENSITY, 1998

County	Land Area (sq km)*	Total Population** January 1, 1998	Population Density (persons/sq km)
Fresno	15,445	786,800	51
Madera	5,539	114,300	21
Mariposa	3,759	16,150	4
Merced	4,996	204,400	41
San Joaquin	3,625	545,200	150
Stanislaus	3,871	427,600	110
Tuolumne	5,790	52,800	9
Total Region	43,025	2,147,250	50
State	403,970	33,252,000	82

Sources:
***Hall and Gaguin, *1997 County and City Extra*, pp. 2, 66.**
****California Department of Finance, Demographic Research Unit, *City/County Population Estimates*, May 1998.**

3.6.1.3 Employment

As reported by Reclamation in the Draft PEIS on the CVPIA, the San Joaquin River Region is comprised of eight counties: Calaveras, Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, and Tuolumne counties (USBR 1997d). This region is slightly larger than the San Joaquin River area project and vicinity discussed above which excludes Calaveras County (population 37,100 for January 1, 1998). Employment in the San Joaquin River Region is described in Technical Appendix, Volume 5 and summarized here (USBR 1997i).

In 1940, agriculture was the largest single employer out of the following industry sectors: agriculture, mining, construction, manufacturing, transportation/communications/utilities, trade, finance/insurance/real estate, services, and government. At that time, agricultural production provided 34.9 percent of total household employment in the region. By 1992, agricultural production provided only 8.3 percent of total wage and salary employment in the area or about 56,000 jobs. Currently, the largest proportions of wage and salary jobs in the region are in services, wholesale and retail trade, and government sectors, respectively (USBR 1997i).

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More recent data on agricultural wage and salary employment is available from the California Employment Development Department (EDD 1998). Table 3.6-4 presents the average employment during March 1996, with March used as a benchmark since agricultural employment peaks during the period May through September with short term and migrant labor. Total agricultural wage and salary employment in the seven county San Joaquin River area averaged 118,290 jobs or nearly 15 percent of all wage and salary jobs in the region. In contrast, only 3 percent of all the jobs in the state were in agriculture in 1996. About 25 percent of the state's farm employment of 408,300 is located in the San Joaquin River area. Wage and salary workers are all employees receiving compensation from agricultural employers, both production workers and other staff not involved in production.

Table 3.6-4: ANNUAL AVERAGE INDUSTRY EMPLOYMENT, MARCH 1996 BENCHMARK

County	Total Employment All Industries	Farm Employment		
		Total	Production	Services
Fresno	312,700	65,900	25,800	40,100
Madera	33,880	10,010	5,180	4,830
Mariposa	5,210	30	NA	NA
Merced	58,700	11,000	7,500	3,500
Stockton-Lodi MSA[1] (San Joaquin County)	179,500	16,000	10,600	5,400
Modesto MSA[1] (Stanislaus County)	143,000	15,200	8,800	6,400
Tuolumne	14,060	150	NA	NA
San Joaquin River Area	747,050	118,290	57,880	60,230
State	13,151,700	408,300	225,700	182,600

Source: EDD, *Annual Average Industry Employment, 1983-1996*, 1998.
NA = Data not available.
[1]1990 Census Metropolitan Statistical Area

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3.6.2 Land Uses

The following discussion of land uses refers to other geographic areas that approximate the San Joaquin River project area and vicinity. These areas are defined in the text as appropriate.

3.6.2.1 General Land Uses

Land use within the San Joaquin River Region (i.e., CALFED's San Joaquin and Tulare Lake hydrologic basins) consists largely of agriculture, particularly in the western portion of the San Joaquin River basin. The foothills of the Sierra Nevada range, located in the eastern portion of the basin is largely open space. Watershed lands, such as the Merced River watershed, contain forest resources at the higher elevations: ponderosa pine, sugar pine, Douglas fir, white fir, incense cedar, black cottonwood, black oak, broad-leaf maple, and California dogwood (Storer and Usinger 1963).

In 1990, urban land use was approximately 295,000 acres (CALFED 1998). Urban areas include the cities of Stockton, Modesto, Merced, and Tracy, as well as smaller communities such as Lodi, Galt, Madera, and Manteca. The western side of the region is sparsely populated. Small farming communities, all along Highway 33, provide services for farms and ranches in the area. CALFED reports that about 4,750,000 acres of important farmland were mapped in the San Joaquin River Region in 1994, excluding the legal Delta portion of San Joaquin County (CALFED 1998).

San Joaquin River

The San Joaquin River flows through an extensive area in the eastern San Joaquin Valley including the counties of San Joaquin, Stanislaus, Merced, and Fresno. In the upper reaches of the project area, it flows through San Luis and Kesterson National Wildlife Refuges. It runs though rural residential and agricultural areas until it enters the Delta near the community of Vernalis, below the confluence with the Stanislaus River.

Stanislaus River

Upstream of Knight's Ferry, the Stanislaus River is the boundary between Calaveras and Tuolumne counties which splits New Melones and Tulloch Reservoirs. Predominant land use within the Stanislaus County portion of the Stanislaus River watershed is agriculture. As the Stanislaus River passes through the city of Oakdale, land uses consist of urban uses including commercial and residential. In the San Joaquin County portion of the watershed, land uses are primarily agriculture and open space. The community of Ripon is located within the lower reaches of the watershed.

Tuolumne River

Land use in the Tuolumne River watershed is primarily agriculture. Urban land uses in the lower reaches of the Tuolumne River watershed include the city of Modesto and the communities of Waterford and Ceres.

Merced River

Land use in the Merced River watershed is primarily open space (foothill pasture) within the upper reaches, and agriculture in the lower reaches. A few rural communities are located within the watershed with the largest being the town of Livingston.

3.6.2.2 Agricultural Land Use

The San Joaquin River Region is located in Central Valley and includes the San Joaquin and the Tulare Lake hydrologic basins. Statistically, CALFED's San Joaquin River Region is comprised of the following counties: Fresno, Kern, King, Madera, Merced, 54 percent of San Joaquin, Stanislaus, and Tulare. The Tulare Lake area is in King County and is, therefore, within the San Joaquin River Region. This area is an important agricultural region for both California and the United States. California has one of the most diversified economies in the world, producing more than 250 crop and livestock commodities. The San Joaquin River Region encompasses approximately 64 percent of farmland in the Central Valley (CALFED 1998).

The importance of agricultural land in the San Joaquin River project area and vicinity (seven counties) is shown in Table 3.6-5 which provides information on land devoted to agriculture: land in farms, cropland, and irrigated acreage. The San Joaquin River area contains 5,391,000 acres of farmland as of 1992. This acreage represents nearly 51 percent of the total land area in the seven counties (10,631,331 total acres) and nearly 19 percent of the total farmland in California. Irrigated acreage in the San Joaquin River area was 2,511,000 acres, over 46 percent of the area's total farmland, which is substantially higher than the 26 percent irrigated farmland for the state.

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Table 3.6-5: AGRICULTURAL LAND AND IRRIGATED ACREAGE, 1992

County	Total Land in Farms (1,000 acres)	Total Cropland (1,000 acres)	Total Irrigated Acreage (1,000 acres)	Percent Irrigated Farmland
Fresno	1,775	1,208	999	56.3
Madera	749	322	276	36.8
Mariposa	206	17	1	0.5
Merced	979	534	428	54.6
San Joaquin	784	556	468	59.7
Stanislaus	760	372	334	43.9
Tuolumne	138	11	5	3.6
San Joaquin River Area	5,391	3,202	2,511	46.6
State Total	28,979	10,479	7,571	26.1

Source: Hall and Gaquin, *1997 City and County Extra*, pp 13, 74-75.

California leads all other states in the value of crops produced, and Central Valley crops, which account for about 10 percent of total U.S. market value of agricultural crops, are responsible for most of this production (USBR 1997d). In the San Joaquin River Region, fruit and nuts, vegetables and cotton account for approximately 50 percent, 20 percent, and 10 percent respectively of the total value of crop production (CALFED 1998).

Cotton is the number one crop in the CALFED San Joaquin River Region in terms of irrigated/harvested acres. It accounts for 25 percent of the region's total irrigated acres. Other important crops in the region are field crops (15 percent), orchards (13 percent), grapes (10 percent), and alfalfa (10 percent). Between 1986 and 1995, grapes and orchards together accounted for less than 25 percent of the total harvest acreage, but they produced about 50 percent of the total production value. Pasture, alfalfa, grains, and field crops produced less than 20 percent of total production value with more than 50 percent of total irrigated acres. Table 3.6-6 presents this irrigated acreage by crop category and the production value of that acreage (CALFED 1998).

Table 3.6-6: IRRIGATED ACRES AND PRODUCTION VALUE IN THE SAN JOAQUIN RIVER REGION, 1986 TO 1995

Crop Category	Irrigated Acres (1,000 acres)	Production Value (million dollars)
Pasture	290	34
Rice	527	374
Truck crops	51	54
Tomatoes	786	532
Alfalfa	18	12
Sugar beets	301	982
Field crops	180	433
Orchards	668	2,074
Grains	344	103
Grapes	507	1,681
Cotton	1,269	1,153
Subtropical orchards	221	973
Total	5,162	8,403

Source: CALFED, *Bay-Delta Draft Programmatic EIR/EIS*, 1998 pp. 8.1-10.

Agriculture in the CALFED San Joaquin River Region receives irrigation water from the CVP, the SWP, local water rights and water projects, and groundwater as shown in Table 3.6-7. Most of this water is delivered to farmers through irrigation districts and other water agencies (CALFED 1988). About 40 percent of irrigation water sources in the San Joaquin River Region are from local water rights or local water projects. CVP water provides 35 percent of total irrigation water uses, mostly to the Westlands Water District, which is south of the project area. The rest of the region's water is from the SWP and groundwater pumping (CALFED 1998).

Table 3.6-7: IRRIGATION APPLIED WATER USE IN THE SAN JOAQUIN RIVER REGION, 1985 TO 1990

Water Source	Thousands of acre-feet (TAF)
Local Surface Water	4,854
CVP Water	4,268
SWP Water	1,168
Local Groundwater	1,803
Total Water	12,093

Source: CALFED, *Bay-Delta Draft Programmatic EIR/EIS*, 1998, pp. 8.1-11.

Agriculture's importance as a land use is also reflected in data on the number and size of farms. According to CALFED, the number of farms in the San Joaquin River Region decreased from 28,742 in 1987 to 26,731 in 1992, partly due to the loss of farmland (439,000 acres) to industrial and urban uses, and partly due to the accumulation of farmland into fewer and larger farms. The average farm size increased from 351 to 361 acres (CALFED 1998). This resulted in an effective reduction of 4.35 percent of the total number of acres farmed.

3.7 CULTURAL RESOURCES

Cultural resources are defined as prehistoric and historic archeological sites, architectural properties (e.g., buildings, bridges, and structures), and traditional properties with significance to Native Americans. This definition includes historic properties as defined by the National Historic Preservation Act (NHPA). This chapter summarizes the prehistoric and historic resources which may exist in the project area within the San Joaquin River Region and in the downstream Sacramento-San Joaquin Delta. The ethnography of the native people in each region is described in each of the sections.

Prehistoric resource locations can often be predicted by environmental variables, such as water, food, and shelter, because prehistoric occupation and use of the surrounding environment was based primarily on subsistence needs. The prehistoric period in the project area and vicinity is generally agreed upon to begin with the Clovis Period. This period, which extended back more than 11,000 years before present (BP) is represented by the distinctive fluted spear points, called Clovis Points. The points were found on shores of extinct lakes in the San Joaquin Valley, indicating that the native population was composed primarily of hunters. Bones of extinct animals, such as mammoth, sloths, and camels, are found on the same surface as the Clovis Points.

Approximately 8,000 years BP the native populations had switched from hunting to seed gathering, evidenced by food grinding implements. Cultural patterns have become better defined in the last 3,000 years. As populations expanded and specialized adaptions to local resources were developed, the archeological record becomes more complex. Many sites in this period contain mortars and pestles, or are associated with bedrock mortars, which implies that acorns were used extensively. In addition, the range of subsistence resources that were used increased and exchange systems expanded. Well-made artifacts, such as charm stones and beads, indicate that this period demonstrated social stratification and craft specialization (USBR 1997d).

Many above ground historical sites have been identified in the project area. To predict the locations of some historical sites, an understanding of the national, regional, and local historical themes that have influenced historical settlement in California is needed.

Initial Euroamerican incursions began with the Spanish missionaries and soldiers who entered California from the south in 1769. This period is characterized by the establishment of missions and military presidios, the development of large tracts of land owned by the missions, and subjugation of the local native population for labor. With Mexico's independence from Spain in 1822, the mission period in California began to end. Large tracts of land were divided by government grants into large ranchos, often tens of thousands of acres or more. These large tracts often maintained large herds of cattle and horses, with agricultural development limited to small garden plots and vegetable-growing operations. In addition to the Spanish explorers and settlers, Russians and American explorers made forays into the region.

With the discovery of gold in the mid-1800s and the ensuing gold rush, development and improvement of a transportation system became a necessity in the region. Between 1850 and 1880, California saw the development of hundreds of primary wagon routes, the evolution of steamboat travel along major rivers, and the completion of numerous railroads. Logging in California paralleled the settlement as the new arrivals needed building materials for homes, businesses, and industries.

As settlements grew, agricultural enterprises became more common. Dry-farming practices predominated during the early years until the 1880s when large-scale irrigation systems were developed. The basis for the irrigation systems were the hydraulic mining conveyances. New crops were added to the grains obtained from dry-farming, such as vegetables, fruits, and nuts. The improvements to the transportation systems allowed the distribution of these new crops to the new settlements.

3.7.1 San Joaquin River Region

The San Joaquin River Region includes Fresno, Mariposa, San Joaquin, and Stanislaus counties, and parts of Calaveras, Merced, Madera, and Tuolumne counties. Agricultural developments in the region have destroyed many archeological sites. Remnants of sites do occur, but they have been highly disturbed.

3.7.1.1 Prehistoric Resources

Although early Holocene (10,000 to 12,000 years BP) people probably inhabited or passed through the west side of the San Joaquin River Basin region, few indications of their activities have been discovered, probably due to deep burial beneath accumulated silt. Evidence of prehistoric occupation of the Sierra Nevada foothills on the east side of the San Joaquin River goes back 9,500 years BP. Recent excavations have revealed details of occupation in the area since approximately 3300 B.C.

The chronological sequence derived from the excavation of San Luis Reservoir best describes the west side of the region, while the excavation of Buchanon Reservoir in Madera County describes the east side. Table 3.7-1 shows the chronology derived from the excavation sites on both sides of the San Joaquin River Region.

The majority of discovered prehistoric sites in the San Joaquin River Region are less than 500 years old. The high Sierra Nevada mountain area is typified by seasonal camps characterized by lithic scatters and few bedrock mortars. The valley/foothill transitional zone often includes sites with midden deposits, structural remains, and numerous bedrock mortars (USBR 1997j).

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Table 3.7-1: PREHISTORIC RESOURCE CHRONOLOGY OF THE SAN JOAQUIN RIVER REGION

West Side		
Period	**Dates**	**Characteristics**
Positas Complex	3300 to 2600 B.C.	Small shaped mortars, cylindrical pestles, milling stones, perforated flat cobbles, and spire-lopped olive snail (*Olivella* spp.) beads
Pacheco Complex	2600 B.C. to A.D. 300	Foliate bifaces, rectangular shell ornaments, thick rectangular *Olivella* beads in the early phase and spire-ground *Olivella* beads, perforated canine teeth, bone awls, whistles, grass saws, large stemmed and side-notched points, milling stones, mortars, and pestles in the later phase
Gonzaga Complex	A.D. 300 to 1000	Extended and flexed burials, bowl mortars, shaped pestles, squared and tapered-stem points, few bone awls, distinctive shell ornaments, and thin rectangular, split-punched, and oval *Olivella* beads
Panoche Complex	A.D. 1500 to 1850	Large circular structures (pits), flexed burials and primary and secondary cremations, varied mortars and pestles, bone awls, whistles, small side-notched points, clamshell disk beads, and other types of beads
East Side		
Period	**Dates**	**Characteristics**
Chowchilla Phase	300 BC to AD 550	Fish spears, large projectile points, milling stones, various shell beads and ornaments, atlatl darts, and extended and semi-extended burials with large quantities of grave goods
Raymond Phase	AD 300 to 1500	Milling stones, core tools, relative lack of *Olivella* beads, absence of abalone (*Haliotis* spp.) shell ornaments, small- to medium-sized projectile points, bedrock mortars, unshaped pestles, and flexed burials with few grave goods
Madera Phase	AD 1500 to 1850	Steatite disc beads and other steatite objects, small points, bedrock mortars, cobble pestles, various types of *Olivella* beads, imported brownware pottery, and flexed burials and cremations with a large quantity of artifacts

Source: USBR, *Draft PEIS, Technical Appendix Volume Six*, 1997.

Table 3.7-2 lists the prehistoric sites by county in the entire San Joaquin River Region and shows approximately what percentage of the county has been surveyed for cultural resources. In addition, information about the locations of the majority of prehistoric resources is included.

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Table 3.7-2: PREHISTORIC SITES BY COUNTY IN THE SAN JOAQUIN RIVER REGION

County	Total No. Recorded Sites	No. of Prehistoric Sites	Percentage of County Land Surveyed	Areas of High Density	Overall Amount of Significant Disturbance in the County
Calaveras	1,527	929	10-15	Stanislaus, N Fork Stanislaus, and Mokelumne rivers; creeks, ridge flats	Low
Fresno	2,891	2,603	5	San Joaquin, Kings, and S Fork Kings rivers; Fancher, White, Panoche, and Dinkey creeks; near Shaver, Huntington, and Millerton lakes, creeks, meadows, ridge flats	Low
Madera	2,074	2,043	1-2	Fresno, San Joaquin, and Chowchilla rivers; Willow Slough; near Millerton and Bass lakes; Crane Valley; near Devils Postpile National Monument; creeks, meadows, ridge flats	Low
Mariposa	1,264	856	5	Merced River; along creeks; in Yosemite National Park	Low
Merced	341	316	2	unknown	Low
San Joaquin	249	189	5	San Joaquin and Mokelumne rivers	Low to Moderate
Stanislaus	350	280	3	Stanislaus, Tuolumne, and San Joaquin rivers; along smaller creeks	Low
Tuolumne	3,540	unknown	10	Stanislaus and Tuolumne rivers; along creeks, ridge flats	Low

Source: USBR, *Draft PEIS, Technical Appendix Volume Six*, 1997.

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3.7.1.2 Historic Resources

Historically, the west side of the San Joaquin River Region was characterized by agricultural settlement. Historic resources include homesteads, economic/industrial facilities, commercial establishments, and government facilities. Due to their establishment during the agricultural development of the valley, numerous rural communities may contain sites and structures of historical significance (CALFED 1998).

The east side of the San Joaquin River Region was characterized by agricultural settlement as well but was also influenced by mining activities. Mining activities were related to the gold rush of the mid-1800s and the subsequent mining activities since the discovery of gold in the Sierra Nevada foothills. The economy of the east side has been based on mining, agriculture, and commercial services since the late 1800s. Historic resources related to the settlement of the east side include mining-related structures and features, railroad grades and associated features, dams and culverts, roads, refuse deposits, and architectural structures (CALFED 1998).

Table 3.7-3 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the San Joaquin River Region.

Table 3.7-3: HISTORIC RESOURCES BY COUNTY IN THE SAN JOAQUIN RIVER REGION

County	No. of Properties in the National Register of Historic Places	No. of California Historic Landmarks	No. of Sites in California Inventory of Historic Resources	No. of California Points of Historical Interest
Calaveras	13	42	56	4
Fresno (eastern portion)	32	7	33	12
Fresno (western portion)	2	1	9	2
Madera	1	0	10	6
Mariposa	29	8	15	0
Merced	12	5	13	7
San Joaquin	31	23	28	8
Stanislaus	17	5	12	7
Tuolumne	19	20	79	4
Total	156	111	255	50

Source: USBR, *Draft PEIS, Technical Appendix Volume Six*, 1997.

3.7.1.3 Ethnography

The San Joaquin River Region was inhabited primarily by the Yokuts, Miwok, and Monache Native American cultural groups. The Yokuts culture consists of three primary divisions: the southern San Joaquin Valley Yokuts, the northern San Joaquin Valley Yokuts, and the Foothill Yokuts. In general the Yokuts were seasonally mobile hunter-gatherers with semi-permanent villages. They traveled to temporary camps to exploit the food resources in other environmental zones. The Southern Valley groups relied more heavily on fish, waterfowl, tule roots, seeds, mussels, turtles, shellfish, and rabbits. The Northern Valley Yokuts relied heavily on acorns, along with salmon and other fish. The Foothill Yokuts' primary foods were deer, acorns, pine nuts, and other foothill zone foods.

The Miwok cultures include three primary divisions: the Coast Miwok, the Lake Miwok, and the Eastern Miwok. The Eastern Miwok included five separate groups (Bay, Plains, Northern Sierra, Central Sierra, and Southern Sierra) that ranged over the area from Walnut Creek and the Delta, the lower Mokelumne and Cosumnes rivers and the Sacramento River from Rio Vista to Freeport, the foothill and mountain areas of the upper Mokelumne and Calaveras river drainages, the upper Stanislaus and Tuolumne river drainages and the upper Merced and Chowchilla river drainages, respectively. In general, the Miwok were seasonally mobile hunter-gatherers with semi-permanent villages. Acorns were the staple food among all the groups. Other food sources included buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects.

The Monache, or Western Mono, consist of six separate groups. At least two of the Monache groups appear to be transitional between the Western Mono and Yokut and were bilingual. In general, the Monache lived on the west slopes of the Sierra Nevada, between 3,000 and 7,000 feet elevation. They ranged over a much wider area, including the eastern slopes of the Sierra. Monache groups were seasonally mobile hunter-gatherers. Acorns were their dietary staple and were collected in large quantities and stored for the winter in elevated granaries in the villages. The Monache also ate deer, bear, rodents, birds, insects, manzanita berries, seeds, honey, and fish.

Prior to Euroamerican contact, it is believed that the areas of the Monache and Yokuts were among the most heavily populated areas in California. It has been estimated that up to approximately 180 individuals per square mile may have inhabited this area. It is estimated that by 1910 only 6 to 9 percent of this number survived (USBR 1997j).

3.7.2 Sacramento-San Joaquin Delta

The majority of the Sacramento-San Joaquin Delta has not been surveyed for cultural resources. Most of the early archeological work in the region focused on prominent prehistoric mounds, during which time additional prehistoric sites were identified. Historic sites have been documented primarily during the past 20 to 30 years.

The cultural resource information for the Sacramento-San Joaquin Delta is not broken out as a separate region because the prehistoric and historic information is generally available by county. The resources for this region are summarized below.

3.7.2.1 Prehistoric Resources

Prehistoric sites which have been identified within the Sacramento-San Joaquin Delta include village sites, temporary campsites, milling-related activity sites, and lithic scatters. The prehistoric sites are not evenly distributed across the Delta Region, however. Although channel deposits, floodplains, and basins make up approximately 40 percent of the total acreage within the region, nearly 80 percent of the prehistoric sites are located within these landforms. Those landforms identified as mucks, organic soils, fans, basins, and terraces make up 25 percent of the delta region but contain less than 5 percent of the prehistoric sites. No prehistoric sites have been recorded in peat or peaty mucks. Former tidal wetlands may be sensitive for prehistoric resources where they contain sand dunes and mounds that have been occupied in prehistoric times.

The landscape of the Sacramento-San Joaquin Delta is radically different today than it was prior to farmland reclamation. Reconstructed watercourses, areas subject to tidal influence, and other surface geology features were used as a basis for generating a predictive model of prehistoric settlement patterns in the south Delta region. Further mapping of extinct watercourses can assist in defining areas of prehistoric site sensitivity (USBR 1997j).

Excavators working in the Stockton area from 1893 to the early 1930s provided the groundwork for the three-phase chronological sequence of the prehistoric period, which was the first system used for central California. The three cultural levels were identified as early, intermediate, and recent and were based on artifacts and burial orientation and condition. Subsequent archeological research has refined this taxonomic system to where it is now based on cultural patterns which may extend across one or more regions, characterized by particular skills, particular economic modes, and by particular mortuary and ceremonial practices.

Little is known of human occupation of the lower Sacramento Valley prior to 4500 BP. Because of rapid alluvial and colluvial deposition in the valley over the past 10,000 years, ancient cultural deposits have been deeply buried in many areas. The earliest evidence of widespread occupation of the Sacramento-San Joaquin Delta region comes from several sites assigned to the Windmiller Pattern. The next phase was the Berkeley Pattern, followed by the Augustine Pattern. Table 3.7-4 details the three periods.

Table 3.7-4: PREHISTORIC RESOURCE CHRONOLOGY OF THE SACRAMENTO-SAN JOAQUIN DELTA

Period	Dates	Characteristics
Windmiller Pattern (formerly Early Horizon)	4500 to 2500 BC	Sites on low rises or knolls in floodplains of major creeks or rivers; abundant grave goods and bodies in ventral position; large projectile points, clay net sinkers, bone fish hooks and spears, and abundant faunal remains; charm stones, quartz crystals, bone awls and needles, *Haliotis* and *Olivella* shell beads and ornaments
Berkeley Pattern (formerly Middle Horizon)	2500 to 1500 BC	Deep midden deposits; abundance of milling slabs, mortars, and pestles; distinct projectile points and faunal remains; quartz crystals, charm stones, projectile point styles, shell beads, ornaments, bone tools; steatite beads, tubes and ear ornaments, slate pendants, flexed burials with variable orientation or cremations and fewer grave goods
Augustine Pattern (formerly Late Horizon)	1500 to 100 BC	Intensified hunting, fishing, and gathering; large, dense populations, highly developed trade networks; elaborate ceremonial and mortuary practices; social stratification; shaped mortars and pestles, bone awls for basketry, bone whistles and stone pipes, clay effigies, bow and arrows, pottery; flexed burials with variable orientation and generally lacked grave goods

Source: USBR, *Draft PEIS, Technical Appendix Volume Six*, 1997.

Due to the long history of agricultural use, it is unlikely that intact surface or shallow subsurface deposits exist. Subsurface deposits may exist below the plow zone or capped beneath pavement or structures. Surface deposits may exist in areas relatively unaffected by development or agriculture (CALFED 1998).

3.7.2.2 Historic Resources

Potential historic resources in the Sacramento-San Joaquin Delta are largely related to agriculture. Other resources are also present, including farmsteads, labor camps, landings for the shipment of agricultural produce, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Labor camps generally consist of at least one wooden bunkhouse or boarding house, a dining hall, a cookhouse, a washroom, and associated buildings. Landings are not elaborate and may consist of a few pilings.

At least 171 sites within the Sacramento-San Joaquin Delta have been listed in the NRHP as individual properties or as districts. Six sites in the region have also been listed as California Historical Landmarks and four are listed as California Points of Historical Interest. Forty known historic sites coincide with prehistoric sites.

Due to the extensive use of the land in historic times, architectural resources are likely to occur throughout the region. However, much of the region is still used for agricultural purposes, and the ground surface is regularly plowed, raked, or tilled (CALFED 1998).

3.7.2.3 Ethnography

The ethnography of the Sacramento-San Joaquin Delta included the Northern Valley Yokuts and Bay Miwoks, which are described above in Section 3.7.1.3, and the Patwin, described here. Most of the western side of the Sacramento Valley north of Suisun Bay was inhabited by Wintun-speaking people at the time of the first Euroamerican contact. The southernmost membership of this population was the Patwin, which held an extensive region west of the Sacramento River from the town of Princeton in the north to Benicia in the south.

Despite their extensive territorial range, relatively little in known of the Patwin culture. The information that does exist about the southern half of the Patwin people has been extrapolated largely from the Patwin peoples to the north. Patwin settlements tended to be located on high ground, along the Sacramento River or tributary streams, such as Cache, Putah, and Ulatis creeks, and in numerous valleys nestled along the eastern side of the Coast Range. Several major settlements, such as the villages of Aguasto and Suisun, were located near the marshy environment of the San Pablo and Suisun bays. The extensive plains to the north and northeast were used primarily for temporary camps, because there was little available firewood and in spring and summer these areas were insect-infested and contained only small quantities of easily obtained food.

Several of the major settlements were very populous and may have contained more than 1,000 people. However, temporary settlements and camps varied in size. Typically, the Patwin settlements ranged from only several residential structures to permanently occupied villages with numerous circular pit houses.

The Sacramento-San Joaquin Delta provided many resources, including an abundant fishery, a wide variety of plant foods, and plenty of game, including tule elk, antelope, and waterfowl. The seasonal availability of these food resources determined the gathering schedule for the Patwins.

The growth of the missions in California significantly impacted the Patwins. Missions Delores, San Jose, and later Sonoma all had potential recruits from the Patwin population. Residents of the village of Aguasots were taken to Mission Delores as early as 1800. The introduction of measles and smallpox significantly reduced the number of Patwins, and the further onslaught of Euroamericans and the gold rush of 1849 decided the fate of the Patwin culture. Early ethnographic surveys of the state in 1871-1872 stated that the Patwin culture no longer existed (USBR 1997j).

3.8 RECREATION

Lakes and rivers have always been a primary focus for outdoor recreation activities in California. Recreational opportunities in the Central Valley have been shaped by the construction of large reservoirs and the alteration of major rivers in addition to the opportunities provided at natural water bodies, streams, and rivers. Many outdoor recreation activities are water dependent or water enhanced. Such activities include boating, fishing, swimming, camping, picnicking, hunting, and wildlife observation. Recreation facilities, such as beaches, boat ramps, trails, restrooms, access roads, picnic areas, and camping facilities, add to the quality of the recreation experience.

The way that a reservoir is operated and water levels are managed directly affects the quality and economic value of recreational activities. Changes in a reservoir's water levels, due to drought or excessive demands, can reduce recreational opportunities and the associated benefits. Receding water levels and reduced water surface area make boat ramps less accessible and leave recreation facilities farther from the shorelines. However, decreased recreation benefits at drawn-down reservoirs may be offset to some extent by increases in river recreation benefits downstream from the affected reservoirs. Whether the reservoir is operated as a water supply or a hydroelectric generating facility can affect recreational opportunities. Hydroelectric generating facilities can have varying impacts on both reservoir and river recreation depending on whether the operation is constant or subject to peaking.

Rivers also provide recreation opportunities, such as boating, fishing, swimming, and white-water sports. Many rivers are unimpaired by water impoundment facilities and provide seasonal recreation opportunities. Other streams, with flows controlled by reservoir releases, offer opportunities to enhance downstream flows that can benefit recreation values. Streams that would run only intermittently, for example, can have year-round flows following reservoir construction and operation. This kind of conversion can develop new fisheries, add to recreational-area attractiveness, and enhance wildlife habitat.

Many wildlife refuges in California have benefitted from the existence of imported water. Seasonal wetland habitat at refuges and at private hunting clubs is integral to the maintenance of waterfowl populations along the Pacific Flyway. Historically, recreation values associated with such wildlife have focused primarily on hunting, but more recently, bird watching has become increasingly popular as a recreation opportunity.

Descriptions of the environmental setting for recreation opportunities at both reservoirs and rivers follow. The primary region that would be affected by the proposed project and other alternative is the San Joaquin River Basin; the Sacramento-San Joaquin Delta could be affected indirectly.

3.8.1 San Joaquin River Basin

Reservoirs with recreation use in the project area and vicinity are described in Table 3.8-1 and in the paragraphs below.

Table 3.8-1: RESERVOIRS WITH RECREATION USE

	New Melones Reservoir (CVP)	New Don Pedro Reservoir (MID/TID)	Lake McClure (Merced ID)	San Luis Reservoir (CVP/SWP)
Maximum Storage (AF)	2,420,000	2,030,000	1,024,600	2,039,000
Maximum Pool Elevation (Ft above msl)	1,088	830	867	544
Maximum Surface Area (Acres)	3,600	13,000	7,100	12,700

3.8.1.1 Reservoirs

Recreation opportunities have been shaped substantially by the construction of reservoirs on the San Joaquin River and its tributaries. The reservoirs include San Luis Reservoir, New Melones Reservoir, Lake McClure, and New Don Pedro Reservoir.

San Luis Reservoir

The San Luis Reservoir State Recreation Area (SRA), owned by Reclamation and operated by the Department of Parks and Recreation (DPR), covers approximately 12,700 surface acres when full. San Luis Reservoir has approximately 65 miles of shoreline and a maximum pool elevation of 544 feet above msl (SWCRB 1997). The capacity of San Luis Reservoir is 2,039,000 acre-feet. It is not directly affected by the proposed project but is described here because it is located in the vicinity of the project area and provides recreation opportunities.

Water dependent opportunities at San Luis Reservoir include boating, waterskiing, and fishing. Boat access is provided in the southeastern portion of the reservoir at the Basalt area by a two-lane concrete boat ramp and boarding dock, and at the northwestern Dinosaur Point use area with a four-lane concrete boat ramp and boarding dock. There are no designated swimming areas at the reservoir. Water enhanced opportunities include picnicking, camping, hunting, and trail use activities. There are no designated lakeside beach areas at the reservoir.

Both boat and shore fishing occur at San Luis Reservoir with striped bass the primary game species. Fishing is usually of high quality from February through summer, with striped bass fishing best during winter and spring. San Luis Reservoir also supports black bass and catfish. Migratory waterfowl hunting is permitted on most of the reservoir approximately 300 feet from established reservoir and recreation facilities. Hunting for deer and wild pig is also allowed on the northwestern reservoir shoreline.

Use at San Luis Reservoir was an estimated 210,000 12-hour recreation visitor days (RVDs) in 1992. Recreation activities and number of users varies with the season, with approximately 77 percent of annual use between April and September. Most visitors come from the Bay/Delta region, followed by the San Joaquin Valley (USBR 1997h).

Recreation use is optimized at San Luis Reservoir at a maximum pool elevation of 544 feet above msl. Use of the Basalt area boat ramp becomes inconvenient at approximately 340 feet above msl but can be used on a limited basis. The boat ramp at Dinosaur Point can be used at the minimum reservoir pool but is difficult to access below 360 feet above msl. Swimming is not affected by the water level fluctuations because there are no designated swimming areas.

New Melones Reservoir

New Melones Reservoir is owned and operated by Reclamation and covers approximately 3,600 surface acres when full, has approximately 105 miles of shoreline, and a maximum pool elevation of 1,088 feet above msl (SWRCB 1997). The capacity of New Melones Reservoir is 2,420,000 acre-feet.

Water dependent opportunities at New Melones Reservoir include boating, waterskiing, swimming, and fishing. Boat access is provided on the north and east shores of the reservoir. There are three boat ramps (seven-lane) used for high, medium, and low reservoir levels at Glory Hole recreation area in the northwestern portion of the reservoir. In addition to the ramps, there is a concession-operated marina with berthing slips and three courtesy docks. The Tuttletown recreation area on the eastern shore features three seven-lane boat ramps used for variable reservoir levels and three courtesy docks. The Mark Twain, Parrot's Ferry, Camp Nine, and Old Town recreation areas are undeveloped and offer minimal facilities.

A developed beach area provides swimming opportunities at the Glory Hole recreation area. The designated beach and swimming area at Angels Arm recreation area is closed. Boating and waterskiing are popular throughout the main reservoir area.

Water-enhanced activities include picnicking and camping. Camping facilities are available at the Glory Hole and Tuttletown recreation areas.

Use at New Melones Reservoir totaled approximately 498,000 12-hour RVDs in 1992. The majority of the use is related to water-dependent activities, such as boating, waterskiing, and fishing. Camping is the most popular water-enhanced activity. Annual recreation use at New Melones Reservoir occurs mainly from April to late September. An estimated 95 percent of the visitors come from local counties in the San Joaquin Valley (USBR 1997h).

The optimal reservoir level for recreation use is at an elevation of approximately 950 to 980 feet above msl. All of the boat ramps except one at Glory Hole are inoperable at reservoir levels of 950 feet above msl. There is one boat ramp at Glory Hole which was designed to access the reservoir at elevations as low as 860 feet above msl. The marina at Glory Hole can be moved at different lake levels, but the marina closes when the elevation reaches 880 feet above msl. Other ramps at Mark Twain, Parrot's Ferry, and Old Town undeveloped recreation areas are old roads that can be used on a limited basis to an elevation of 850 feet above msl.

New Don Pedro Reservoir

New Don Pedro Reservoir is owned by MID and TID. Recreational activities are managed by the Lake Don Pedro Recreation Agency (USBR 1997h). New Don Pedro Reservoir covers approximately 13,000 surface acres when full, has approximately 160 miles of shoreline, and a maximum pool elevation of 830 feet above msl (SWRCB 1997). The capacity of New Don Pedro Reservoir is 2,030,000 acre-feet (TID 1998).

Water dependent opportunities at New Don Pedro Reservoir include boating, swimming, waterskiing, jet skiing, windsurfing, saiiing, houseboating, fishing, and boat-in camping. There are boat launch facilities at Fleming Meadows recreation area on the southern shoreline, Blue Oaks recreation area on the southwestern shoreline, and Moccasin Point recreation area on the northeastern arm of Moccasin Bay. In addition, there are two full service marinas with docks, boat slips, mooring areas and provisions located at Fleming Meadows and Moccasin Point recreation areas. In addition, there are 257 privately-owned house boats and 20 rental house boats based on New Don Pedro Reservoir under permit (Cornell 1997).

Boating and waterskiing occur throughout the reservoir. Swimming occurs mainly at the Fleming Meadows swimming lagoon, which is a 2-acre pool separated from the main reservoir. The lagoon has a maximum depth of 6 feet, picnic facilities, and a sandy beach area. Shore and boat fishing is mainly for bass, trout, salmon, crappie, bluegill, and catfish.

Water-enhanced activities include picnicking, camping, and sightseeing. There are a total of 550 camping sites at Fleming Meadows, Blue Oaks, and Moccasin Point recreation areas.

Use at New Don Pedro Reservoir totaled approximately 280,000 RVDs in 1992. The majority of the use is related to water-dependent activities, such as boating, waterskiing, and fishing. Camping is the most popular water-enhanced activity. Recreation use occurs mainly from May through September (84 percent) with some use from November to February (4 percent). The majority of visitors (38 percent) come from Santa Clara, Alameda, and San Joaquin counties, with other visitors (27 percent) coming locally from Stanislaus and Tuolumne counties (USBR 1997h).

Historical data shows a strong correlation between water levels measured in feet above msl and recreation use measured in visitor days at New Don Pedro Reservoir. The peak recreation period during the year is from May through August, and June 30 was selected as representative for the season for correlating trends. For the period 1975 through 1996, the mean reservoir elevation on June 30 annually was approximately 780 feet above msl. When the reservoir level exceeds the mean level, recreation use in visitor days exceeds the average for the 1975-1996 period, which is 368,900 RVDs (Cornell 1997).

The maximum reservoir level for recreation use is at an elevation of 830 feet above msl. The Fleming Meadows boat ramp ceases operation when the elevation drops to 600 feet above msl. Between 710 and 600 feet above msl, five ramps become unusable. The Moccasin Point boat ramp cannot be used below an elevation of 722 feet above msl, and the Blue Oaks ramp cannot be used at 726 feet above msl. The Fleming Meadows and Moccasin Point marina operations are limited at 600 and 630 feet above msl, respectively (SWRCB 1997).

In addition to losing boat ramp operations at lower reservoir levels, other changes occur which affect recreation use. Lower levels reduce the aesthetic appeal of the reservoir surroundings, may cause conflicts between water users as surface area of the reservoir declines, reduce the shoreline accessibility due to steeper banks, and expose hazards. An economic consideration related to recreation use of New Don Pedro Reservoir is the increased cost of maintenance of the hazard warning devices with lowered reservoir levels (Cornell 1997).

Lake McClure

Lake McClure is owned and operated by the Merced ID. Lake McClure covers approximately 7,100 surface acres when full, has approximately 80 miles of shoreline, and a maximum pool elevation of 867 feet above msl (SWRCB 1997). The capacity of Lake McClure is 1,024,600 acre-feet (http://www.mercedid.org/irrifac.htm).

Water dependent opportunities at Lake McClure include boating, sailing, waterskiing, jet skiing, swimming, and fishing. Boat access is provided at ramps located around the shoreline. There are three boat launch lanes at McClure Point, two boat ramps with a total of five lanes at Barrett Cove, a two-lane boat ramp at Horseshoe Bend, and a one-lane boat ramp at Bagby recreation area.

There are swimming lagoons at McClure Point, Barrett Cove, and Horseshoe Bend and marinas at McClure Point and Barrett Cove. Rainbow trout fishing occurs either on the shoreline or in boats and is enhanced by year-round fish planting. Bass fishing has also improved since the Florida largemouth bass was introduced. There are also black bass and bluegill in Lake McClure.

Water-enhanced activities include picnicking and camping. Camping facilities are available at McClure Point, Barrett Cove, Horseshoe Bend, and Bagby recreation areas.

Use at Lake McClure totaled approximately 606,000 12-hour RVDs in 1992. Day use activities accounted for most of the visitor days. Annual recreation use occurs largely between May and September. Most of the visitors originate from the following counties, listed from highest to least attendance: Santa Clara, Stanislaus, San Joaquin, Merced, Mariposa, Sacramento, Fresno, Madera, Tuolumne, and Calaveras (USBR 1997h).

Lake McClure boat ramps cease operation between 590 and 793 feet above msl. The ramp at Bagby is the first to close when the reservoir reaches an elevation of 793 feet above msl, followed by Horseshoe Bend at 758 feet above msl, McClure Point at 650 feet above msl, southern Barrett Cove ramp at 630 feet above msl, and northern Barrett Cove and Piney Creek, both at 590 feet above msl (SWRCB 1997).

3.8.1.2 Rivers

Construction and operation of the dams and reservoirs have substantially affected instream recreation uses below these structures. Sport fisheries in rivers below major lakes and reservoirs have declined. The rivers in the San Joaquin River Basin include the San Joaquin, Merced, Tuolumne, and Stanislaus rivers.

San Joaquin River

The San Joaquin River runs more than 250 miles from Millerton Lake to the Sacramento-San Joaquin Delta (Fults 1998, personal communication). Although there are no major public recreation features along this stretch, public access is available at several road and highway crossings. The river borders the San Luis National Wildlife Refuge and crosses the Fremont Ford State Recreation Area in Merced County. Stanislaus County recreation facilities include the Las Palmas fishing access site, Laird County Park, and numerous public access points. Recreation facilities in San Joaquin County include Durham Ferry SRA, Mossdale Landing County Park, Dos Reis County Park, and numerous public road crossings. Stockton has three recreational facilities on the Stockton Deep Water Channel, and the Buckley Cove Marina is located on the San Joaquin River east of Stockton.

Summer flows in the San Joaquin River below Millerton Lake average from 480 cfs in critically dry years to over 2,600 cfs in wet years (using Reclamation's model). Water dependent activities include fishing and boating. Fish species in this stretch of the San Joaquin River include catfish and smallmouth bass. Water enhanced activities include a minor amount of picnicking.

Recreation use estimates for the entire lower San Joaquin River are not available from a single source because the use is dispersed across 250 miles and five counties. Based on information from recreation sites on the river, boating and fishing activities on the river are estimated to total 157,000 6-hour RVDs. Most of the use is assumed to come from the local counties (USBR 1997h).

Stanislaus River

The Stanislaus River runs 60 miles from New Melones Reservoir to its confluence with the San Joaquin River and crosses primarily private agricultural and grazing lands in Tuolumne, Stanislaus, and San Joaquin counties. There are a number of developed and undeveloped public parks along the lower Stanislaus River, including Caswell Memorial State Park, located approximately three miles upstream from the Stanislaus/San Joaquin confluence. There is also public access to the river at numerous road crossings. Below Goodwin Dam is access for a whitewater boating run that is rated advanced for the four-mile stretch from the Dam to Knights Ferry (SWRCB 1997).

Summer flows in the Stanislaus River below New Melones Reservoir average from 400 cfs in critically dry years to over 800 cfs in wet years (using Reclamation's model). Water dependent activities include fishing, swimming, and whitewater boating. Fish species in this stretch of the Stanislaus River include catfish, crappie, largemouth bass, and smallmouth bass. Water enhanced activities include picnicking and camping.

In 1992 the Corps of Engineers estimated that the use of the lower Stanislaus River below Goodwin Dam at 122,000 6-hour RVDs. Use of the recreational facilities on or near the Stanislaus River has increased substantially since 1980 because of increased park development along the river. Most of the parks attract local residents, but Caswell Memorial State Park is capable of attracting nonlocal visitors (USBR 1997h).

Tuolumne River

The Tuolumne River, from New Don Pedro Reservoir to its confluence with the San Joaquin River, is approximately 52 miles long. This reach traverses mainly private open space and grazing lands, City of Modesto property, and several public parks. Major recreational facilities include the La Grange County Regional Park on Yosemite Boulevard near La Grange, Turlock Lake SRA located on Lake Road between Turlock Lake and the river, Fox Grove Regional County Park near the Greer

Road/Albers Road crossing, two golf courses adjacent to the river near the SR 99 crossing, and the Shiloh fishing access site at the Shiloh Road crossing upstream of the confluence (SWRCB 1997).

Summer flows in the Tuolumne River below New Don Pedro Reservoir average from 120 cfs in critically dry years to over 1,300 cfs in wet years (using Reclamation's model). Water dependent activities include fishing, swimming, and rafting. The primary game fish in this stretch of the Tuolumne River is the chinook salmon. Water enhanced activities include picnicking and camping. Water-related recreation activities and wildlife viewing accounted for an estimated 150,000 6-hour RVDs in 1992. Most of the use is assumed to come from Stanislaus County (USBR 1997h).

Merced River

The reach of the Merced River below McSwain Dam is 50 miles long to its confluence with the San Joaquin River and crosses private agricultural and grazing land in Merced County. Major public recreation facilities include Henderson County Park on Merced Falls Road east of Snelling, McConnell SRA northeast of Livingston on SR 99, Hagaman County Park at the SR 165 river crossing, and George J. Hatfield SRA on Kelley Road near the San Joaquin River confluence. The county parks are primarily day-use facilities, while the State recreation areas provide both day-use and camping units (SWRCB 1997).

Summer flows in the Merced River below McSwain Dam average from 130 cfs in critically dry years to over 900 cfs in wet years (using Reclamation's model). Water dependent activities include some canoeing and rafting in the lower portion of the river. There is no swimming or other water contact activities allowed at either county park because there are no lifeguards. No boat ramps are provided at the county parks because the river is shallow due to the upstream diversions. Fish species in this stretch of the Merced River include catfish and smallmouth bass. Water enhanced activities include picnicking, camping, and softball.

Because recreation is dispersed along the 50-mile stretch of the Merced River, no formal recreation surveys have been conducted. Based on information from recreation sites on the river, water-related recreation activity on the river is estimated to total 73,000 6-hour RVDs. Most of the use is assumed to come from Merced County (USBR 1997h).

3.8.1.3 Conveyance Facilities

Fishing is popular along many of the canals in the area. Public access is provided on the California Aqueduct and the Delta-Mendota Canal.

California Aqueduct

The California Aqueduct is owned and operated by DWR. Fishing access is provided along much of the California Aqueduct. Most of the portion of the aqueduct that passes through the San Joaquin River region has walk-in access for fishing. There are 12 fishing access sites which provide parking and toilet facilities. In addition, there are 170 miles of bikeways along the aqueduct.

Several fish species exist in the aqueduct, including striped bass, largemouth bass, catfish, crappie, green sunfish, bluegill, and starry flounder. An estimated 61,000 visitor days were reported at the aqueduct for fishing purposes in 1991.

Delta-Mendota Canal

The Delta-Mendota Canal is owned by Reclamation and operated by the Fresno and Stanislaus County Parks and Recreation Department. Fishing access to the Delta-Mendota Canal is provided at Delta-Mendota Canal Site 2A in Stanislaus County and Delta-Mendota Canal Site 5 in Fresno County. There are parking areas and restrooms at both the Canal Site 2A and Canal Site 5, but there are no picnicking or camping facilities.

Fishing access to the Delta-Mendota Canal is limited to the developed access points. Fish species include both striped bass and catfish. An estimated 23,000 visitor days were recorded for the two fishing sites in 1992. The more popular site was Canal Site 5, which accounted for approximately 99 percent of the use in 1991. Most of the visitors to the canal originate in the local area (USBR 1997h).

3.8.1.4 Wildlife Refuges

Wildlife refuges in the San Joaquin River region include the San Luis and Merced National Wildlife Refuges (owned and operated by the U.S. Fish and Wildlife Service) and Los Banos Wildlife Management Area (owned and operated by the California Department of Fish and Game). Most recreation activities associated with wildlife refuges is associated with the presence of waterfowl and upland game birds.

All activities associated with wildlife refuges are water-enhanced. Activities include hunting, hiking, and wildlife observation. Hunting of ducks, geese, and pheasants are permitted between October in January in portions of each refuge. Fishing is permitted at San Luis National Wildlife Refuge only. Both national wildlife refuges provide self-guided tours, and camping is permitted at the staging areas during hunting season. Camping is not permitted at Los Banos Wildlife Managment Area.

In 1992, combined recreation use at the refuges totaled approximately 56,000 5-hour RVDs. The most popular activities have been nonconsumptive uses, such as wildlife viewing. An estimated 15 percent of the visitors to the refuges originate in the local area.

3.8.1.5 Private Hunting Clubs

There are approximately 176 private hunting clubs in the San Joaquin River Basin. These private clubs provide opportunities for hunting ducks, geese, and pheasants and encompass approximately 96,800 acres. Waterfowl hunting activity was estimated at 241,000 hunter days in 1992.

3.8.2 Sacramento-San Joaquin Delta

The Delta environment has been extensively altered over the past 125 years by construction of levees, land reclamation, and development. The Delta remains, however, a valuable and unique recreational asset due to the natural and aesthetic values still present. Waterfowl and wildlife are still abundant, sport fishing is still popular, and the vegetation and beaches lining the channels and islands are still attractive (SWRCB 1995b).

Water dependent activities in the Delta include motor boating, fishing, swimming, waterskiing, and sailing with motor boating and fishing leading in popularity. There are approximately 20 public and more than 100 commercial recreational facilities in the Delta that provide rentals, services, camping guest docks, fuel, supplies, and food. Sport fishing in the Delta occurs year-round and may take place on private vessels or from shore. Popular sport fishing species include striped bass, white sturgeon, salmon, American shad, catfish, and largemouth bass (SWRCB 1997).

Recent trends in the striped bass fishery indicate a substantial decline in harvest rates between 1983 and 1990. Although exact sport catch data for white sturgeon are not available, the estimated catch rate for sturgeon has increased 40 percent over the last two decades. Fishing for sturgeon has become more popular, especially with the decline in other game fish, such as striped bass. Few salmon are harvested in the sport fishery in the Bay/Delta Region. Angler effort was estimated at 0.8 percent of total sport fishing effort for the period between July 1990 and June 1991 when an estimated 34 fish were caught. The estimated effort was 4.9 percent of total sport fishing effort for the period between July 1991 and June 1992 when an estimated 1,860 salmon were caught. A comparison of recent catch data and data collected in the 1970s suggests that the American shad sport fishery in the Bay/Delta Region has remained stable (USBR 1997h).

Water enhanced activities in the Delta include overnight camping, picnicking, photography, bicycling, hunting, and wildlife observation. There are numerous private waterfowl and pheasant hunting clubs in the Delta region.

Overall recreation use in the Bay/Delta region has increased substantially since 1963 when it was estimated at approximately 2.4 million visitor days. By 1987, annual recreation use had reached an estimated 7 million visitor days (USBR 1997h). Visitor use in the Delta was estimated by DWR to be 12 million visitor days in 1993 (SWRCB 1997). The most important activity in the region is boating (not including fishing), followed by fishing, relaxing, sightseeing, and camping. An estimated 77 percent of recreationists in the Bay/Delta region originate from the local area (USBR 1997h).

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3.9 ENERGY RESOURCES

Energy resources in the project area consist of hydroelectric power generation. Hydroelectric power generation plants provide approximately 24 percent of California's electrical generation capacity. The Central Valley Project hydropower system provides a significant portion of the available energy to the San Joaquin Valley. The CVP system of power plants and pumping plants has an installed capacity of 749,000 kilowatts. Most of the power that is generated from the CVP system is used to operate CVP pumping plants or is sold to public agencies.

The major storage reservoirs that supply water for hydroelectric power generation located in the project area are New Melones, Tulloch, New Don Pedro, and Lake McClure. Hydroelectric power generation facilities located downstream of these reservoirs include the New Melones and Tulloch projects on the Stanislaus River, the New Don Pedro Project located on the Tuolumne River, and the Exchequer, McSwain, and Merced Falls projects located on the Merced River.

3.9.1 New Melones and Tulloch Projects

The New Melones Project is located in Calaveras and Tuolumne counties on the Stanislaus River. It is part of the CVP hydropower system that is owned and operated by Reclamation. Project facilities include: New Melones Reservoir, New Melones Dam and powerhouse. The Tulloch Project is located in Calaveras and Tuolumne counties on the Stanislaus River downstream of the New Melones Project, and it is owned and operated by OID and SSJID. Project facilities include: Tulloch Reservoir and powerhouse. Table 3.9-1 describes the project facilities associated with the New Melones and Tulloch projects.

Table 3.9-1: HYDROELECTRIC POWER FACILITIES LOCATED ON THE STANISLAUS RIVER

Reservoir/Powerhouse	Total Storage Capacity (1,000 ac-ft)	Hydropower capacity (MW)	Estimated Average Annual Generation (1,000 KWH)
New Melones Reservoir and Powerhouse	2,420.0	300	385,000
Tulloch Reservoir and Powerhouse	56.0	17	93,000

Source: Federal Energy Regulatory Commission. *Hydroelectric Power Resources of the United States, Developed and Undeveloped*, 1992.

3.9.2 New Don Pedro Project

The New Don Pedro Project (NDPP) is located at the western edge of Tuolumne County on the Tuolumne River. It is owned and operated jointly by MID and TID. The NDPP consists of the New Don Pedro Dam, Don Pedro Reservoir, and the New Don Pedro Powerhouse (FERC 1996). MID

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and TID own 31.54 percent and 68.46 percent respectively of the New Don Pedro hydroelectric plant. This equates to approximately 63 MW and 136.2 MW of the power produced. In addition to providing water, flood control, and recreational opportunities, the NDPP system produces hydropower. There are four dams and associated powerhouses in the system, described in Table 3.9-2.

Table 3.9-2: HYDROELECTRIC POWER FACILITIES LOCATED ON THE TUOLUMNE RIVER

Reservoir/Powerhouse	Total Storage Capacity (1,000 ac-ft)	Hydropower capacity (MW)	Estimated Average Generation (1,000 Kilowatt hours)
New Don Pedro Reservoir and Powerhouse (TID and MID)	2,030.0	199.2	618,400
La Grange Reservoir and Auxiliary Powerhouse (TID)	0.5	4.0	18,000
Turlock Lake and Powerhouse (TID)	48.0	3.3	not available
Modesto Reservoir and Powerhouse (MID)	28.0	1.1	not available

Source: Federal Energy Regulatory Commission. *Reservoir Release Requirements for Fish at the New Don Pedro Project, California, Final Environmental Impact Statement*, 1996, pg 2-2.

Reservoir operations at NDPP are controlled by various agreements between CCSF, MID and TID, the COE, and CDFG as well as FERC license articles. The NDPP has a minimum flow requirements schedule below New Don Pedro Dam in order to protect fishery resources.

3.9.3 Exchequer, McSwain, and Merced Falls Projects

The Exchequer, McSwain, and Merced Falls projects (Table 3.9-3) are located downstream of Lake McClure on the Merced River in Mariposa County. The Exchequer and McSwain project are owned and operated by Merced ID. The Merced Falls project is owned by PG&E. Both the Exchequer and McSwain projects include storage facilities, but the Merced Falls project does not.

Table 3.9-3: HYDROELECTRIC POWER FACILITIES LOCATED ON THE MERCED RIVER

Reservoir/Powerhouse	Total Storage Capacity (1,000 ac-ft)	Hydropower capacity (MW)	Estimated Average Generation (1,000 Kilowatt hours)
Lake McClure and Exchequer Powerhouse	1,024.6	80.1	316,000
Lake McSwain and McSwain Powerhouse	9.2	9.0	45,000
Merced Falls Powerhouse	none	3.4	19,100

Source: Federal Energy Regulatory Commission, *Hydroelectric Power Resources of the United States, Developed and Undeveloped*, 1992.

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3.10 INDIAN TRUST ASSETS

Although there is no concise legal definition of Indian Trust Assets (ITA), the courts have traditionally interpreted them as being tied to real property. ITAs are property interests held in trust by the United States for the benefit of Indian tribes or individuals. Indian reservations, rancherias, and public domain allotments are common ITAs. The land associated with these ITAs, as well as the resources within the boundaries, such as trees, minerals, oil, and gas, are also considered trust assets. Other ITAs include traditional-use areas and fishery resources. Hunting and fishing rights may be ITAs, although under P.L. 280 fishing and hunting are regulated by the California Department of Fish and Game, both on and off reservations (CALFED 1998).

Types of actions which could affect ITAs include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts to fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely impacts uses of the reserved land (USBR 1997d).

3.10.1 San Joaquin River Region

The San Joaquin River Region includes Fresno, Mariposa, San Joaquin, and Stanislaus counties, and parts of Calaveras, Merced, Madera, and Tuolumne counties. Approximately 11 reservations or rancherias are located in the counties that make up this region, although some of these reservations fall outside the region. There are also an unknown number of public domain allotments within the region. Each reservation, rancheria, or allotment represents an ITA unless they have been dropped from trust status.

The Monache, which are one of the native cultures in this region, have several places of mythical importance in the region. Table Mountain near Friant was thought to be visited by mythical beings. Burial or cremation sites may also exist within the San Joaquin River Region (CALFED 1998).

3.10.2 Sacramento-San Joaquin Delta

No reservations or rancherias are located in the Sacramento-San Joaquin Delta. It is unlikely that there are any public domain allotments located within this region. There are no traditional properties or sacred sites in the area; however, several burial and cremation sites have been discovered (CALFED 1998).

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3.11 ENVIRONMENTAL JUSTICE

Presidential Executive Orders constitute a form of high level federal regulation. Executive Orders have been utilized to address a number of environmental related problems such as wetlands. Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority populations and low-income populations of the United States. EPA's Office of Environmental Justice offers the following definition:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies* (EPA 1997).

This section provides baseline demographic information used in the subsequent analyses of environmental justice impacts (Section 4.11).

3.11.1 Race and Ethnicity

The minority population in the San Joaquin River project area and vicinity is based on an analysis of race and ethnicity population data from the 1990 Census of Population and Housing for seven counties that approximate the area of potential impact from the proposed action and alternative action. Population data are summarized by five racial categories: White, Black, American Indian/Eskimo/Aleut, Asian and Pacific Islander, and Other (Table 3.11-1). These categories as used in the 1990 Census relied on self-identification by respondents to racial/ethnic categories. Persons of Hispanic origin may be of any race, so this ethnic category is summarized separately.

In comparison to the California state demographics, the San Joaquin River Area is proportionately higher in Hispanic population (28.1 percent). Racially, the area contains greater percentages of whites (71.1 percent) and other races (15.2 percent) than does the state (69.0 percent and 13.2 percent, respectively). The Hispanic population in the San Joaquin River area is concentrated in Fresno, Madera, and Merced counties (Table 3.11-1). Native Americans (American Indians) represent 1.1 percent of the area's population, and are proportionately higher in Madera, Mariposa, and Tuolumne counties. Both the Black and Asian/Pacific Islander populations are under-represented in the San Joaquin River Area in comparison to the state.

Table 3.11-1: POPULATION BY RACE AND ETHNICITY, 1990

County	Total Persons, April 1, 1990	Race (Percent) White	Black	Amer. Indian, Eskimo, Aleut	Asian/Pacific Islander	Other	Percent Hispanic
Fresno	667,490	63.3	5.0	1.1	8.6	22.0	35.0
Madera	88,090	71.9	2.8	1.6	1.4	22.2	34.5
Mariposa	14,302	92.4	0.9	4.5	0.9	1.3	4.9
Merced	178,403	67.4	4.8	0.8	8.5	18.5	32.6
San Joaquin	480,628	73.5	5.6	1.1	12.4	7.4	23.4
Stanislaus	370,522	80.2	1.7	1.1	5.2	11.7	21.8
Tuolumne	48,456	90.4	3.2	2.0	0.8	3.6	7.7
San Joaquin River Area*	1,847,891	71.1	4.3	1.1	8.3	15.2	28.1
State	29,758,213	69.0	7.4	0.8	9.6	13.2	25.8

* Calculated from county percent distributions.

Source: Hall and Gaquin, *1997 County and City Extra*, pp. 52, 66.

3.11.2 Low Income

Low income populations in the San Joaquin River Area are identified by several socioeconomic characteristics of the population residing in the area. As categorized by the 1990 Census (and updated by the U.S. Bureau of Census, 1995), specific characteristics used in this description of the existing environment are: per capita income, persons below the poverty level, families below the poverty level, substandard housing, and unemployment rates (Table 3.11-2).

Income and poverty, based on income in 1989 as reported in the 1990 Census, illustrates that the San Joaquin River area counties' per capita and median household incomes are all lower than the averages for the state (Table 3.11-2). Merced County had the lowest per capita income, only $10,606; and Mariposa County had the lowest household income, only $25,272 (1989 dollars). Similar results are found for the percentages of persons and families living below the poverty level. Poverty status is based on the definition prescribed by the Federal Office of Management and Budget. Families and persons are below the poverty level if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children present under age 18 years. For persons not in families, poverty status is determined by their income in relation to the appropriate poverty threshold. For example, the 1989 poverty threshold for one person under age 65 was $6,451; for a family of four persons it was $12,674; and for a family of eight persons it was $21,328 (Hall and Gaquin 1997).

Table 3.11-2. INCOME AND POVERTY, 1989

County	Money Income 1989 $		Percent Below Poverty Level	
	Per Capita	Median Household	All Persons	Families
Fresno	11,824	26,377	21.4	16.8
Madera	10,856	27,370	17.5	13.1
Mariposa	13,074	25,272	12.7	10.7
Merced	10,606	25,548	19.9	15.4
San Joaquin	12,705	30,635	15.7	12.0
Stanislaus	12,731	29,793	14.1	11.4
Tuolumne	13,224	27,030	9.1	6.9
San Joaquin River Area	NA	NA	NA	NA
State	16.409	35,798	11.7	8.6

NA=Not Available. Averages and percentages were given and are not additive.
Source: Hall and Gaquin, *1997 County and City Extra*, Table B, pp. 55,69.

Other measures of low income, such as substandard housing and unemployment, also characterize demographic data in relation to environmental justice (Table 3.11-3). Substandard housing units are occupied units which are overcrowded (1.01 persons or more per room) or lack complete plumbing facilities. The San Joaquin River Area counties of Fresno and Merced have higher percentages of substandard housing, 13.7 percent and 15.6 percent, than does the state. The civilian labor force is comprised of civilians 16 years old and older who were either "at work" or "with a job, but not at work" during the reference week. It includes those who worked 15 hours or more as unpaid workers in a family farm or business. The San Joaquin River Area's unemployment rate in 1995 was 14.1 percent, significantly higher than the state unemployment rate of 10.8 percent. The highest unemployment rate was in Merced County (16.9 percent) followed by Stanislaus (15.3 percent) and Madera (15.1 percent) counties.

Table 3.11-3: HOUSING, LABOR FORCE, AND EMPLOYMENT, 1990 AND 1995

	Housing Units 1990		Civilian Labor Force 1995	
County	Total	Percent Substandard	Total	Unemployment Rate (percent)
Fresno	235,563	13.7	371,805	14.1
Madera	30,831	12.0	50,516	15.1
Mariposa	7,700	5.0	7,447	9.4
Merced	58,410	15.6	84,726	16.9
San Joaquin	166,274	12.4	242,880	12.3
Stanislaus	132,027	10.4	193,963	15.3
Tuolumne	25,175	4.5	20,522	10.8
San Joaquin River Area*	655,980	12.3	971,859	14.1
State	11,182,882	12.0	15,415,475	10.8

*Calculated from county percentage distributions.
Source: Hall and Gaquin, *1997 County and City Extra*, pp. 58, 72.

4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

This chapter evaluates the environmental consequences of the no action, proposed action, and alternative action for each resource area and concern described in Chapter 3, Affected Environment. The proposed action of meeting flow objectives for the San Joaquin River system through the implementation of the San Joaquin River Agreement (SJRA alternative) is compared with the No Action alternative. Finally, the alternative action of the Water Right Priority System is discussed in comparison with no action. The terms "effects" and "impacts" are synonymous.

4.1 INTRODUCTION

4.1.1 Scope of Analysis

Chapter 3 described the environmental setting for the following environmental resources and concerns that were determined to be potentially affected by the alternatives:

- Surface Water
- Groundwater
- Terrestrial Resources (Vegetation and Wildlife)
- Aquatic Resources
- Land Use
- Cultural Resources
- Recreation
- Energy Resources
- Indian Trust Assets
- Environmental Justice

These resources are described in this action-specific or project EIS/EIR based on a 1998 Environmental Assessment/Initial Study (EA/IS) for a one-year water acquisition by the Bureau of Reclamation (Reclamation) from the San Joaquin River Group Authority's (Authority's) willing sellers (USBR 1997c). The 1998 EA/IS concluded that these concerns were appropriate for an in depth evaluation of additional stream flows in the San Joaquin River measured at Vernalis. The public scoping process for this focused EIS/EIR confirmed that resource issues were limited to these ten that meet NEPA and CEQA requirements (see Section 5.1). As a result, impacts on resources such as climate and air quality, soils and geology, noise, aesthetics, transportation/circulation, growth inducement, and public services are not evaluated based on a high probability of no impact. These resource areas are unlikely to be affected by an instream flow project that does not involve the construction of major new facilities. Should any of the willing sellers construct new canals or other facilities to store or convey water, these projects would be subject to independent NEPA/CEQA analyses.

4.1.2 Determination of Impact and Mitigation

The environmental consequences of the alternatives are classified into the following impact categories:

- **Significant.** Significant adverse environmental impacts are those that can be clearly identified as significant based on the criteria identified for each resource area. There is no mitigation available to reduce the impact to less than significant.

- **Potentially Significant.** Adverse impacts have been identified that have the potential to be significant. In the absence of sufficient information to determine that the potential impact is less than significant, the impact is treated as significant. Also, if the potentially significant impact cannot be mitigated to a less-than-significant level, then it is considered significant.

- **Less-Than-Significant.** This type of adverse impact is determined to be small or insignificant based on the criteria identified for each resource area. This type of environmental effect is usually short term or measurably small. It may or may not contribute to a cumulative impact over the long term.

- **No Impact.** Using the criteria for determining significance of impact, this category means that no adverse impact can be identified. There is no adverse physical or social change that can be determined based on available information.

- **Beneficial.** The environmental consequences are positive or otherwise beneficial to the resource. A beneficial impact may be further described as a significant beneficial impact when the magnitude of the positive effect is large.

This classification system is based on criteria contained in the CEQA Guidelines (OPR 1995) and others explained in the first section under each resource category. Both qualitative and quantitative thresholds of significance are used, depending on the resource and the availability of measurable standards.

Adverse and beneficial impacts can be direct (primary), indirect (secondary), short-term, long-term, and/or cumulative. Cumulative impacts are those that are not significant when considered alone but when combined with other similar actions may have a cumulative effect that is significant. Cumulative as well as unavoidable impacts, irreversible commitments of resources, and the relationship between short-term uses and long-term productivity are described in Chapter 4 in summary sections following the impact evaluations for each resource area.

Mitigation measures to reduce significant adverse impacts to a less-than-significant level are specific, feasible actions that will improve or mollify adverse conditions. A mitigation measure is

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feasible if it can be accomplished in a successful manner within a reasonable period of time, taking into consideration economic, environmental, legal, social, and technological factors.

According to Section 15370 of the CEQA EIR Guidelines, the term "mitigation" includes:

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

Impacts that are less than significant or not significant (no impact) do not require mitigation. Impacts that are potentially significant or significant that can be mitigated, and the feasible mitigation measures, are described in Appendix G, Mitigation Monitoring Program.

4.1.3 Water Uses Potentially Affected

The subsequent analyses of adverse impacts of the proposed action consider the water uses that would be potentially affected by the proposed action to implement the flows contained in the SJRA The SJRA provides for a redirection of up to 137,500 acre-feet of water annually from existing uses to instream flows for fish and related environmental benefits (110,000 acre-feet for spring and 12,500 acre-feet for fall and 15,000 acre-feet available at any time during the year). This potential redirection is shown in Table 4.1-1 with the amounts shown as a range of outcomes. The subsequent analyses of impacts to surface water, groundwater, and land use/agriculture rely on this distribution of affected uses.

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Table 4.1-1: WATER USES POTENTIALLY AFFECTED BY PROPOSED PROJECT (TAF)

Water Uses	Exchange Contractors	OID[1]	SSJID	MID	TID	Merced ID[2]	All
Irrigation	0	0-26	0-11	0	0	0-67.5[3]	104.5
Municipal	0	0	0	0	0	0	0
Carryover Storage/Conservation[4]	0	0-26	0-11	0-11	0-11	0-67.5[5]	126.5
Surface Runoff	0-11	0	0	0	0	0	0-11
Return Flows	0-11	0-15	0	0	0	0	0-26
Groundwater Recharge	0	0-15	0	0	0	0-67.5[6]	0-82.5
Range of Total Available Water	**0-11.0**	**0-26.0**	**0-11.0**	**0-11.0**	**0-11.0**	**0-67.5**	**0-137.5**

[1]Water includes 15,000 acre-feet for release at any time during the year. The additional water is to be used for ramping around the spring or October pulse flows or at other times to support spawning, to control water temperature, or to meet other needs consistent with the New Melones Interim Plan of Operation. See Section 2.1.3.3.
[2]Water includes 12,500 acre-feet for delivery in October for fall attraction flow.
[3]Potential impact in only the most severe drought years. Reduced deliveries may occur in nine out of 71 years, based on historical hydrology. The proposed conjunctive use project is expected to offset water supply impacts.
[4]OID and SSJID have a conservation account that is tightly regulated on when water can be used.
[5]During some years, the maximum annual quantity may come from storage releases and, therefore, result in a reduction in carryover storage.
[6]Merced ID is to implement a conjunctive use project to provide dry year supplies and sustain groundwater levels to 1992 levels.

4.1.4 Model Results Used in Analyses

The impact analysis of the proposed action is based upon the Hydrologic Analysis–San Joaquin River Agreement (Appendix A) specifically conducted for this EIR/EIS. This study utilized several operation simulation models developed by Reclamation: Projects Simulation Model (PROSIM) representing CVP/SWP operations and West Side deliveries; San Joaquin Area Simulation Model (SANJASM) representing Merced and Tuolumne operations, West Side streams, West Side return flows, flow above the Stanislaus, and water quality above the Stanislaus; and, the Stanislaus Operations Model (STANMODAM) which is a spreadsheet model representing Stanislaus operations under assumptions of Reclamation's Interim Plan of Operation for New Melones, and Vernalis flow and water quality. To evaluate the effects of the proposed action across a range of hydrologic events, a long-term 71-year (1922 through 1992) hydrological sequence was simulated. Within that period of record various combinations of hydrologic events occurred ranging from periods of extended drought to floods. The SJRA is a twelve-year proposed action, and it is not possible to predict the hydrologic conditions which will occur over the proposed life of the project, 1999-2010. However, by analyzing a long term record containing a historical sequence of water year types, it is possible to illustrate how the proposed action would perform over numerous different sequences of hydrologic conditions.

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A No Action alternative was also analyzed to produce a basis for comparing the effects of implementing the proposed action (SJRA). The full set of detailed assumptions of the No Action setting are provided in Appendix A. The major assumptions are:

- New Melones Reservoir is operated consistent with the 1997 Interim Plan of Operation.
- The Merced and Tuolumne River reservoir systems are modeled to operate to meet diversion demands and minimum instream flow requirements.
- Implementation of the SWRCB's 1995 WQCP is accomplished through operations of the SWP and CVP.
- Delta smelt and winter run chinook salmon Biological Opinions constraining operations of the SWP and CVP.

These No Action (base case) model settings result in San Joaquin River flow conditions at Vernalis that define the "existing flow" and operational conditions for the SJRA.

The impacts of implementing the Water Right Priority System alternative were determined by analyzing the SWRCB Draft EIR/EIS (1998). The Board utilized the Department of Water Resources Project Simulation Model (DWRSIM) to determine the operational changes required in the San Joaquin Basin to meet the Vernalis flow objectives of the 1995 WQCP. Similar to the above analysis, the SWRCB used an historic hydrology (1922 through 1994) to characterize the impacts across a range of hydrologic conditions. The base case utilized to determine the magnitude and direction of change upon implementation of their alternatives was different than the base case used for analysis of the proposed project (SJRA). The SWRCB assumed, as a no action alternative, that the regulatory environment would revert back to a condition where the SWP and CVP would be solely responsible for meeting pre-Bay/Delta Plan flow objectives (required by D-1485 and D-1422), that is, no implementation of either the New Melones Interim Plan of Operation for achieving the Vernalis flow or the export reduction standards required by the 1995 WQCP to protect fishery and water quality beneficial uses. The SWRCB, however, did simulate an alternative (Alternative 2) in which they assumed that the SWP and the CVP would be solely responsible for meeting the flow and export requirements called for in the 1995 WQCP. In using the SWRCB analysis of the impacts associated with implementing the Water Right Priority System, Alternative 2 was used as the best approximation of "no action" or base line condition.

4.2. SURFACE WATER RESOURCES

This section evaluates the surface water/water supply impacts of the two flow alternatives for providing fishery beneficial use protection required in the 1995 WQCP (SWRCB 1995). The two alternatives, the San Joaquin River Agreement (SJRA) and the State Water Resources Control Board (SWRCB) Water Right Priority System, are described in detail in Chapter 2.

4.2.1 Key Impact Issues and Evaluation Criteria

To evaluate the effects of implementation of either alternative on water supply, two key parameters are analyzed: delivery changes and carryover storage changes. These represent the major water supply parameters affected by implementation of the project alternatives.

Key issues identified in the scoping process and considered in this analysis are:

1. Flow changes at Vernalis

2. How sales and transfers of water and changes in flow schedules affect both upstream and downstream water quality and quantity (including the Delta) in the different water year types.

3. Impacts on water supply availability from the New Melones Project.

    - The impact of SJRA on the long-term operations of New Melones Reservoir and the availability of Stanislaus River water for existing and reasonably foreseeable future in-basin needs.

    - Whether the reallocation of Stanislaus River/New Melones water adversely impacts the ability of local agencies to develop future water supplies or impairs their ability to exercise their watershed, basin, or area of origin priorities.

    - Impact on the New Melones Project's ability to meet water quality objectives at Vernalis including the impacts associated with a different release pattern/timing of releases caused by the acquisition of water on the tributaries.

An issue raised in the public scoping but not addressed in this EIS/EIR is the effects on south Delta water quality, quantity, and flow due to changes in export pumping rates and operation of the South Delta Barrier Program. These issues (i.e., those directly related to exports and the operation of fish and flow control sturctures) are the subject of other independent NEPA/CEQA analyses for the Interim South Delta Program (ISDP) including the Temporary Barriers Program. The ISDP is to improve water levels and circulation in the South Delta channels and to allow full pumping capacity at Banks Pumping Plant (DWR and USBR 1996). The issues are not within the scope of this

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proposed action. See Section 4.12, Cumulative Effects, especially Section 4.12.1.3 for more information on the ISDP.

4.2.2 Environmental Consequences

The water supply impact assessment of the proposed project is based upon the hydrologic analysis specifically conducted for this EIR/EIS (Section 4.1.4 and Appendix A). This analysis utilized several operation simulation models developed by Reclamation (PROSIM, SANJASM and STANMOD). A long-term, 71-year (1922 through 1992) hydrological sequence was simulated to characterize impacts over various combinations of hydrologic events, ranging from periods of extended drought to floods.

The water supply impacts of implementing the alternative action (Water Right Priority System) were determined by analyzing the SWRCB Draft EIR (1998) on the 1995 WQCP which used DWRSIM (see Section 4.1.4) to simulate project operations. Unlike the SWRCB Draft EIR analysis, however, the impact assessment conducted here utilized the SWRCB Flow Alternative 2 (rather than Flow Alternative 1) as the base case. Flow Alternative 2 simulated the conditions occurring if the SWP and the CVP were solely responsible for meeting the 1995 WQCP flow and water quality objectives at Vernalis. This represents the closest approximation to the "existing flow and operational conditions" that could be obtained from the SWRCB Draft EIR (1998) analysis.

4.2.2.1 Water Deliveries

No Action

Water deliveries under the No Action alternative would be similar to existing conditions. The San Joaquin River Group willing sellers would continue to operate under present contractual arrangements. The SWP and CVP would be responsible for meeting the Vernalis flow standards stated in the 1995 WQCP. The 1997 New Melones Interim Plan of Operation would continue for the 12-year life of the project.

Proposed Action

The proposed action (SJRA) specifies a protocol by which the SJRGA would provide up to 110,000 acre-feet of water for a pulse flow in April-May, attraction flows in October, and some additional water, provided by Oakdale Irrigation District (OID), to be used at the discretion of Reclamation and the USFWS (see Section 2.1.1 or Appendix A). The need for this water, and hence the potential impact on other surface water beneficial uses, varies with water year type. Consequently, the hydrologic modeling of the SJRA implementation over the historic 71-year hydrologic record (Appendix A) was used to characterize the magnitude of water affected by the proposed action.

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Tables 4.2.1 and 4.2.2 summarize the resulting water allocation for April and May, respectively. Averages for each water year type were developed for the purpose of evaluating potential impacts.

Table 4.2-1: AVERAGE ALLOCATION OF SJRA WATER (TAF) OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992) AND ALLOCATION AS A PERCENT OF MAXIMUM SURFACE WATER AVAILABLE (APRIL RELEASE)

Water Year Type	Exchange Contractors		OID/SSJID		MID/TID[1]		Merced ID		Total	
	(TAF)	%	(TAF)	%	(TAF)	%	(TAF)	%	(TAF)	%
Wet	0.00	0	0.06	0.01	0.00	0	1.32	0.2	1.37	0.4
Above Normal	1.81	0.2	3.83	0.6	3.62	0.4	14.99	2.2	24.26	0.8
Below Normal	4.86	0.6	10.45	1.7	9.27	1.1	29.37	4.2	53.96	1.8
Dry	6.33	0.8	13.99	2.3	11.19	1.3	37.78	5.4	69.29	2.3
Critically Dry	2.59	0.3	5.33	0.9	3.56	0.4	18.13	2.6	29.61	1.0
71-yr. Average	2.88	0.3	6.19	1.03	5.10	0.6	19.35	2.8	33.52	1.1

[1] Maximum surface water available was unknown (see Table 3.1-1), thus average annual diversion amounts used to characterize available water.

Table 4.2-2: AVERAGE ALLOCATION OF SJRA WATER (TAF) OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992) AND ALLOCATION AS A PERCENT OF MAXIMUM SURFACE WATER AVAILABLE (MAY RELEASE)

Water Year Type	Exchange Contractors		OID/SSJID		MID/TID[1]		Merced ID		Total	
	(TAF)	%	(TAF)	%	(TAF)	%	(TAF)	%	(TAF)	%
Wet	0.38	0.04	0.99	0.2	0.57	0.01	5.54	0.8	7.49	0.2
Above Normal	5.56	0.7	12.30	2.1	10.17	1.2	32.18	4.6	60.21	2.0
Below Normal	6.57	0.8	13.71	2.3	12.52	1.5	38.77	5.6	71.56	2.4
Dry	5.84	0.7	12.92	2.2	11.46	1.3	37.66	5.4	67.87	2.2
Critically Dry	2.86	0.3	6.93	1.2	5.34	0.6	20.92	3.0	36.04	1.2
71-yr. Average	3.84	0.5	8.64	1.4	7.20	0.8	25.18	3.6	44.86	1.5

[1]Maximum surface water available was unknown (Table 3.1-1), thus average annual diversion amounts used to characterize available water.

Tables 4.2-1 and 4.2-2 document that the average water allocation across all year types and willing sellers ranges from 33,530 acre-feet to 44,860 acre-feet or between 1.1 to 1.5 percent of the total water available from these sellers (based on surface water use provided in Table 3.1-1). The greatest potential adverse impact occurs during below normal and dry years with Merced Irrigation District

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exhibiting the largest potential change in water supply. Depending upon the water year type and the month in which the fish water release occurs (April or May), Merced ID provides an average of 4.2 percent to 5.6 percent of their total water supplies to the proposed action. This constitutes a potentially significant negative impact on water deliveries which is above the 71-year average.

Table 4.1-1 (see Section 4.1.3) presents the water uses (deliveries) potentially affected by implementation of the preferred alternative. Merced ID potentially provides up to 67,500 acre-feet of water to meet the proposed action needs (October attraction flows and April/May pulse flow). Table 4.2-3 shows the number of times, in a 71-year hydrologic sequence, that the full allocation from each willing seller would be required. There are from 6 to 8 occurrences of this allocation event in the simulated record (8 - 11 percent of the years). In most instances, these full allocations occur during below normal or dry hydrologic conditions when irrigation demand would also be high. Based on the afore stated assumptions, in years of full allocations and in certain sequential hydrologic conditions, Merced ID would potentially experience significant reductions in irrigation deliveries when and if these conditions occurred within the 12-year life of the proposed project.

Table 4.2.3: NUMBER OF OCCURRENCES OF FULL ALLOCATIONS (110 TAF) NEEDED TO MEET SJRA FLOW OBLIGATIONS OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992)

Water Year Type	April Pulse Flow Release (number of times 110 TAF cap reached)	May Pulse Flow Release (number of times 110 TAF cap reached)
Wet	0	0
Above Normal	0	3
Below Normal	2	2
Dry	4	3
Critically Dry	0	0
Total	6	8

The other willing sellers (Exchange Contractors, OID/SSJID, MID/TID) are not as greatly affected. Based on the long term average allocations of 2,880 acre-feet (for the Exchange Contractors) to 6,190 acre-feet for OID/SSJID (Tables 4.2-1 and 4.2-2), these represent only 1 percent or less of their available water supplies and, on average, are less-than-significant impacts to the deliveries of surface water within their service areas. When periods of full allocation are considered (Table 4.2-3), it is possible for the Exchange Contractors, OID/SSJID, and MID/TID to provide 1.3 percent, 6.2 percent, and 2.6 percent respectively of their total supplies (see Tables 2.1-3 and 3.1-1) to meet their obligations under the Agreement. This is considered a less-than-significant impact when there are full allocations. OID, however, has committed to provide up to 26,000 acre-feet of water

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independent of water year type. As a result, there is a potentially significant adverse impact to OID's water deliveries during critically dry years (when allocations are reduced under the 1988 stipulation and agreement with Reclamation). Because some of the 26,000 acre-feet may come from groundwater (conjunctive use), tailwater recovery, or conservation (Table 2.1-3) during critically dry years, the impact to water deliveries in critically dry years can be mitigated to less-than-significant levels.

Alternative Action

To evaluate impacts resulting from implementation of the alternative action (SWRCB Water Right Priority System), data from the *Draft Environmental Impact Report for the Implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998) were used. In particular, the State showed 73-year period (1922-1994) and critical period (May 1928-October 1934) annual average water delivery changes for each alternative analyzed (Table V-1 and Table V-2). The SWRCB Alternative 2, where the SWP and CVP were entirely responsible for meeting the 1995 WQCP Vernalis flow objectives, is similar to the base case used in the analysis of the above described preferred alternative (SJRA). It is therefore reasonable to compare the delivery changes of the SWRCB Alternative 2 with the SWRCB Water Right Priority System alternative (SWRCB Alternative 3) to determine the impacts of implementing the alternative action.

The total average annual change in deliveries resulting from implementing the Water Right Priority System is a minus 31,000 acre-feet (the difference between -367,000 thousand acre-feet for Alternative 3 and -336,000 thousand acre-feet for Alternative 2 in Table V-1, SWRCB 1995). For the San Joaquin River Basin, the surface water delivery change is -62,000 acre-feet (Table VI-75, SWRCB 1995). This average annual reduction is distributed across a completely different array of water users (up to 38) than is the proposed action (which uses six specific willing sellers). This reduction is a potentially significant negative impact, since many junior water appropriators would have to completely curtail their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. Similarly, in critically dry years, implementation of the SWRCB Water Right Priority System would result in 12,000 acre-feet of delivery reduction from junior appropriators. This is also considered a potentially significant adverse impact since the delivery change is imposed without regard to the consequences or willing ability of the appropriator(s) to provide the water. The SWRCB analysis does not provide any information on the total water supplies available to the junior appropriators affected by this alternative. Therefore, an objective determination of the magnitude of impact is not possible, and the effect is considered a potentially significant adverse impact.

4.2.2.2 Carryover Storage in San Joaquin Basin Reservoirs

Carryover storage is the amount of water retained in a reservoir at the end of September of each water year. Carryover storage helps meet future demand in the event that the next year is dry. The amount of water dedicated to carryover storage is balanced against the amount needed to meet

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immediate delivery needs, hydropower generation needs, and instream flow requirements of a project, according to operation rules that differ for each reservoir (SWRCB 1998).

To determine the impacts of implementing the project alternatives on carryover storage, average September end-of-month storage volumes for each flow alternative are compared to those of the base case. Reservoirs in this analysis include New Melones Reservoir, New Don Pedro Reservoir and Lake McClure.

No Action

Average carryover storage in the reservoirs of the San Joaquin River Basin under the No Action alternative are shown in Tables 4.2-4 and 4.2-5. The SWP and CVP would be responsible for meeting the Vernalis flow standards stated in the 1995 WQCP. The New Melones Interim Operation Plan would continue for the 12-year life of the project. These No Action storage levels reflect any existing operational constraints (e.g., flood control, FERC license agreements, etc.) which affect the volume of water in the reservoir or determine a minimum carryover storage.

Table 4.2-4: AVERAGE END-OF-YEAR STORAGE (TAF) IN PROJECT RESERVOIRS FOR NO ACTION - APRIL*

Water Year Type	New Melones Reservoir (TAF)	New Don Pedro Reservoir (TAF)	Lake McClure (TAF)
Wet	1831	1703	749
Above Normal	1330	1445	659
Below Normal	1251	1260	501
Dry	1144	1218	400
Critically Dry	746	864	317
71-yr. Average	1299	1325	544

* "April Pulse" releases are included in the No Action alternative from the Stanislaus and Tuolumne rivers.

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Table 4.2-5: AVERAGE END-OF-YEAR STORAGE (TAF) IN PROJECT RESERVOIRS FOR THE NO ACTION - MAY

Water Year Type	New Melones Reservoir (TAF)	New Don Pedro Reservoir (TAF)	Lake McClure (TAF)
Wet	1831	1697	749
Above Normal	1331	1426	659
Below Normal	1251	1241	501
Dry	1145	1204	400
Critically Dry	754	856	317
71-yr. Average	1300	1312	544

Proposed Action

Implementation of the preferred alternative, the flows in the San Joaquin River Agreement, affects carryover storage in the reservoirs within the project area. These changes have been summarized, by water year type for the New Melones, New Don Pedro, and Lake McClure reservoirs (Tables 4.2-6 through 4.2-8).

The changes in carryover storage in New Melones Reservoir resulting from implementation of the proposed action are shown in Table 4.2-6. This Stanislaus River reservoir experiences an average increase in storage over the 71 years of the hydrologic sequence of 53,000 to 59,000 acre-feet (8 to 9 percent increase over the base case). Change in end-of-year storage varies by water year type, with the greatest change (77,000 to 72,000 acre-feet) occurring in critically dry water years (a 24 to 21 percent increase over No Action alternative depending upon which month the pulse flow is released). Under the proposed action, this significant beneficial impact to carryover storage during critically dry years is the direct result of using project water obtained from willing sellers, rather than having Reclamation provide requisite flows via releases from their facility. In addition, the May 1997 New Melones Interim Plan of Operation, and its stakeholder refinement during 1998, will result in an operation plan to be determined by U.S. Department of Interior.

Table 4.2-6: NEW MELONES RESERVOIR-STANISLAUS RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

Water Year Type	Average Change in Storage (TAF) (April Release)	Percent Change (April Release)	Average Change in Storage (TAF) (May Release)	Percent Change (May Release)
Wet	47	3	42	2
Above Normal	66	6	55	5
Below Normal	57	5	52	5
Dry	49	6	47	5
Critically Dry	77	24	72	21
71-yr. Average	59	9	53	8

The project can affect New Melones Reservoir operations. Up to 26,000 acre-feet per year would be made available to Reclamation by OID. As modeled, this water would be made available to Reclamation in New Melones Reservoir as a reduction in the amount of water that is diverted by OID. The current Interim Operations Plan would initially treat this water as additional carryover storage after the year has passed, and then enter that effect on storage into the next year's allocation of water. The current rules for allocating additional storage (or inflow) at new Melones Reservoir under the Interim Operations Plan will not allocate "out" every additional acre-foot of additional storage or inflow. Thus, as modeled, a substantial portion of the OID water remains in storage, carried forward into the next year, and at times accumulating several years in a row. There is no attempt in this analysis to presume how the additional water would be allocated among Reclamation purposes, one of which is a desire for additional carryover storage.

Additionally, although not experienced in the modeling, at times there may be occasions when releases from the SJRG members under the SJRA may contribute to flows at Vernalis that would otherwise be required of Reclamation. To the extent that Reclamation can reduce its releases from New Melones Reservoir in recognition of this occurrence, water will be conserved in New Melones Reservoir for additional allocation or reserved as carryover storage.

As a result of project implementation, the New Don Pedro Reservoir would experience less-than-significant changes in carryover storage (Table 4.2-7). The average change (over the 71-year hydrology) is only a 1 percent decrease from the base line; an 11,000 acre-feet decrease in storage for a reservoir which has over 2.3 million acre-feet in capacity. Even the largest average decrease observed, 24,000 acre-feet during below normal years with a May pulse flow release, would represent only a 2 percent decrease from the base line in carryover storage. At a lake elevation of 763.7 feet (the elevation corresponding to the average storage over the 71-year period) the largest

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change in storage (a 24,000 acre-feet decrease) would result in only a 2.6 foot drop from the normal water level elevation.

Table 4.2-7: NEW DON PEDRO RESERVOIR-TUOLUMNE RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

Water Year Type	Average Change in Storage (TAF) (April Release)	Percent Change (April Release)	Average Change in Storage (TAF) (May Release)	Percent Change (May Release)
Wet	0	0	-1	0
Above Normal	-12	-1	-22	-2
Below Normal	-20	-2	-24	-2
Dry	-22	-2	-23	-2
Critically Dry	-10	-1	-17	-2
71-yr. Average	-11	-1	-16	-1

With implementation of the proposed action (SJRA), Lake McClure, on the Merced River, would sustain the largest drop in carryover storage (Table 4.2-8). The average decrease over the 71-year hydrologic sequence was 47,000 to 58,000 acre-feet of storage; this represents a 10 to 13 percent reduction in carryover storage. The largest decrease occurred during below normal and dry years where from 79,000 to 91,000 acre-feet were removed depending upon the release month and year type. This constitutes a potentially significant negative impact; between 17 and 23 percent reduction in carryover storage occurs compared to the No Action alternative. Lake McClure is the smallest of the reservoirs within the project area with slightly over 1.0 million acre-feet of capacity. At a lake elevation of 782.2 feet (the elevation corresponding to the average 71-year storage), the lake pool elevation would drop approximately 22.2 feet during a dry year with a May pulse flow release due to implementation of the proposed project. To look at this comparison another way, the average lake elevation in a below normal water year is 772.1 feet and in a dry year is 745.5 feet. The lake would drop approximately 23.7 feet during a below normal year and 28.5 feet during a dry year with the May pulse flow release due to the implementation of the proposed project.

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Table 4.2-8: LAKE MCCLURE (NEW EXCHEQUER)-MERCED RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

Water Year Type	Average Change in Storage (TAF) (April Release)	Percent Change (April Release)	Average Change in Storage (TAF) (May Release)	Percent Change (May Release)
Wet	0	0	-1	0
Above Normal	-49	-7	-73	-11
Below Normal	-79	-16	-91	-18
Dry	-84	-21	-91	-23
Critically Dry	-53	-17	-67	-21
71-yr. Average	-47	-10	-58	-13

Alternative Action

Implementation of the alternative action, the SWRCB Water Right Priority System, would have beneficial impacts to New Melones Reservoir, and potentially significant negative impacts to New Don Pedro Reservoir and Lake McClure, respectively. Table 4.2-9 shows the changes in reservoir carryover storage for the three San Joaquin Basin reservoirs within the project area. The changes are determined using the SWRCB Alternative 2 as the base case. In the San Joaquin system, New Melones would carry all the responsibility for meeting the Vernalis standards, which in effect, would be equivalent to the New Melones Interim Plan of Operation which governs current operational conditions.

Table 4.2-9: CHANGE IN RESERVOIR CARRYOVER STORAGE (TAF) RESULTING FROM IMPLEMENTATION OF THE SWRCB WATER RIGHT PRIORITY SYSTEM (FROM SWRCB 1998).

Period	New Melones Reservoir (TAF)	New Don Pedro Reservoir (TAF)	Lake McClure Reservoir (TAF)
73-year Period Average	219	-90	-55
Critical Period Average	486	-325	-47

With the alternative action, New Melones Reservoir would experience a significant increase in carryover storage related to the use of other water supplies within the San Joaquin Basin. The 73-year average increase in storage of 219,000 acre-feet is a beneficial impact of implementing this

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alternative. Similarly, the average increase of 486,000 acre-feet of carryover storage during the critical period (1928- 1934) is also a significant beneficial impact to New Melones carryover storage.

Conversely, with the alternative action, New Don Pedro Reservoir would experience a significant negative impact to carryover storage. The average decrease of 90,000 acre-feet over the 73-year period, and 325,000 acre-feet during the critical period constitute a significant reduction in storage within this reservoir resulting directly from implementation of the Water Right Priority System allocation of flow.

With implementation of the alternative action, Lake McClure would also be subjected to a decrease in carryover storage. The 73-year period average was 55,000 acre-feet lower than the base case. The critical period average was 47,000 acre-feet lower than the base case. These reductions in carryover storage constitute a potentially significant adverse impact to this 1.1 million acre-feet reservoir as a result of implementing the alternative action (SWRCB Water Right Priority System).

4.2.2.3 Water Quality

Changes in water quality at Vernalis due to implementation of the alternatives were evaluated using the hydrologic analysis. Reclamation models predicted Total Dissolved Solids (TDS) at Vernalis for every month within the hydrologic sequence simulated (1922-1992). Comparison of the predicted TDS for each month against the 1995 WQCP objective for that month (converted from Electrical Conductivity to TDS) facilitate an assessment of whether the standard was exceeded or met. Instances when the action causes an incremental exceedence of the standard are interpreted as a negative affect; conversely, actions causing an incremental attainment of water quality values below the standard are considered to be a benefit.

No Action

The No Action alternative assumes that New Melones Reservoir is operated consistent with the Interim Operation Plan (USBR 1997c) and is solely responsible for meeting the SWRCB 1995 WQCP objectives. When there is insufficient water in New Melones Reservoir to meet all of the demands, salinity objectives cannot be met. Table 4.2-10 shows the number of times the Vernalis salinity objectives were exceeded over the 71-year hydrologic period simulated in the hydrologic analysis. This table only shows the months of exceedence; other months of the year never exhibited water quality in excess of the standards. The No Action alternative for both the April and May pulse flow release is shown, since differences in average monthly values occur depending upon the release month.

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Table 4.2-10: NUMBER OF EXCEEDENCES OF 1995 BAY/DELTA WATER QUALITY OBJECTIVE AT VERNALIS OVER THE 71-YEAR HYDROLOGIC PERIOD

Alternative	Oct.	Nov.	Feb.	Jun.	Jul.	Aug.	Sep.	Total
No Action- April	8	4	4	8	22	28	11	85
SJRA Action- April	0	4	4	7	20	27	11	73
No Action- May	10	5	4	5	20	27	11	82
SJRA Action- May	0	4	4	4	19	27	11	59

Water quality exceedence based on monthly averages occurs in the fall (October and November), winter (February), and through the summer low flow period (June through July). The greatest number of months with exceedences, and the largest magnitude of exceedence, occur during the low flow summer period (Table 4.2-10). The standards during this period (June through August) are also at their lowest of the year, 455 TDS (SWRCB 1997).

Table 4.2-11 presents the average monthly values for total dissolved solids (TDS) for the No Action and SJRA alternatives for the 71-year hydrologic period by water year type. Of concern is the June through August period when the water quality standard for salinity is 455 TDS.

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TABLE 4.2-11: AVERAGE WATER QUALITY (TDS) AT VERNALIS BY WATER YEAR TYPE

WATER YEAR AVERAGE - NO ACTION APRIL - WATER QUALITY (TDS) AT VERNALIS													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	553	553	344	217	153	160	159	176	225	412	442	424	318
Above Normal	526	490	350	262	199	270	218	317	393	452	453	516	370
Below Normal	557	539	442	421	413	418	278	404	454	456	482	546	451
Dry	504	507	451	430	438	517	336	453	460	574	608	650	494
Critical	621	582	485	491	578	556	405	455	488	648	649	624	549
WATER YEAR AVERAGE - PROPOSED ACTION APRIL - WATER QUALITY (TDS) AT VERNALIS													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	505	559	350	218	158	160	158	176	224	412	442	424	315
Above Normal	481	489	352	261	202	279	205	314	395	453	453	515	367
Below Normal	510	539	443	422	414	418	234	391	454	455	474	543	441
Dry	448	516	446	421	443	517	275	452	459	564	603	648	483
Critical	549	590	485	489	577	555	372	455	477	636	648	626	538
WATER YEAR AVERAGE - NO ACTION MAY - WATER QUALITY (TDS) AT VERNALIS													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	552	553	349	218	154	160	164	163	231	412	442	425	319
Above Normal	527	491	352	263	202	270	264	239	393	452	453	516	369
Below Normal	556	542	442	422	412	419	363	294	454	455	480	546	449
Dry	504	507	451	431	437	517	431	348	459	566	602	649	492
Critical	621	583	485	491	578	556	446	420	482	647	651	625	549
WATER YEAR AVERAGE - PROPOSED ACTION MAY - WATER QUALITY (TDS) AT VERNALIS													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	505	559	355	222	159	160	164	160	232	412	442	425	316
Above Normal	482	491	355	263	207	280	265	204	401	453	453	515	364
Below Normal	515	542	442	425	414	420	359	248	454	455	478	543	441
Dry	450	516	446	421	445	517	429	281	457	560	600	649	481
Critical	550	590	485	490	577	556	447	372	475	634	650	626	538

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Proposed Action

Implementation of the proposed action results in an overall reduction in the number of salinity standard exceedences at Vernalis. The most significant beneficial impact occurs during the month of October where all exceedence events would be eliminated by the proposed action. There also would be some improvement in June and July, and potential improvement in November (if the pulse flow were released entirely in May) or August (if the pulse flow were released entirely in April).

The improvements in water quality at Vernalis take into consideration the increased flow of high quality water from the San Joaquin River tributaries, which occurs in October and during the spring (April/May). No improvements (as measured by numbers of exceedence) were seen from the Spring Pulse Flows, since water quality is inherently good in the basin at this time as pulse flows occur in the basin. Evaluation of the average change in TDS during the pulse flow periods revealed a measurable improvement in water quality. The average decrease in TDS was 27 mg/l and 36 mg/l for the April and May release, respectively.

While not modeled, the potential use of agricultural return flow water by OID/SSJID and by the Exchange Contractors to meet their SJRA commitments does not appear to impact overall quality of the San Joaquin River at Vernalis. This is largely due to the fact that small quantities of potentially lower quality return flow would be added to large flows from the Merced, Tuolumne, and Stanislaus rivers that are high in quality.

The improvement in water quality at Vernalis resulting from implementation of the proposed project should also maintain or improve water quality in the South Delta. The exact magnitude and distribution of this beneficial impact cannot be assessed by the monthly analysis performed herein which is based on Appendix A.

Alternative Action

The SWRCB evaluated the change in salinity as a result of implementing the suite of flow alternatives they considered in their DEIR (SWRCB 1998). Using the Board's Flow Alternative 2 (SWP/CVP responsible for meeting 1995 WQCP objectives), a comparison was made with the predicted salinity resulting from implementing the Water Right Priority System (Flow Alternative 3). The SWRCB's analysis simulated average end-of-month Electrical Conductivity for the 73-year hydrologic period. Their results indicated that monthly averages during the 73-year period only exceeded the salinity standard during June, July, and August.

Overall the SWRCB predicted a net improvement in water quality due to implementation of the alternative action in November, December, January, February, and March. These were times when the salinities were lower than the standard, even for the base case (Flow Alternative 2). During the remaining months of the year, the SWRCB's analysis indicated that salinities were greater with the alternative action than with no action; the quality exceeded standards during June, July, and August. Furthermore, during these exceedence periods the implementation of the alternative action actually increased the salinity. Since implementation of the alternative action would create further

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degradation in an already degraded water quality environment in the San Joaquin River at Vernalis, this is a potentially significant adverse impact.

Inspection of the SWRCB's impact analysis (1998) leads to the qualitative conclusion that implementation of the Water Right Priority System alternative would lead to potentially significant impacts to water quality during the summer months (when quality is already exceeding standards and further degradation could potentially limit the beneficial uses of water). Some benefits to quality occur during the late fall and winter months when quality is naturally high. The significant negative impacts would need to be mitigated by releases of water from New Melones Reservoir sufficient to achieve the standards.

4.2.3 Impact Summary and Mitigation of Impacts

4.2.3.1 Water Deliveries

Proposed Action

- Implementation of the preferred alternative (SJRA) would result in potentially significant impacts to water deliveries for Merced ID during critically dry conditions and under below normal or dry hydrologic conditions only when full allocations and certain sequential hydrologic conditions occur. Under such circumstances, impacts can be mitigated by implementation of a conjunctive use program to store surface water in groundwater aquifers during times of surplus which can then be pumped to augment surface supplies during times of shortages.

- Implementation of the preferred alternative (SJRA) would result in potentially significant adverse impacts for OID water deliveries during critically dry years when the District does not receive its full allocation. OID does not have storage capacity to offset these shortages. Therefore, to reduce these potentially significant impacts to less-than-significant levels, OID through conjunctive use, reclamation, and improved efficiency, could make up for the water shortage in critically dry years.

- All other willing sellers/willing buyers water deliveries would either be unaffected by the preferred action or experience less-than-significant impacts.

Alternative Action

- Implementation of the SWRCB Water Right Priority System would have significant adverse impacts to water deliveries within the San Joaquin River Basin. Average annual deliveries would be reduced by 62,000 acre-feet and, at times, complete curtailment of diversions by junior water right appropriators. The number and composition of the affected appropriators are different than the preferred alternative and vary with water year type. It was not possible with available information to determine if these potentially significant impacts to junior appropriators could be mitigated.

4.2.3.2 Water Storage

Proposed Action

- Implementation of the preferred alternative (SJRA) would result in beneficial impacts to carryover water storage for New Melones Reservoir. No mitigation is required.

- A less-than-significant adverse impact to carryover storage in New Don Pedro Reservoir would result. No mitigation is required.

- A potentially significant negative impact to carryover storage for Lake McClure (Merced Irrigation District) would occur during below normal or dry hydrologic conditions. These impacts are unmitagable and therefore unavoidable.

Alternative Action

- A beneficial impact (i.e., a large increase in storage) would occur to New Melones reservoir as other water supplies within the San Joaquin Basin would be used to meet the 1995 WQCP Vernalis flow objectives.

- A significant negative impact to New Don Pedro Reservoir storage would occur with implementation of the alternative action as reservoir storage would be used to meet 1995 WQCP Vernalis flow objectives. These impacts are unmitagable and therefore unavoidable.

- A potentially significant negative impact to Lake McClure storage would occur with implementation of the alternative action as reservoir storage would be used to meet 1995 WQCP Vernalis flow objectives. These impacts are unmitagable and therefore unavoidable.

4.2.3.3 Water Quality

Proposed Action

- Beneficial impacts to water quality would occur in the San Joaquin River at Vernalis during October as instances of the exceedence of standards are reduced. No mitigation is required.

- Beneficial impacts to water quality may also occur in June and July, and potentially in November or August (depending upon when the pulse flow would be released) as the number of times the salinities exceed the standards at Vernalis are reduced. No mitigation is required.

- April or May Spring Pulse flow would reduce salinities, on the average, by 27 to 36 mg/l and would be a beneficial impact. No mitigation would be required.

Alternative Action

- Implementation of the Water Right Priority System would improve water quality at Vernalis during November, December, January, February, and March and would be a beneficial impact. No mitigation would be required.

- Potentially significant adverse impacts to water quality at Vernalis would occur during the summer months (June, July, and August). Quality at Vernalis already exceeds standards during this period, and based on the SWRCB modeling assumptions, further degradation of water quality as a result of implementing the alternative action could limit beneficial uses. Mitigation of these impacts to a less-than-significant level would require additional water releases from New Melones by Reclamation.

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4.3 GROUNDWATER

This section describes changes to groundwater conditions associated with the project alternatives, as compared to the No Action alternative. Groundwater conditions for each alternative are compared to the No Action alternative, and associated impacts are reported.

In certain alternatives, specific groundwater basins within the project area may be affected by the proposed action. However, the groundwater basins within the San Joaquin River Group Authority members' service areas are all part of the San Joaquin River Region, thus are to some extent hydraulically connected.

4.3.1 Impact Issues and Evaluation Criteria

Specific environmental impacts and concerns that were identified during the public scoping phase of this project include:

- Impacts on the Eastern San Joaquin Groundwater Basin from the acquisition of water on the San Joaquin River tributaries.
- Impacts of reductions of the use of surface water from the Stanislaus and Tuolumne Rivers in Stanislaus County on groundwater usage in Stanislaus County. Will the water acquisitions for SJRA be offset locally by increased groundwater pumping, and if so, what will be the impact on local groundwater resources?
- Extent to which San Joaquin River Agreement (SJRA) would result in additional groundwater pumping.
- Cumulative effects of the proposed project and other ongoing projects on water quality and quantity.

Groundwater impacts for each alternative are summarized as changes to groundwater overdrafting, groundwater levels, groundwater quality, subsidence, subsurface drainage, and waterlogging compared to the No Action alternative. These conditions represent the general response of the groundwater basins to potential increases in groundwater withdrawals as part of the water required for the proposed SJRA flows. Changes in groundwater storage provide a measure of associated groundwater impacts such as changes in groundwater-surface water interaction, subsidence of the ground surface, migration and upwelling of poor-quality groundwater, impairment of subsurface drainage systems in areas of poorly drained soils, and high groundwater tables adjacent to streams with known seepage-induced waterlogging problems.

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Significance determinations for the impact analysis are based on the quantity of groundwater involved directly or indirectly and on the existing overdraft conditions in the basin.

4.3.2 Environmental Consequences

Within the San Joaquin River Region, approximately 2.6 million acre-feet of groundwater is extracted in a typical year (DWR 1998). The majority of the groundwater is pumped by a combination of private agricultural interests and municipalities. The approximate annual volume of groundwater utilized by the willing sellers at present ranges from 9,668 acre-feet by OID to 144,000 acre-feet utilized by the Exchange Contractors (Table 3.1-1). The willing sellers' total groundwater use annually ranges from approximately 0.4 percent to 5.5 percent of the total groundwater pumped within the basin. The following sections are by basin or service area.

4.3.2.1 Groundwater Overdrafting

Groundwater overdraft is defined by Department of Water Resources (DWR) as the condition of a groundwater basin where the amount of water extracted exceeds the amount of groundwater recharging the basin "over a period of time" (DWR 1980). To quantify overdraft, the period of time must be of sufficient duration to produce a record that can be used to approximate the long-term average hydrologic conditions in the basin. In the California Water Plan Update (Draft) (DWR 1998), DWR estimated the amount of groundwater overdraft in the Central Valley. In the San Joaquin River Basin, groundwater overdraft is estimated to be 240,000 acre-feet and occurs throughout the basin.

Because groundwater is typically used to replace much of the shortfall in surface water supplies, water delivery reductions resulting from the proposed alternative could increase groundwater overdraft within the various willing sellers' groundwater basins. Water delivery reductions for the willing sellers resulting from the proposed action are reported in Table 4.1-1. For this evaluation of groundwater storage, these quantities are assumed to be the maximum increase in groundwater pumping that would result from the different alternatives. The deficiency caused by the surface water diversion can also be made up by other water management methods including, but not limited to, tailwater recovery and water conservation.

South San Joaquin Irrigation District (SSJID) Service Area

DWR Bulletin 118 (1996) has identified the groundwater basin underlying eastern San Joaquin County as a critically overdrafted basin. Groundwater extraction in the urban area of SSJID is estimated to exceed the safe yield of one acre-foot per acre per year, while groundwater extraction in agricultural areas is significantly below the safe yield. As a result, the average extraction rate within the SSJID is less than the estimated safe yield; and, therefore, the SSJID's portion of the groundwater basins technically is not overdrafted (SSJID 1994).

SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Projected agricultural and municipal groundwater demands for the SSJID service area are 58,000 acre-feet per year. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, overdrafting of the SSJID groundwater basin from SSJID pumping would not increase.

Proposed Action. The proposed action, outlined in the San Joaquin River Agreement, provides water from the Authority for achieving the Vernalis Adaptive Management Plan (VAMP) pulse flow, up to 110,000 acre-feet (except in double-step years where it could be 160,000 acre-feet). The volume of water for all flows (excluding double-step years) is capped at 137,500 acre-feet in any year (see Table 2.1-3). Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no impact to the overdraft problem within eastern San Joaquin County as a result of this action.

Alternative Action. To evaluate impacts resulting from implementation of the alternative action (SWRCB Water Right Priority System), data from the *Draft Environmental Impact Report for the Implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998) was used. In particular, the State showed 73-year period (1922-1994) and critical period (May 1928-October 1934) annual average water delivery changes for each alternative analyzed (Table V-1 and Table V-2). The total average annual change in deliveries resulting from implementing the Water Right Priority System is a minus 31,000 acre-feet. This average annual reduction is distributed across a completely different array of water users than is the proposed action (which uses specific willing sellers). Similarly, in critically dry years, implementation of the SWRCB Water Right Priority System would result in 12,000 acre-feet of delivery reduction from junior appropriators and would be imposed without regard to the consequences or willing ability of the appropriator(s) to provide the water. The SWRCB analysis does not provide information on the total water supplies available to the junior appropriators affected by this alternative.

If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by SSJID and other water right holders to supplement reduced surface water deliveries is not known

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at this time for the SSJID area; but for the entire San Joaquin River Basin, it is up to 62,000 acre-feet (Table V1-75, SWRCB 1998). The effect is considered a potentially significant impact.

Oakdale Irrigation District (OID) Service Area

Groundwater depletion within OID is estimated to be approximately 5,100 acre-feet per year (MW April 13, 1995, Memorandum). OID estimates that the typical groundwater production rate in the service area is 55,900 acre-feet. Of this volume approximately 30,000 acre-feet per year is pumped by private irrigators with the remainder pumped from District and Reclamation wells. Annual average use from OID wells is 9.668 acre-feet (Table 3.1-1). The data shows that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8, 1995, Memorandum). On a local level, groundwater extraction rates vary throughout the basin based on factors such as location of municipalities, depth to groundwater, and crop water needs.

No Action. Projected groundwater demands for the OID service area are 55,900 acre-feet per year. OID estimates that groundwater extraction rates within their service area would continue to slightly exceed infiltration rates. Given their projected usage of groundwater, slight overdrafting of the OID groundwater basin from pumping would continue. The groundwater budget for the OID service area suggests that current pumping rates do not appear to significantly threaten the continued long-term viability of their groundwater resources (MW 1995, Memorandum).

Proposed Action. The maximum annual surface water diversion for the flow events from the OID service area is 26,000 acre-feet. To substitute for this water, OID projects pumping between zero and 15,000 acre feet of groundwater to serve its irrigation customers using existing facilities. If the total 15,000 acre-feet is groundwater, this represents approximately 27 percent of the total groundwater pumped annually from the service area. However, groundwater levels have been historically relatively high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID's service area.

Alternative Action. If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by others to supplement reduced surface water deliveries is not known at this time for the OID service area. Since an objective determination of the magnitude of impact is not possible, the effect is considered a potentially significant impact.

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Modesto Groundwater Basin

The average annual overdraft in the Modesto Basin is estimated at 15,000 acre-feet (MID 1996). DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. Projected agricultural and municipal groundwater demands for the Modesto Irrigation District (MID) service area are summarized in Table 3.3-5. Total groundwater demand in the basin is projected to increase from 108,000 acre-feet per year in 1995 to 222,000 acre-feet per year in 2030 (MID 1996). Given the projected usage of groundwater, overdrafting of the Modesto Groundwater Basin would continue to increase if other groundwater conservation methods are not implemented.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater and that they would make up the diverted water by reduced carryover storage in the New Don Pedro Reservoir. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows.

Alternative Action. The modeling studies used to calculate water deliveries for the 1995 WQCP DEIR (SWRCB 1998) assumed that water right holders in the San Joaquin Basin would pump groundwater to compensate for reductions in surface water deliveries. The 1995 WQCP DEIR projects that MID would have zero reduction in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, MID would not have to pump groundwater to make up for reductions in surface water deliveries. Therefore, this action would have no impact on groundwater overdrafting in the Modesto Groundwater Basin from MID, but water obtained from other water right holders could contribute to overdraft. In the absence of specific information on these other holders and the amounts of water involved, the impact is considered potentially significant.

Turlock Groundwater Basin

The average annual overdraft in the Turlock Basin is estimated at 70,000 to 85,000 acre-feet (TID 1997). Maximum annual surface water diversion for the pulse flow event from the Turlock Groundwater Basin is 11,000 acre-feet. TID projects that none of this water would come from groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

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No Action. Projected agricultural and municipal groundwater demands for the TID service area are summarized in Appendix B, Table B1-3. Total groundwater demand in the basin is projected to increase from 447,405 acre-feet per year in 1995 to 520,100 acre-feet per year in 2030 (TID 1997). Given the projected usage of groundwater, overdrafting of the Turlock Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). TID projects that they can make up for the diverted water by incorporating conservation measures into their water plan. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows (Godwin 1998, personal communication).

Alternative Action. The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action. Therefore, TID would have no impact on groundwater overdrafting. Other water right holders could contribute to overdraft, so the impact is potentially significant.

Merced Groundwater Basin

The average annual overdraft in the Merced Groundwater Basin is estimated at 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998). Based on factors such as location of municipalities, depth to groundwater, and crop water needs, on a local level, groundwater extraction rates vary throughout the basin.

No Action. Projected agricultural and municipal groundwater usage for the Merced ID service area is approximately 638,000 acre-feet per year (Merced ID 1996). Of this volume, Merced ID pumps approximately 25,000–30,000 acre-feet per year (Table 2.1-3). Total agricultural groundwater demand in the basin is projected to decrease by 12 percent over the next 40 years, from 601,800 acre-feet per year in 1996 to 529,584 acre-feet per year in 2036 (Merced ID 1997). Total groundwater demand for municipal uses, in the basin, is projected to increase by approximately 33 percent by 2030, from approximately 40,000 acre-feet per year in 1996 to 121,000 acre-feet per year in 2036 (Merced ID 1997). No estimates were given for the increase in demand for industrial uses. Given the projected usage of groundwater, overdrafting of the Merced Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the percentage of this water that may come from groundwater ranges from zero to 100 percent as an indirect impact due to the potential use of groundwater to substitute for reduced surface water delivery. No groundwater would be

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pumped directly by Merced ID to meet SJRA flows. For the worst case, this 67,500 acre-feet represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This amount could result in a significant impact to the overdraft problem, if other groundwater conservation measures are not implemented.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The SWRCB DEIR assumes that Merced ID would have zero reductions in surface water deliveries that may have to be offset with groundwater. This action would have no impact on additional groundwater overdrafting from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The surface water supply is supplemented by an unreasonably high groundwater supply in dry and critical water years. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, since an objective determination of the magnitude of impact is not possible from material provided in the DEIR, the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. DWR does not provide an estimate of the typical groundwater production rates in the service area; however, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. DWR estimated the groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The total average annual volume of groundwater pumped by users in the Exchange Contractors service area is estimated at approximately 100,000 acre-feet. Total groundwater demand in the basin, including private water users, has fluctuated from a low of 196,167 acre-feet in 1995 to a high of 390,000 acre-feet in 1994. The average annual volume of groundwater pumped during the five year period from 1991 through 1995 is 265,000 acre-feet (SJRECWA 1997). The projected overdraft for the service area is not reported.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 7.6 percent of the typical annual groundwater production rate of 144,000 acre-feet per year pumped by the Exchange Contractors.

The 11,000 acre-feet is 2.2 percent of the Delta Medota Basin production of 511,000 acre-feet. Based on this worst case scenario, if the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase by a small amount. This would result in a less-than-significant impact to the basinwide overdraft problem.

Alternative Action. The 1995 WQCP DEIR projects that the Exchange Contractors would experience approximately 5,000 acre-feet increase in surface water deliveries (as the difference between Alternative 2 and Alternative 3). The groundwater overdraft in the Exchange Contractors service area would not increase. This would result in no impact to the basinwide overdraft problem from the Exchange Contractors. However, the volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantifiable; so the impact is potentially significant.

4.3.2.2 Water Levels

Changes in water level are the result of many factors including surface water and groundwater use, irrigation technologies, changes in crop mix and streamflow. Declining water levels can result in additional power consumption as a result of having to lift the water a longer distance as well as upwelling of saline water which reduces water quality.

South San Joaquin Irrigation District (SSJID) Service Area

Semi-annual monitoring of groundwater levels throughout San Joaquin County, including SSJID have been conducted since the fall of 1997. Measurements of the water levels are collected during the spring and fall of each year. The spring measurements reflect natural recharge that occurred during the wet season, while the fall measurements indicate the impact of groundwater pumping during the summer months.

Within the District, groundwater movement is generally from the southeast to the northwest. Since 1964, groundwater levels within the District have declined between 20 and 30 feet, with about 10 feet of this decline occurring between 1987 and 1993, as a result of the extended dry conditions at this time (SSJID 1994). The majority of this decline has occurred in the central and eastern areas of the District as a possible result of a large cone of depression located east of Stockton.

Water levels will continue to decline within the SSJID service area as a result of the overdrafting that is occurring within the eastern area of the county (Brown and Caldwell 1985). The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside SSJID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such, location of municipalities, depth to groundwater, and crop water needs).

No Action. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, water levels within the SSJID groundwater basin should not decline. However, as a result of the overdrafting in urban areas located within and adjacent to the SSJID service area, water levels would probably continue to decline if other conservation methods are not implemented in the SSJID service area.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no negative impact on water levels within the service area.

Alternative Action. If SSJID is required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries in the SSJID service area is not known at this time. Therefore, while an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

OID has been monitoring water levels within seven wells. An analysis of water levels for spring and fall of 1992 showed that water levels ranged from more than 100 feet above mean sea level in the northern part of the service area to less than 50 feet above mean sea level in the northwest portion of the service area, indicating that groundwater generally flows from east to west. Groundwater levels decline by approximately five feet from spring to fall and appear to be a seasonal variation.

No Action. OID estimates that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8 , 1995, Memorandum). Given projected usage of groundwater, water levels within the OID groundwater basin should not decline.

Proposed Action. OID projects that groundwater pumping to supplement instream flows could range from zero to 15,000 acre-feet per year. OID conducted an analysis in 1995 of hydrologic impacts likely to be associated with potential water transfers from their service area (MW April 13, 1995, Memorandum). The analysis simulated three levels of water level transfers from the

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portion of the OID north of the Stanislaus River: 10,000 acre-feet per year, 20,000 acre-feet per year, and 30,000 acre-feet per year over a period of 70 years. The results of the simulation showed that groundwater levels would decline between two and four feet over the 70 year period for 10,000 and 20,000 acre-feet per year diversions. Conditions in the portion of the OID service area south of the Stanislaus River are considered a mirror image of northern area conditions, and similar water level declines would be expected (MW April 13, 1995, Memorandum). These results indicate that use of 15,000 acre-feet per year for the proposed action would have no significant impacts to groundwater water levels within the OID service area.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect on groundwater levels is considered a potentially significant impact.

Modesto Groundwater Basin

Long term water level monitoring conducted by DWR indicates that the Modesto Groundwater Basin has experienced groundwater declines of 15.3 feet from the period 1970-1990 (HCI 1992). This decline represents depletion of storage of 404,000 acre-feet. The average annual water budget for 1952-1991 indicates an average annual overdraft in the basin of 2,300 acre-feet per year (MID 1996). The overdraft is indicated by water level declines of approximately 0.5 feet per year (HCI 1993).

Water levels will probably continue to decline within the MID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside MID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The data presented in MID's Groundwater Management Plan (MID 1996) suggests that the groundwater basin would continue to be overdrafted by approximately 15,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels are projected to continue to decline if conservation methods are not implemented in the Modesto Groundwater Basin.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.1-3). Of this volume, MID projects that none of this water would come directly from groundwater. This would result in no impact to declining groundwater levels in the Modesto Groundwater Basin.

Alternative Action. The 1995 WQCP DEIR projects that MID would have no reduction in surface water deliveries that may have to be offset by increased groundwater pumping as a result of implementing the alternative action (Table VI-75, SWRCB 1998). Therefore, this action would have no impact on water levels in the Modesto Groundwater Basin from MID but there could be impacts from other water right holders in this basin. These impacts cannot be quantified based on information in the DEIR, so the overall impact to the basin is potentially significant.

Turlock Groundwater Basin

Water level data shows that water levels have declined between 1971 and 1991 (TID 1997). The largest water level declines have occurred within the eastern part of the Basin, where declines are as much as 90 feet. Water levels have declined approximately five feet throughout the western part of the Basin.

These declines are largely the result of pumping in excess of recharge, resulting in annual overdrafting in the Turlock Basin at an annual estimated rate of 70,000 to 85,000 acre-feet (TID 1997). DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the TID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside TID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

No Action. The data presented in TID's Groundwater Management Plan (TID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 70,000 to 85,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given the projected usage of groundwater, water levels within the Turlock Groundwater Basin are projected to continue to decline if conservation methods are not implemented.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). This action would have no negative impact on water levels within the Turlock Groundwater Basin.

Alternative Action. The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, TID would not have to pump additional groundwater to make up for reductions in surface water deliveries. The alternative action would have no impact on groundwater levels within the Turlock Groundwater Basin from TID. However, there could be impacts from other water right holders in this basin. These impacts cannot be quantified at this time, so the impact on groundwater levels is potentially significant.

Merced Groundwater Basin

The Merced Irrigation District monitors static and high groundwater levels on a monthly basis from a total of 196 active wells within its irrigation boundaries. In addition, Merced ID monitors shallow monitoring wells, located at the section corners, to determine localized areas of high or perched groundwater table conditions. Long term water level data indicates that the Merced Groundwater Basin has experienced groundwater level declines of up to 40 feet during the period 1960-92. This decline represents depletion of storage of 404,000 acre-feet.

These declines are largely the result of pumping in excess of recharge resulting in annual overdrafting in the Merced Groundwater Basin at a estimated rate of 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rates in the basin is 555,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the Merced ID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside Merced ID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

No Action. The data presented in Merced ID's Groundwater Management Plan (Merced ID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given their projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline if conservation methods are not implemented in the Basin.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID ranges is 67,500 acre-feet (see Table 2.1-3). Of this volume, Merced ID projects that the percentage of this water that may come indirectly from groundwater to substitute for reductions in surface water deliveries ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater storage, this would represent less than 12 percent of the total

groundwater pumped in the basin in a typical year. This could result in a significant impact to declining groundwater levels.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The 1995 WQCP DEIR projects that Merced ID would have zero reductions in surface deliveries as a result of the alternative action and would not have to pump groundwater to make up for loss in water deliveries. Consequently, the alternative action would have no impact on groundwater levels within the Merced Groundwater Basin from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. Nevertheless, there could be impacts from other water right holders which cannot be quantified at this time; therefore the impact is potentially significant.

Exchange Contractors Water Authority Service Area

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. The *Draft Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act* (USBR 1997d) reports that water level declines began occurring in the 1940s along the west side of the San Joaquin River Region, dropping more than 30 feet by 1960.

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin, which includes the Exchange Contractors service area, of 511,000 acre-feet per year (DWR 1998).

No Action. No data was available on water level fluctuations in response to overdrafting in the area.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents about two percent of the typical groundwater production rate in the Delta Mendota Basin. If the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase slightly, but this would result in a less-than-significant impact to the water level problem.

Alternative Action. If the water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. Modeling conducted to calculate water deliveries for the 1995 WQCP projects that the Exchange Contractors may have average annual reductions in

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surface water deliveries of approximately 15,000 acre-feet for Alternative 3 and 20,000 acre-feet for Alternative 2 (see Table VI-75, SWRCB 1998). The difference is 5,000 acre-feet less of a delivery reduction. The alternative action would have no impact on groundwater levels in the Exchange Contractors service area. However, impacts from other water right holders are unclear; so the impact on reduced water levels is potentially significant.

4.3.2.3 Water Quality

Groundwater quality conditions in the San Joaquin River Region vary throughout the area. Only those parameters that may be problems in the groundwater basins within the San Joaquin River Authority's willing sellers' service areas are discussed here. Groundwater quality for the proposed action and alternative action are compared to the No Action alternative.

South San Joaquin Irrigation District (SSJID) Service Area

With the exception of wells owned by the cities, water quality is not monitored in the District (SSJID 1994). As a result, comparatively little long-term data is available on water quality. The cities are required by the Department of Health Services to periodically sample and test wells used as a source of potable water. Water samples from city wells in Manteca, Ripon, and Escalon contain both inorganic and organic contaminants including nitrates and DBCP. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Levels of both inorganic and organic contaminants would continue to increase.

Proposed Action. SSJID predicts that none of their annual surface water diversion for the pulse flow event would come from groundwater. This action would have no impact on groundwater water quality within the Basin.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water holders from the groundwater basin underlying the SSJID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

Water quality is reported to be generally acceptable for most uses within the OID service area (Black and Veatch, et. al. 1995). Problem levels of some constituents, including salinity, nitrates,

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radionuclides, dibromochloropropane (DBCP) and other trace organics have been detected in groundwater within the service area. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

No Action. OID reports that there is no evidence of any significant threat to groundwater quality such as saline intrusion in the aquifers below their service area (MW March 31, 1995, Memorandum).

Proposed Action. OID predicts that the amount of their annual surface water delivery for instream flows that may come from groundwater ranges from zero to 15,000 acre-feet per year. Data shows that this rate of pumpage would have only limited impacts to groundwater depletion and water levels and should have no impacts on groundwater water quality within the service area.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water right holders from the groundwater basin underlying the OID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact on water quality is not possible, and the effect is considered potentially significant.

Modesto Groundwater Basin

Groundwater quality within the Modesto Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including total dissolved solids (TDS), nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater. In addition to the water constituents listed above, some localized areas within the area have been contaminated through spills or dumping of hazardous materials. The area includes two Superfund sites: the Norris plant located south and east of Riverbank, and Halford Cleaners located in the City of Modesto.

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Groundwater quality would remain acceptable for most uses.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.3-1). Of this volume, MID projects that none of this water would come from groundwater. This would result in no impact to groundwater quality within the basin.

Alternative Action. MID is not projected to experience any surface water delivery reductions as a result of the alternative action (see Table VI-75, SWRCB 1998). As a result, additional groundwater pumping would not be required. The alternative action would have no impact on water

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quality in the Modesto Groundwater Basin from MID. However, there could be impacts from other water right holders. An objective determination of the magnitude of impact is not possible based on information in the DEIR, so the effect is considered a potentially significant impact.

Turlock Groundwater Basin

Groundwater quality within the Turlock Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics have been found in the groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998).

No Action. Groundwater quality would remain generally acceptable.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). TID projects that none of this water would come from groundwater. This action would have no negative impact on water quality within the Turlock Groundwater Basin.

Alternative Action. The SWRCB (1998) projects that TID would not be required to curtail any portion of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The alternative action would not have any impact on groundwater in the Turlock Groundwater Basin from TID. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect is considered a potentially significant impact.

Merced Groundwater Basin

There are numerous constituents detected in the Merced Groundwater Basin groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. The constituents identified in this section either currently impact groundwater usage within the Basin, or have the potential to impact the Basin's future groundwater usage. Groundwater quality within the Merced Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater.

Maximum annual surface water diversion for the Spring and October flow events from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the volume of water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998).

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No Action. Existing conditions of both acceptable quality for some uses and problems with levels of some constituents would continue.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet (see Table 2.3-1). Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater (to substitute for surface water deliveries) ranges from zero to 67,500 acre-feet. Based on the worst case, the extraction of this quantity of water from the basin may increase TDS slightly and could result in a less-than-significant impact.

Alternative Action. Projections of average annual surface water diversions required to achieve the 1995 WQCP Vernalis flow objectives show that the Merced ID reduction in surface water deliveries is zero and would not have to be supplemented by pumping groundwater (Table VI-75, SWRCB 1998). However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, an objective determination of the magnitude of impact to water quality cannot be made and the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) report in their AB3030 plan that water quality issues within their service area occurs only in urban areas. High manganese concentrations have been detected from groundwater samples collected from wells in Firebaugh and Mendota. The city of Dos Palos developed a surface water quality problem because of the poor quality of groundwater. The Exchange Contractors report that localized areas west and southwest of their boundaries contain poor quality water (SJRECWA 1997).

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998).

No Action. Water quality problems may continue in the urban areas.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.3-1). The Exchange Contractors project that up to 100 percent of this water could come from groundwater. This represents approximately two percent of the total groundwater pumped, so the impact on water quality is less than significant.

Alternative Action. The 1995 WQCB DEIR projects that the Exchange Contractors may experience a 5,000 acre-feet increase in surface water deliveries. This would result in no impact to the groundwater quality. However, other water right holders could be responsible for providing water. The amount of groundwater pumping that may result from reduced surface water deliveries cannot be quantified, and the impact is considered potentially significant.

4.3.2.4 Subsidence

Subsidence occurs in the western San Joaquin Valley where land that had been used for grazing or dry farming was converted to irrigated agriculture. Subsidence in the San Joaquin Valley results from lowered groundwater elevations and the subsequent compaction of the dewatered soil interstitial spaces. A negative effect of subsidence is the permanent loss of aquifer capacity. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than one foot. Land subsidence is a significant problem in the western San Joaquin Valley in the San Joaquin River Basin. The largest of the three land subsidence areas in the San Joaquin Valley is the 2,600 square mile Los Banos-Kettleman City area which extends from Merced County to Kings County and lies within both the San Joaquin and Tulare Basins. Groundwater production, prior to completion of the California Aqueduct in 1967, caused land subsidence of one foot regionally and up to 29 feet locally. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas (DWR 1998). Recent increases in subsidence are the result of increased groundwater extraction to compensate for water supply deficiencies caused by drought, Bay-Delta export restrictions, and Central Valley Project Improvement Act (CVPIA).

South San Joaquin Irrigation District (SSJID) Service Area

No Action. Ground subsidence is not a problem within the SSJID service area. Overdrafting in urban areas located within and adjacent to the SSJID service area water levels may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on land subsidence within the Basin.

Alternative Action. If water right holders, including SSJID, are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so the effect on subsidence is potentially significant.

Oakdale Irrigation District (OID) Service Area

No Action. Ground subsidence is not a problem within the OID service area. Overdrafting in urban areas located within and adjacent to the OID service area may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual water deliveries for the instream flows from the OID service area would be 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year of this water would come from groundwater. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to subsidence within OID's service area.

Alternative Action. If water right holders including OID are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so there could be a potentially significant effect on subsidence.

Modesto Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem within the MID service area and the Modesto Groundwater Basin.

Proposed Action. MID projects that no water would come from groundwater to achieve the SJRA pulse flow. There would be no impact to subsidence in the Modesto Groundwater Basin.

Alternative Action. MID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, so the reduction in surface water deliveries would not be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. While an objective determination of the magnitude of impact is not possible, the effect on subsidence is considered a potentially significant impact.

Turlock Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem in the Turlock Groundwater Basin.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). Of this volume, TID projects that none of this water would come from groundwater. Consequently, this action would have no negative impact on land subsidence within the Basin.

Alternative Action. TID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. The magnitude of impact on ground subsidence cannot be quantified at this time; therefore, the effect on subsidence is considered a potentially significant impact.

Merced Groundwater Basin

No Action. Ground subsidence is not a problem within the Merced Groundwater Basin and the Merced ID service area. The groundwater basin is projected to continue to be overdrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline, which could result in a loss of aquifer storage and local land subsidence.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater substitution ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur and result in potentially significant impacts to the basin.

Alternative Action. Merced ID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantified and may be significant. An objective determination of the magnitude of impact on land subsidence is not possible, so the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The Exchange Contractors' Water Authority have measured land subsidence annually within their service area from 1957 to 1962. During this period, land subsidence in their service area has ranged

from less than a foot under the San Luis Water District to over four feet near the Mendota Pool. The Exchange Contractors will continue the annual subsidence monitoring within their service area.

No Action. Ground subsidence is a problem with the service area. Overdrafting may cause continued ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors' service area is 11,000 acre-feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre-feet. The 11,000 acre-feet is approximately 2.2 percent of the Delta Mendota Basin production of 511,000 acre-feet. This additional volume of groundwater would result in a less-than-significant impact to the basin subsidence problems.

Alternative Action. The Exchange Contractors would not be required to curtail diversions in order to achieve the 1995 WQCP Vernalis flow objectives by comparing Alternatives 2 and 3. The reduction in surface water deliveries may be supplemented by pumping groundwater. Their impact to ground subsidence would be no impact. However, the impact from other water right holders and their possible groundwater pumping cannot be quantified and must be considered potentially significant.

4.3.2.5 Agricultural Subsurface Drainage

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake Regions (USBR 1997d).

The area of subsurface drainage problems primarily extends along the western side of the San Joaquin River and Tulare Lake Regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions of the San Joaquin River Region, natural drainage conditions are inadequate to remove the quantities of deep percolation that accrue to the water table. Therefore, groundwater levels often encroach on the root zone of agricultural crops, and subsurface drainage must be supplemented by constructed facilities for irrigation to be sustained. Few wells pump from this shallow groundwater zone because of high salinity concentrations.

South San Joaquin Irrigation District (SSJID) Service Area

No Action. Agricultural subsurface drainage is not a significant problem in the San Joaquin Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus and San Joaquin Rivers.

Proposed Action. The San Joaquin River Agreement flows would raise water levels temporarily in the San Joaquin River, which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flows would not exceed 7,000 cfs (measured at Vernalis) and are not large enough to cause a significant impact on agricultural subsurface drainage within the SSJID service area.

Alternative Action. Additional flows released to implement the Water Right Priority System alternative may raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped by SSJID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

Oakdale Irrigation District (OID) Service Area

No Action. Agricultural subsurface drainage is not a significant problem in the Oakdale Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus River.

Proposed Action. The San Joaquin River Agreement flows from OID would result in minor rises in water levels in portions of the Stanislaus River which flows through OID and subsequently would raise water levels temporarily in the San Joaquin River. This potential rise is insignificant and would have a very low potential to cause additional agricultural subsurface drainage. The 31-day pulse and other flows are not large enough to cause an impact on agricultural subsurface drainage within the OID service area.

Alternative Action. Additional flows released to implement the Water Right Priority System alternative may raise water levels in the Stanislaus River and subsequently result in minor rises in water levels in the San Joaquin River. This rise in water levels may have a slight, but temporary, impact on agricultural subsurface drainage in areas adjacent to the rivers. Groundwater pumped by OID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

Modesto Groundwater Basin

Drainage wells have been employed by MID to control shallow groundwater levels in the western part of the MID service area since 1918 (MID 1996). The drainage wells pump excellent quality groundwater to maintain groundwater levels below the crop root zone. Maintaining the water table below the crop root zone also maintains the salt balance within the root zone.

The area affected by shallow groundwater and quantity of shallow groundwater pumped has declined through the years because of the increased use of groundwater in the Modesto area. The use of many of the drainage wells in areas no longer affected by shallow groundwater has been discontinued or the wells are now used as irrigation wells (MID 1996).

No Action. As reported by MID, agricultural subsurface drainage in the Modesto Groundwater Basin is declining as groundwater extraction has increased in the urban Modesto area. Groundwater usage in the urban Modesto area is projected to expand in response to population growth. Agricultural subsurface drainage should continue to decline in areas that are hydraulically connected to groundwater pumping near Modesto.

Proposed Action. The Spring pulse flow would raise water levels temporarily in the San Joaquin River which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough (7,000 cfs or less at Vernalis) to have a significant impact on agricultural subsurface drainage within the MID service area.

Alternative Action. MID would not be required to curtail surface water deliveries. However, other water right holders could be called upon to participate in the Water Right Priority System. This action could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. The expansion of groundwater pumping in the Modesto urban area should have the reverse effect and locally depress water levels reducing potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is considered a less-than-significant impact.

Turlock Groundwater Basin

Several areas in the western portion of the Basin experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet from ground level would not be uncommon, resulting in agricultural subsurface drainage and potentially adverse impacts to local crop production (TID 1997).

To minimize these potentially adverse impacts on crops, TID provides groundwater control or drainage pumping in areas where groundwater levels are within six feet of the ground surface. TID owns and operates approximately 170 drainage wells within their service area. In recent history subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage is typically discharged into the District's canal system where it is utilized, as much as possible, for irrigation (TID 1997).

No Action. TID reports that several areas in the western portion of the Basin experience localized high groundwater levels that are controlled by drainage pumping. Localized areas with the Turlock

Groundwater Basin should continue to experience subsurface drainage in areas where groundwater levels approach the ground surface.

Proposed Action. The pulse flow would raise water levels temporarily in the Tuolumne and San Joaquin Rivers which have a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough to have an impact on agricultural subsurface drainage within the TID service area.

Alternative Action. While TID would not be required to curtail surface water deliveries, other water right holders could be responsible for releasing additional flows to implement the Water Right Priority System, and this action may raise water levels in the San Joaquin River and subsequently have an impact on agricultural subsurface drainage in areas adjacent to the river. Increased groundwater pumping to offset reductions in deliveries would help to depress water levels. Assuming both processes occur, the effect is expected to be less than significant.

Merced Groundwater Basin

The area of the Basin located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has experienced localized high groundwater levels (Merced ID 1997). Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet below the ground surface would not be uncommon, resulting in potentially adverse impacts to local crop production (Merced ID 1997).

To minimize these potentially adverse impacts, Merced ID provides groundwater control in areas where groundwater levels were within six feet of the ground surface. This condition within Merced ID has declined steadily over the last 10 years. As a result, many of the drainage wells are now used exclusively for irrigation during periods when insufficient surface water is available. Water pumped from these wells is typically discharged in to District's water distribution system where it is utilized, as much as possible, for irrigation (Merced ID 1997).

No Action. Merced ID reports that an area in the northwestern portion of the basin experiences localized high groundwater levels that are controlled by drainage pumping. However, agricultural subsurface drainage in the Merced Groundwater Basin has continually declined over the past ten years. Agricultural subsurface drainage should continue to decline in areas that are overdrafted.

Proposed Action. The SJRA flows would raise water levels in the Merced and San Joaquin Rivers which have the potential to locally increase the occurrence of local agricultural subsurface drainage. The small increase in flows and water levels would have a less-than-significant impact on agricultural subsurface drainage within the Merced ID service area.

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Alternative Action. Merced ID would not be required to release water to implement the Water Right Priority System, but other water right holders could be affected. The additional flows could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. With existing drainage control wells and potential increases in groundwater pumping to offset reductions in surface water deliveries, the overall impact to subsurface drainage would be less than significant.

Exchange Contractors Water Authority Service Area

No Action. Approximately ten percent of the Exchange Contractors Water Authority service area experiences some subsurface drainage problems. To minimize these potentially adverse impacts, the Exchange Contractors maintain a system of groundwater control wells in areas where groundwater levels may rise to within six feet of the ground surface (SJRECWA 1997).

Proposed Action. The addition of up to 11,000 acre-feet to the San Joaquin River at a rate of 7,000 cfs or less at Vernalis would not raise water levels significantly. The 31-day pulse flow period would not have an impact on agricultural subsurface drainage within the Exchange Contractors service area.

Alternative Action. Additional flows released to implement the Water Right Priority System may raise water levels in the San Joaquin River and could be large enough to have an impact on agricultural subsurface drainage in areas adjacent to the river. With problems occurring in very limited areas and existing groundwater control wells, the impact would be less than significant.

4.3.3 Impact Summary and Mitigation of Impacts

4.3.3.1 Groundwater Overdrafting

Proposed Action

- Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no increase in overdrafting within the SSJID service area as a result of this action. No mitigation is necessary.

- Maximum annual water diversion for instream flows event from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet of this water may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID's service area. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. There would be no additional overdrafting within the Modesto Groundwater Basin as a result of this action. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. There would be no impacts to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flow.

- The maximum annual surface water diversion for the flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the Merced Groundwater Basin (DWR 1998). This could result in a significant impact to the groundwater basin. Mitigation could include implementing a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the Exchange Contractors project that the amount of this water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 2.2 percent of the Delta Mendota Basin production rate of 511,000 acre-feet per year. This amount would result in a less-than-significant impact to the basinwide overdraft problem. No mitigation is necessary.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the San Joaquin River Basin. While an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas,

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importing water to supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater. Mitigation would reduce the impacts to less than significant.

4.3.3.2 Water Levels

Proposed Action

- Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on water levels within the service area. No mitigation is necessary.

- Maximum annual water diversion for instream flows from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to the water levels within OID's service area as a result of this action. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. This action would result in no impact to the water levels in Modesto Groundwater Basin. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. This action would have no impact on water levels within the Turlock Groundwater Basin. No mitigation is necessary.

- The maximum annual surface water diversion for the flow events from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This could result in a significant impact to water levels within the groundwater basin. Mitigation includes implementing groundwater management programs to reduce pumpage or increase recharge. Measures could include a proposed conjunctive groundwater use program, programs to improve conservation of surface water, restrictions or limitations to groundwater pumping in highly overdrafted areas, importation of water to supplement the loss of groundwater, or supplementation of groundwater with treated water.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents approximately 2 percent of the typical annual groundwater production rate of 511,000 acre-feet per year in the Delta Mendota Basin, a less-than-significant impact to groundwater levels within the Exchange Contractors service area. No mitigation is required.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water.

4.3.3.3 Water Quality

Proposed Action

- SSJID projects that no groundwater would be pumped to provide water for achieving the VAMP pulse flow. This action would have no impact on groundwater water quality within the SSJID service area. No mitigation is required.

- OID projects that a maximum annual water diversion for the instream flows from their service area is 26,000 acre-feet. Of this volume, OID projects that the amount of this water that may come directly from groundwater ranges from zero to 15,000 acre-feet. This increase in groundwater extraction is projected to be balanced by additional inflow into the OID service area. There should be no impact to water quality as a result of this action. No mitigation is necessary.

- No groundwater would be pumped by MID from the Modesto Groundwater Basin, so there would be no impact to groundwater quality within the basin. No mitigation is required.

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- TID projects that no groundwater would be pumped to provide water for achieving the SJRA pulse flow. This action would have no impact on water quality within the Turlock Groundwater Basin. No mitigation is required.

- The Merced ID projects that a maximum annual surface water diversion for the SJRA flows is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater(to replace surface water reductions), this may increase TDS slightly and could result in a less-than-significant impact to groundwater quality. No mitigation is required.

- The Exchange Contractors project that the maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre feet. DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractor's service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre feet per year (DWR 1998). Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the basin. The impact on groundwater quality in the service area is less than significant. No mitigation is required.

Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact on groundwater quality. Mitigation measures could include limiting or restricting groundwater pumping in affected areas to improve groundwater quality, implementing a conjunctive use program, and implementing programs to improve conservation of surface water supplies to lessen future demands for groundwater.

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4.3.3.4 Subsidence

Proposed Action

- SSJID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within their service area. No mitigation is necessary.

- OID projects that the amount of water that may come from groundwater to achieve the instream flows ranges from zero to 15,000 acre-feet per year. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area would be recharged by inflow from the Stanislaus River. These actions should not result in a negative impact to subsidence within OID's service area. No mitigation measures are required.

- MID projects that no groundwater would be pumped to achieve the SJRA pulse flow. There would be no impact on subsidence in the Modesto Groundwater Basin. No mitigation is required.

- TID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within the Turlock Groundwater Basin. No mitigation is required.

- The maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Merced ID projects that the amount of water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet per year. Based on the worst case, if the total amount comes from groundwater storage, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur which are potentially significant impacts to the Merced Groundwater Basin. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre feet. Of this volume, the amount of this water that may come from groundwater ranges from zero to 11,000 acre feet. Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the area. This is a less-than-significant impact on subsidence in the service area. No mitigation is required.

Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from all of these districts is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, an objective determination of the magnitude of impact on land subsidence for each service area or sub-basin is not possible; the effect is considered a potentially significant impact. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

4.3.3.5 Agricultural Subsurface Drainage

Proposed Action

- The pulse flow may temporarily raise water levels within the San Joaquin River and its tributaries as it flows along the boundaries of the San Joaquin River Group Authority willing sellers' service areas. However, the 31-day pulse flow period and other identified flows would have no impact on agricultural subsurface drainage within the willing sellers' service areas. No mitigation is required.

Alternative Action

- The action would raise water levels in the San Joaquin River and affect agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped to replace reductions in surface water deliveries would have a reverse effect and locally depress water levels. Assuming that both processes would occur, the effect is less than significant. No mitigation is required.

4.4 TERRESTRIAL RESOURCES

Terrestrial resources are divided into two sections: riparian vegetation and wildlife species.

Predicted impacts to riparian vegetation are based upon extensive riparian oriented field experience on other gravel and sand-bedded rivers in California. Specifically, considerable time has been spent studying riparian vegetation and relationships to hydrology and fluvial geomorphology on the Tuolumne River. While it is acknowledged that San Joaquin River, Merced River, and Stanislaus River terrestrial resources are inherently different than those of the Tuolumne River, due to land management practices, geology, and watershed size, after a field inspection of each river it was felt that the differences between rivers were not significant enough to warrant detailed independent comparisons of each. Instead, a prior understanding of the Tuolumne River riparian vegetation relationships to the physical environment was extrapolated to observations made on the San Joaquin River and its major tributaries (Merced and Stanislaus rivers).

Impacts to wildlife resources are based on changes in the quality of habitat as the result of loss or change of habitat. The changes in vegetation and resulting changes in terrestrial habitat are used as the measure of impacts on wildlife. The severity of impacts is determined by the magnitude of changes in quality or condition of terrestrial habitat and the potential for adversely affecting any threatened and endangered species (TES).

The habitat requirements of each TES wildlife species, as defined in the literature (CNDDB and WHR), were used to evaluate the effect of changes resulting from the proposed alternatives. It is assumed that the distribution and abundance of TES species is proportional to the amount and quality of habitat available. Assessment of impacts is based on the potential to impact TES species, their habitat, and/or their range. Although rare, threatened, and endangered plant species are known to live in the project area (Appendix D, Table D-2), field inspection within the riparian corridor has shown that no TES plant species live in the corridor and are all associated with non-riparian habitat types (Appendix D, Table D-1).

4.4.1 Key Impact Issues and Evaluation Criteria

4.4.1.1 Riparian Vegetation

Key impact issues for riparian vegetation are those that cause a positive or negative change to riparian vegetation health or survival. Where possible, impacts of stress are differentiated from impacts causing mortality to riparian vegetation.

Consistent with other sections in this chapter, impacts of the alternatives to riparian vegetation are assessed in terms of "significant impact", "potentially significant impact", "less than significant

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impact (if mitigated)", and "no impact." This section identifies specific impacts to riparian vegetation, identifies specific thresholds of significance criteria for impact determination, assesses each alternative with respect to these significance criteria, and recommends measures to mitigate potential negative impacts. Conclusions relevant to CEQA and NEPA are the impacts of the two alternatives in comparison to the No Action alternative.

Potential Impact Types

Because riparian vegetation can both benefit from and be negatively impacted by the exact same process, many impacts of the alternatives can be positive, negative, or a mixture of both. For example, plant scour during excessively high flows can uproot all the riparian vegetation causing plant death. In most circumstances however, moderate amounts of plant scour result in positive impacts including preventing riparian encroachment, encouraging woody debris input and channel complexity, and cropping ecological succession so as to keep early seral stages in higher levels of productivity. In addition, riparian plants are negatively impacted by a variety of factors, including insufficient water availability during their growing season, and sand and silt deposition around the plant root collars (causing suffocation). The significance of the potential impacts not only has temporal aspects (depending on season and duration), but also magnitude/stage height aspects as well. The evaluation of the alternatives, combined with an understanding of riparian plant life history, narrowed down the range of potential impacts, as follows.

Potential positive impacts include:

- Improved natural riparian regeneration on surfaces at or near the bankfull channel/floodplain transition zones.
- Increased survival of established riparian vegetation.
- Slowing the decline in the health of relic stand riparian vegetation by increasing ground water availability.
- Improved natural riparian regeneration by timing pulse flows to coincide with seed dispersal periods of plant species whose populations are currently declining (e.g., Fremont cottonwood).
- Increased overall areal abundance in riparian vegetation in the project area.

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Potential negative impacts include:

- Rapid downramping rates could cause stresses or mortality to riparian vegetation (due to desiccation or inundation). The summer Tuolumne flows, set by FERC, would always meet minimum flows, regardless of alternative.

- Increased abundance and/or areal extent of nuisance/exotic species (tree of heaven, eucalyptus, and other drought tolerant species with long lived seeds) due to flow timing not being correlated with native species seed dispersal periods.

- Encouraged growth of riparian encroachment along low flow channel margins (during dryer years) due to absence of high flows facilitates the initiation, establishment, and maturation of encroaching vegetation such as narrow-leaf willow, box elder, and white alder. This encroachment concurrently decreases riparian vegetation age and species diversity.

Perceived but not significant impacts include:

- Mortality to riparian vegetation due to recurring high flow scour events thus suppressing natural regeneration. Recommended flows, however, would not be of sufficient magnitude and frequency to cause this type of impact.

- The survival, regeneration, and bank location for each species. Due to magnitude and frequency of flows, this would change over current conditions.

Several components of the alternatives that could cause direct impacts to riparian vegetation include the magnitude of peak flows, the timing of high flows, and the ramping rates on ascending and descending limbs of high flows. Plant growth, germination, and establishment are periods during the plant's annual life history that have sensitivity to such changes and thus could potentially be impacted by the proposed alternatives (Figure 3.4-1).

Project alternatives would have little or no affect on riparian vegetation as long as the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000 to 8,000 cfs on the Tuolumne River). Consequently, impacts associated with flow timing are:

- Spring (March-May): Most riparian plants begin annual growth and flower during early spring; by late spring Fremont cottonwoods are dispersing their seeds (Figure 3.4-4). Initiating riparian seedlings are susceptible to mortality caused by downramping rates that exceed their root growing capabilities. April and May pulse flows for both alternatives begin and end during Fremont cottonwood's initiation period and would potentially impact this

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species. The alternatives having the most adverse impacts on riparian vegetation would occur during spring months.

- Summer (June-August): Riparian plants grow at their maximum potential during summer. Most riparian plants have finished seed dispersal, with the exception of narrowleaf willows (Figure 3.4-4). Stable summer flows experienced under No Action and the two alternative actions could potentially increase the encroachment of the invasive, narrowleaf willow. A long-term, cumulative indirect impact of low summer flows could be additional loss of riparian habitat due to enhanced encroachment by narrow-leaf willows (due to their long seed dispersal period).

- Fall (September-November): Riparian plants become dormant in the fall as valley oak, box elder, and white alder disperse seeds. Significant deviations in flows above or below the No Action alternative are not expected to have significant negative impacts.

- Winter (November-February): Riparian plants are dormant during winter. Flows of sufficient magnitude to induce bed mobility could scour establishing 1 and 2 year old plants. This could be either a positive or negative impact, depending on previous sequencing of scouring flows, however as long the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000 to 8,000 cfs on the Tuolumne River) no impacts are anticipated.

Many stress or mortality factors could cause negative impacts (Figure 3.4.4). By overlaying these mortality factors with life history trends, flow timing, magnitude, and ramping, impact thresholds can be developed above which significant impacts to riparian vegetation would likely occur. Stressors which could potentially create impacts (during times of year when vegetation is most susceptible) include:

- Desiccation - Decreases in soil moisture immediately adjacent to the channel caused by changes in groundwater levels resulting from rapid flow rampdown can cause water availability stress, reducing growth and potentially causing death. Several species can grow roots quickly to follow a decreasing wetted soil front, but not necessarily fast enough to prevent stress or death (Segelquist et al. 1993). This could be a primary impact on riparian vegetation.

- Inundation - Prolonged inundation during extended duration spring and summer high flows can drown vegetation. The mortality of vegetation within active channels could reduce encroachment of vegetation and enhance the deposition of fine sediments (positive impact). Conversely, inundation may prevent seed access to areas that could serve as germination sites. This could be a primary impact on riparian vegetation.

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- Scour - One and two year-old riparian plants are most susceptible to scour mortality, because their roots are shallow and not well developed. Higher flows may mobilize silt, sand, and small gravel during winter peaks, scouring and killing newly established riparian vegetation. Spring and summer flow magnitude and timing may impact mortality due to scour because flows during this window define where a given year's cohort initiates. Low flows during the seeding period coupled with seed establishment close to the low water edge, result in the potential for scour-related mortality during upcoming winter peak increases. If flows during the seeding period are higher, then riparian establishment would be occur higher on the channel margin, thus decreasing the potential for winter scour related mortality.

- Deposition - As flows recede following high flows, sand and silts deposition occurs. Sediment deposition around the root collars of several riparian species (e.g., box elder, white alder) could suffocate vegetation if the deposits are deep enough (~ 0.5-1.0 feet deep). The significance of this secondary impact depends on the inundation impact on riparian regeneration.

Thresholds of Significance

Determining whether an alternative had a negative or positive impact on riparian vegetation depended upon how an alternative flow schedule interacted or impeded each species life history. The following thresholds of significance criteria were defined for determining potential impacts:

- Discharges during April 1-June 1 (spring) created potential impacts if:

  1. The magnitude and duration of flows are sufficient to inundate floodplains during seed dispersal period and initiation period, potentially creating a positive impact.

  2. Stage decreased at a rapid rate after May 1, primarily during flowramping, could potentially create a negative impact to germinating and establishing Fremont cottonwood seedlings.

  3. Stage increased during, or after, Fremont cottonwood seed dispersal period, drowning newly initiated plants could potentially create a negative impact.

- Discharges during June 1-Sept 30 (summer) created potential impacts if: Summer base flows were achieved by June 15 and did not have wide day to day variation over the three month period, thereby encouraging narrowleaf willow encroachment along the low water channel and potentially creating a negative impact.

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- Discharges during October 1-March 31 (fall/winter) created potential impact if: Bedload mobilization thresholds were reached, discouraging narrowleaf willow encroachment, thereby potentially creating a positive impact.

4.4.1.2 Wildlife

Consistent with other sections, impacts of the three alternatives to wildlife species are assessed in terms of "significant impact", "potentially significant impact", "less than significant impact ", and "no impact." This section identifies impacts to wildlife habitat, identifies specific thresholds of significance criteria for impact determination, assesses each alternative with respect to these significance criteria, and recommends measures to mitigate potential negative impacts if needed. Impacts to wildlife, to a large extent, are reflected from changes in vegetation. Therefore, impacts to wildlife are closely tied to the vegetation impacts discussed above.

Those species associated with valley riparian communities are the ones most likely to be impacted as a result of the alternatives. Positive and negative impacts discussed in the vegetation section illustrate the range of potential impacts to wildlife habitat. Changes in vegetation and associated wildlife habitat may result in a shift of species presence within the riparian system, where some areas may see a reduction in quantity of riparian habitat and others are improved in the quality. Wildlife species most likely to be affected are those that rely on riparian habitat to fulfill several critical life requisites such as primary foraging or nesting habitat. In addition, those species that use riparian corridors to move throughout the region may also be positively or negatively, impacted depending on the resulting change or alteration in riparian vegetation.

The significance criteria for evaluation of impacts to wildlife resources are:

- Temporary or permanent removal, filling, grading, or disturbance of wetlands and riparian communities;
- Substantial decrease in the area of important wildlife habitats or use areas in the San Joaquin, Merced, Stanislaus, and Tuolumne river systems;
- Substantial fragmentation or isolation of wildlife habitats or movement corridors, especially riparian and wetland habitats;
- Loss of occupied TES species habitat or direct mortality of TES species;
- Reduction in area or habitat value of critical habitat areas designated under the federal Endangered Species Act.

4.4.2 Environmental Consequences

Potential impacts for the SJRA alternative and the Water Right Priority System alternative are compared to the No Action alternative and to the existing conditions described in Section 3.4.2. Each alternative was evaluated separately, and no comparison between the SJRA alternative and the Water Right Priority System alternative was made. Using the thresholds of significance criteria requires a shorter time-step (hourly or daily) than that provided by the simulation model (monthly). Because of differences in the temporal resolution of the model compared to plant life history, the SJRA alternative thresholds of significance were evaluated using flow data for water year 1993, (a wet water year class) and water year 1994 (a below normal water year class); prior years when pulse flows occurred on the Tuolumne River. The SJRA alternative was compared to water years 1972 and 1978, years that were similar in water year class but did not have pulse flows. Potential impacts identified by this analysis on the Tuolumne River are inferred to have occurred on the other tributaries as well.

4.4.2.1 Riparian Vegetation

No Action

Due to the combination of contemporary hydrologic and geomorphic processes, human disturbance, each riparian plant's specific physiologic tolerances, and the invasion of ruderal plants, no change to the current condition of a narrow riparian corridor with low species diversity described in Section 3.4.1 would occur. Plant communities would remain as described in the affected environment section. The threat of riparian encroachment by exotic species can increase in many of the tributaries as other channel restoration projects are implemented. Newly created alluvial surfaces that provide high quality salmonid habitat are vulnerable to riparian initiation and eventual encroachment. Preventing or avoiding narrowleaf willow encroachment is important in project areas where channel restoration has improved channel morphology (such as the Tuolumne River).

Proposed Action

The SJRA alternative simulates average monthly discharges using three models, and because of different modeling assumptions, the SJRA alternative was simulated for the months of April and May (instead of April 15- May 15).

One hydrograph for each water year class was generated for each modeled node in the project area (Figure 4.4-1 through Figure 4.4-25). The hydrographs portray the actual gaged discharges for that water year, the No Action alternative discharge simulation, the April pulse flow simulation and the May pulse flow simulation. If the flows for each alternative are equal for a given time period, the lines are superimposed and will appear as one thick line on the hydrograph. For example, on Figure

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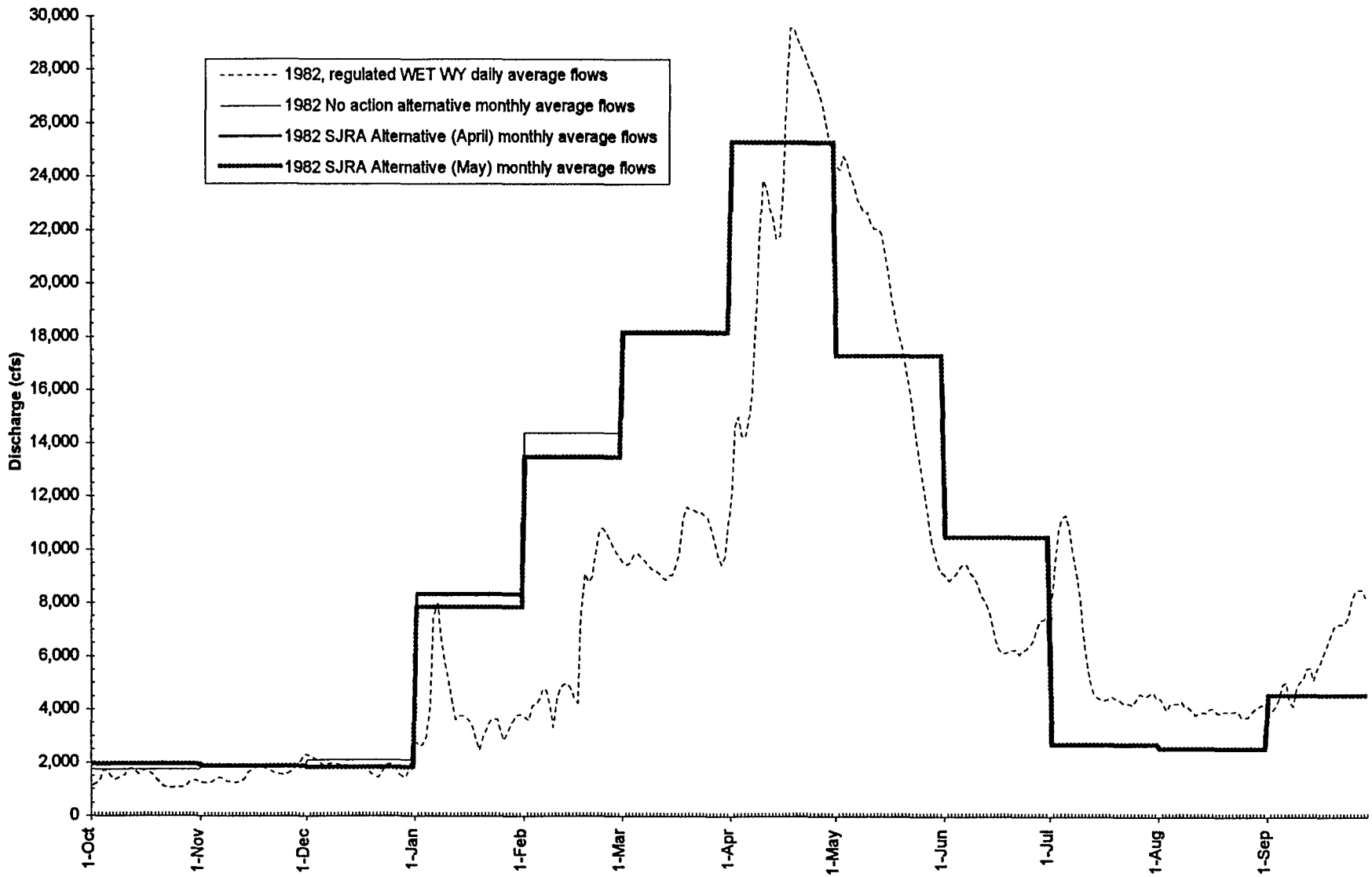

Figure 4.4-1. Annual hydrograph for the San Joaquin River near Vernalis, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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C-095923

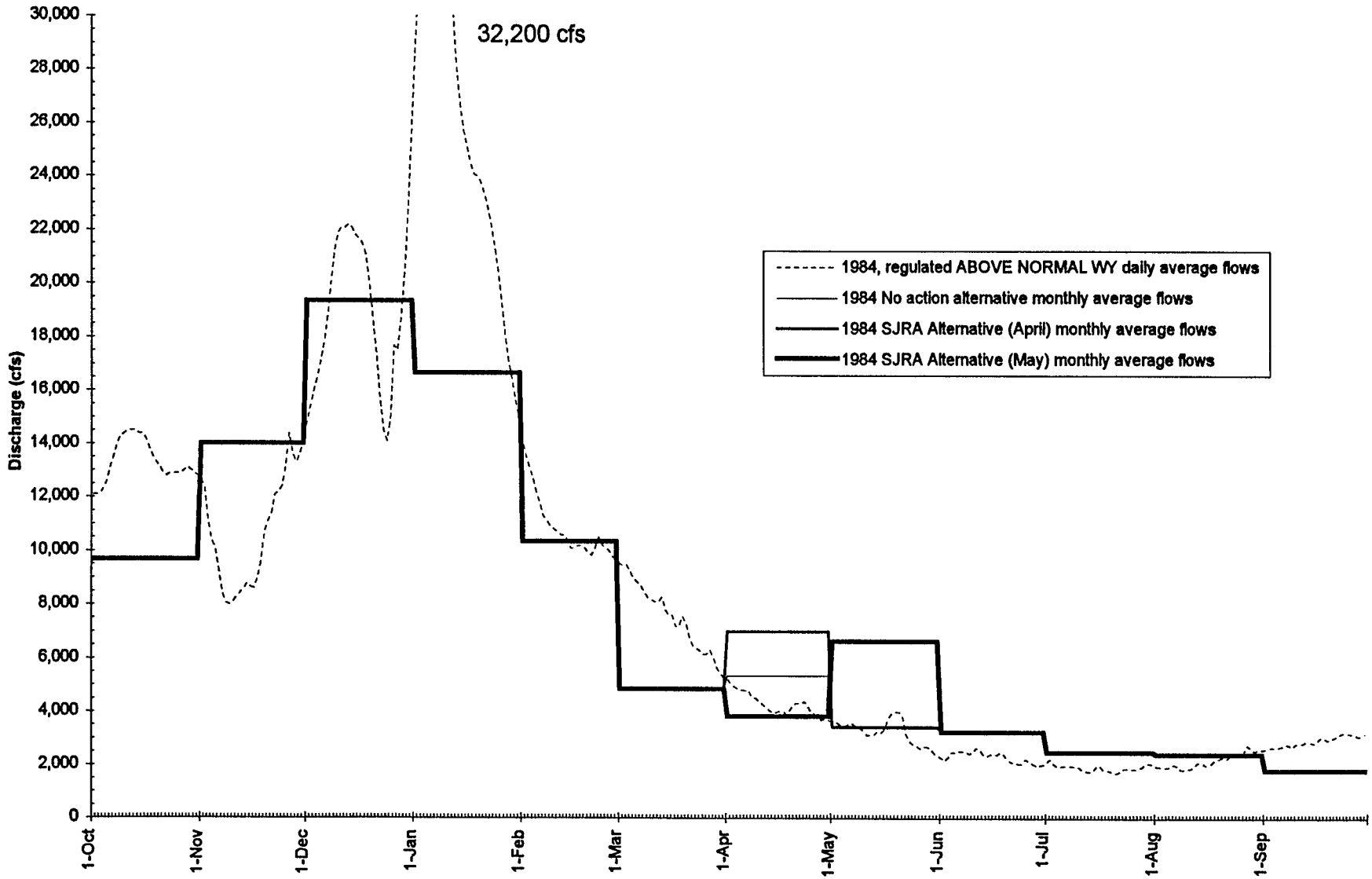

Figure 4.4-2. Annual hydrograph for the San Joaquin River near Vernalis, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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C-095924

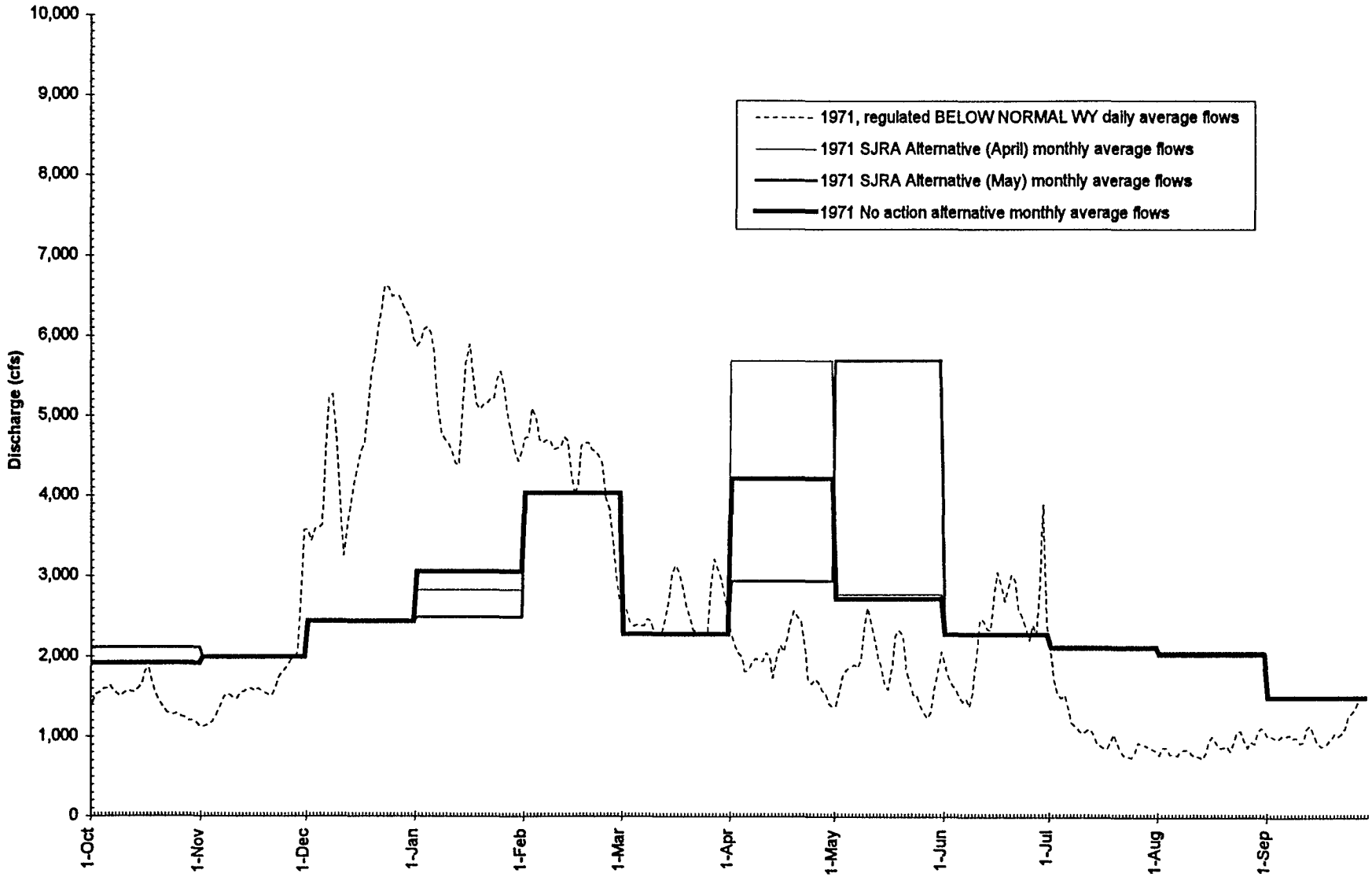

Figure 4.4-3. Annual hydrograph for the San Joaquin River near Vernalis, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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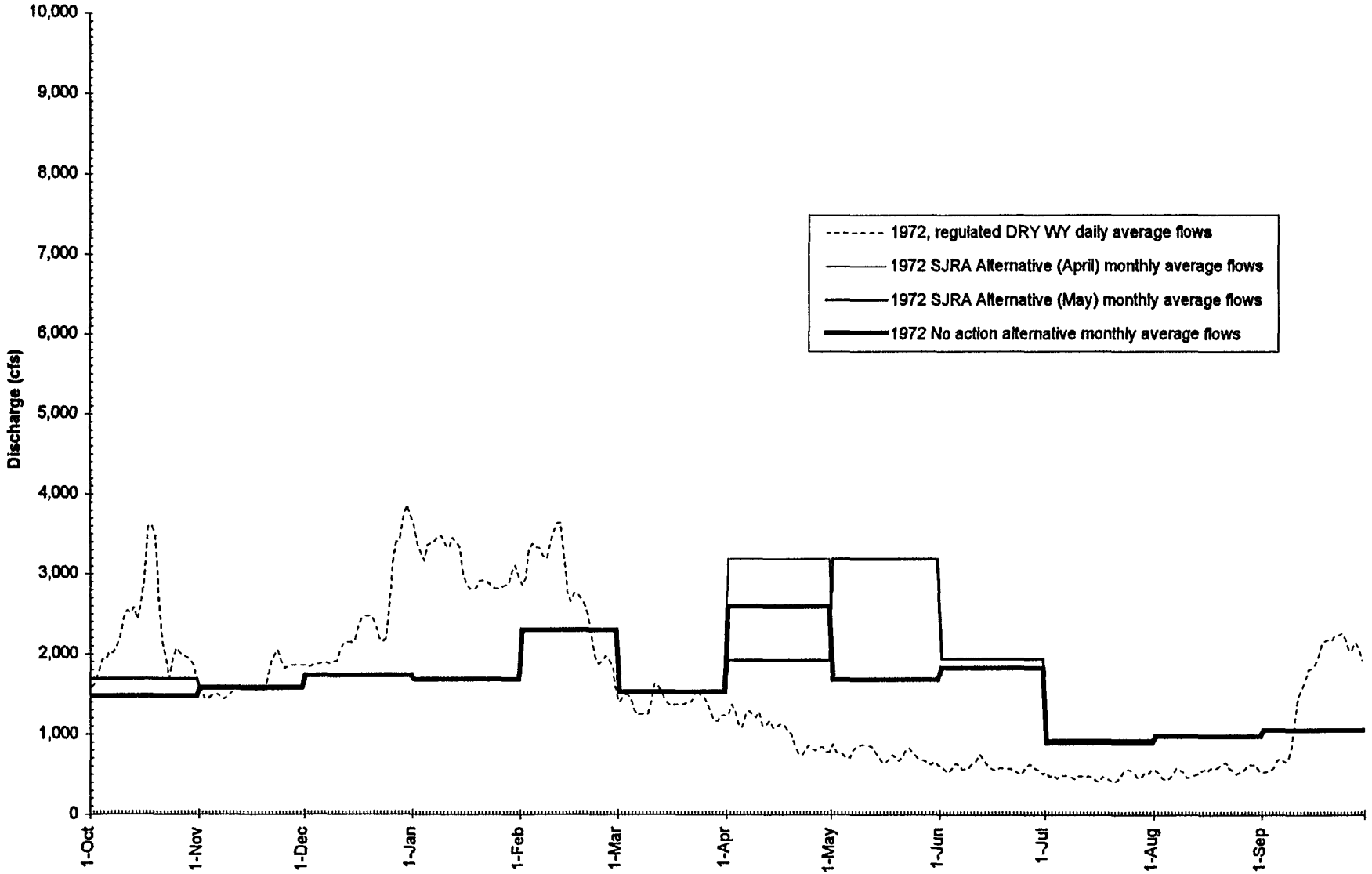

Figure 4.4-4. Annual hydrograph for the San Joaquin River near Vernalis, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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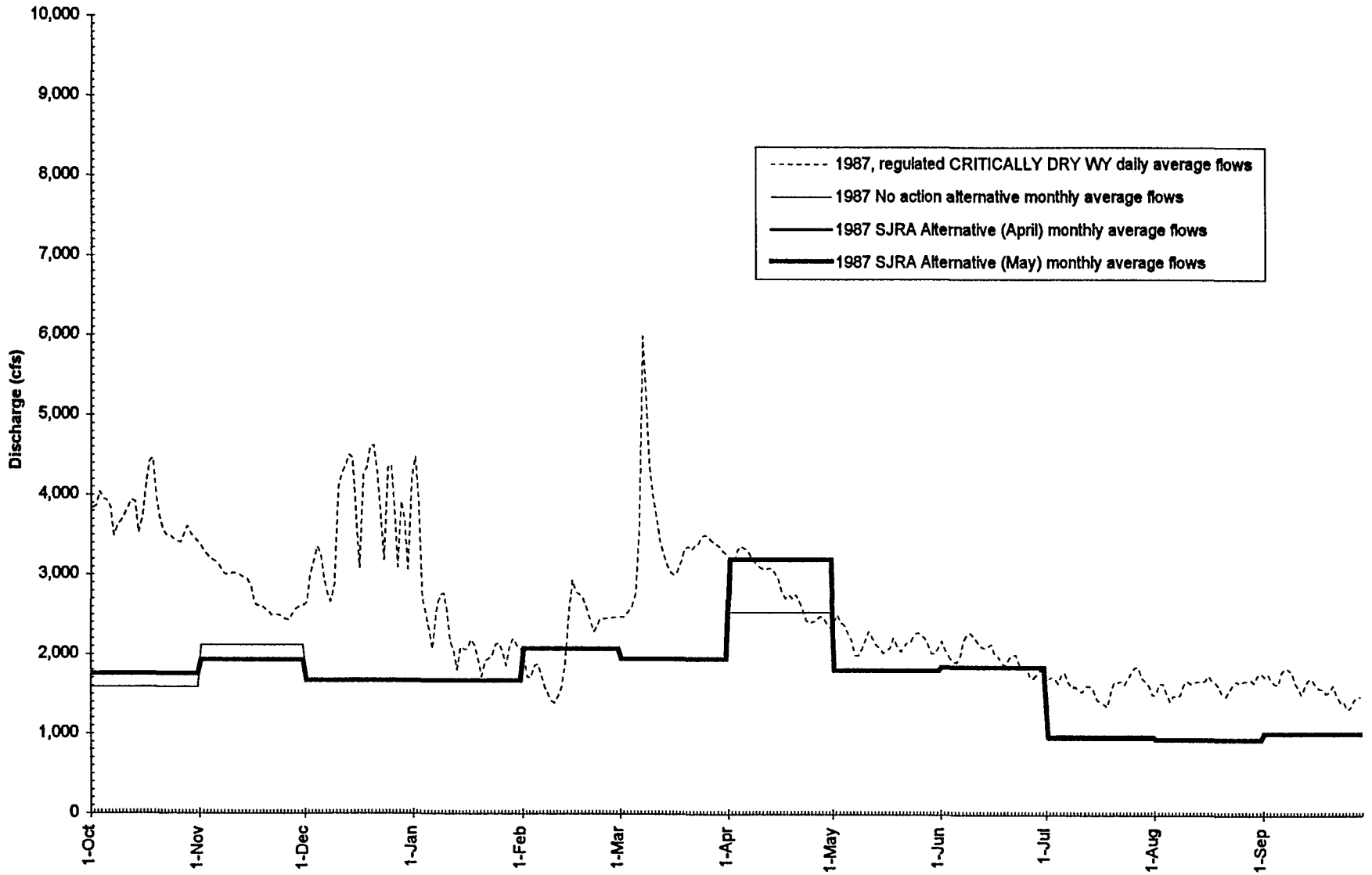

Figure 4.4-5. Annual hydrograph for the San Joaquin River near Vernalis, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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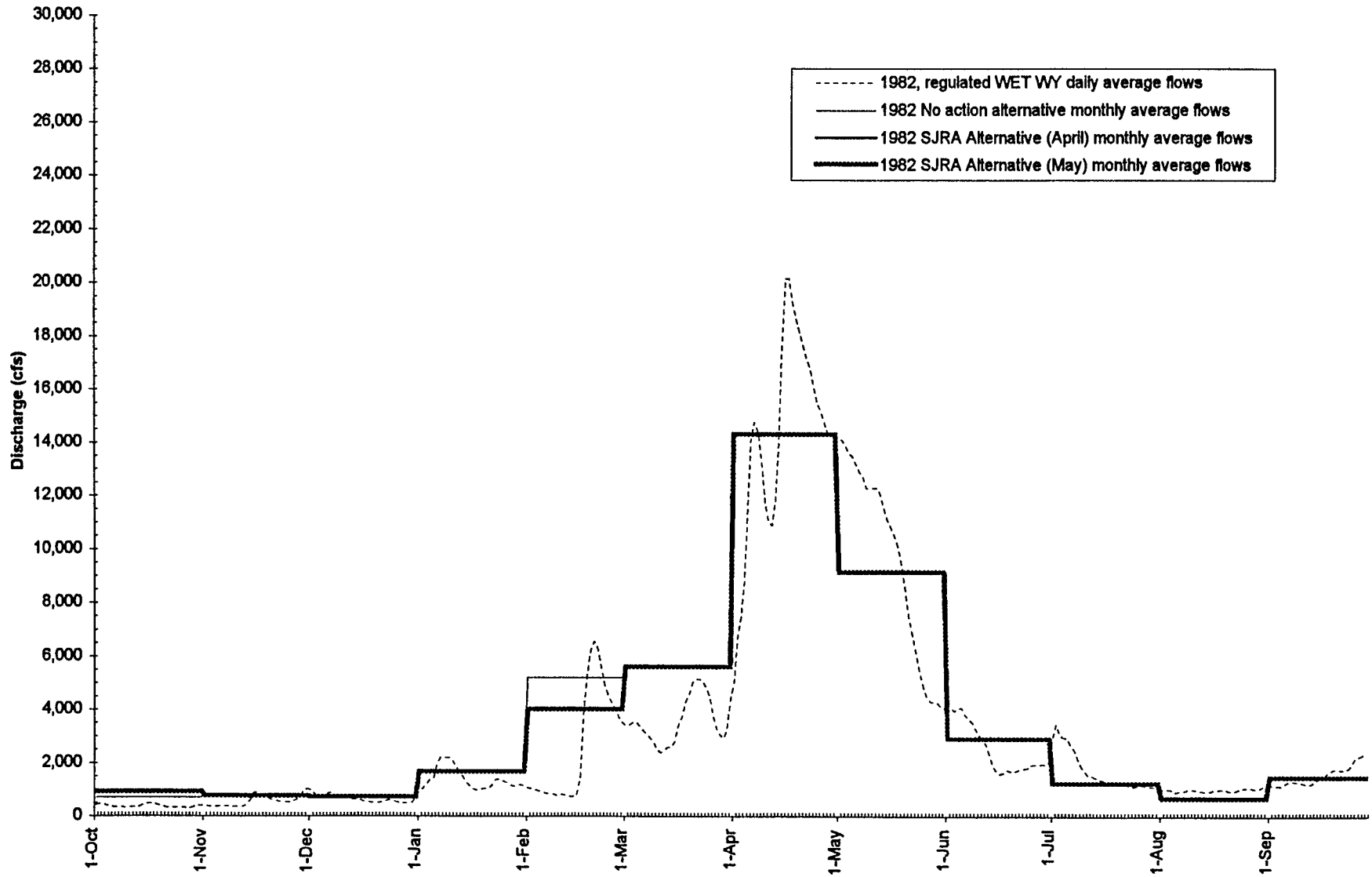

Figure 4.4-6. Annual hydrograph for the San Joaquin River near Newman, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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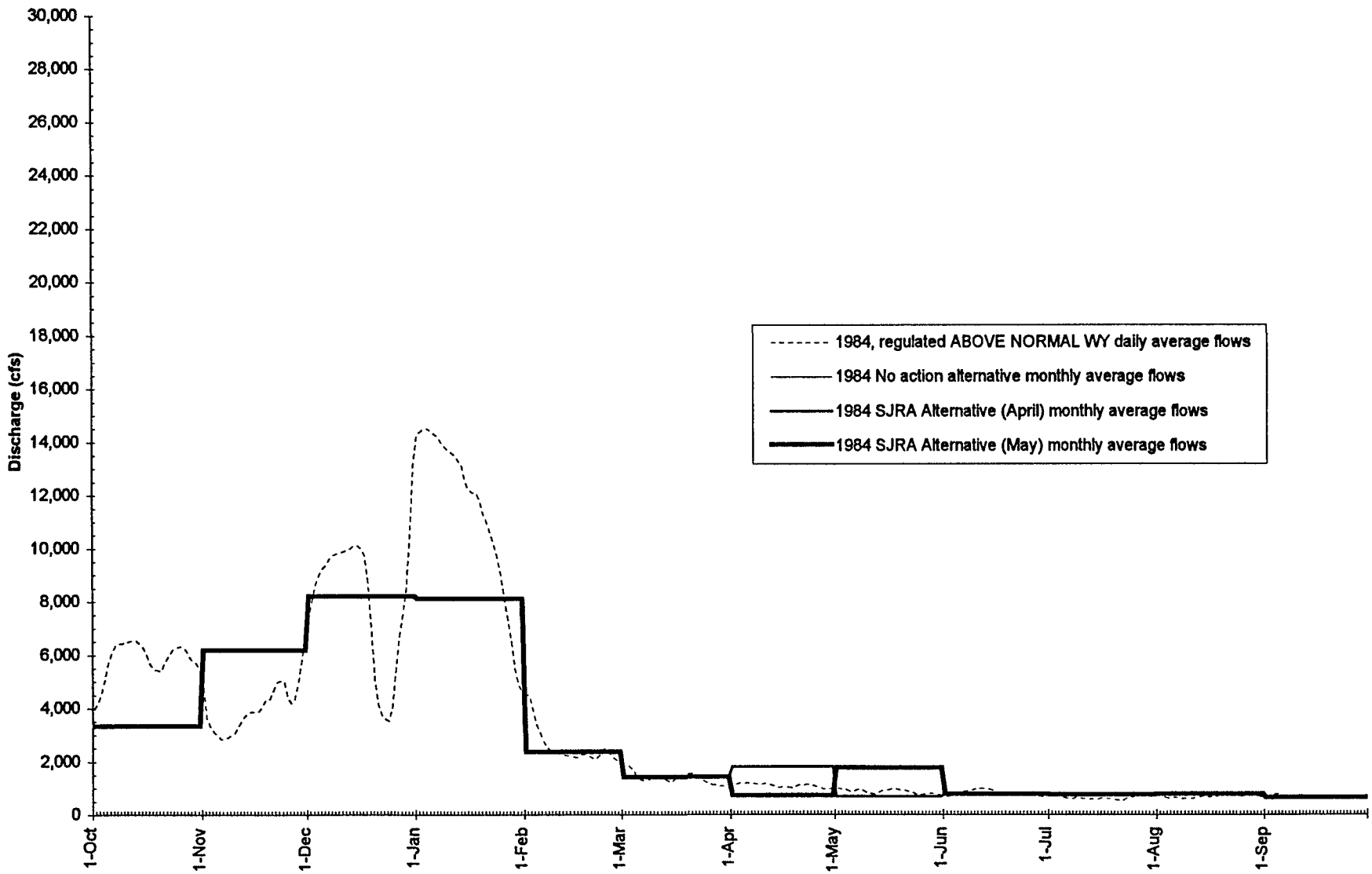

Figure 4.4-7. Annual hydrograph for the San Joaquin River near Newman, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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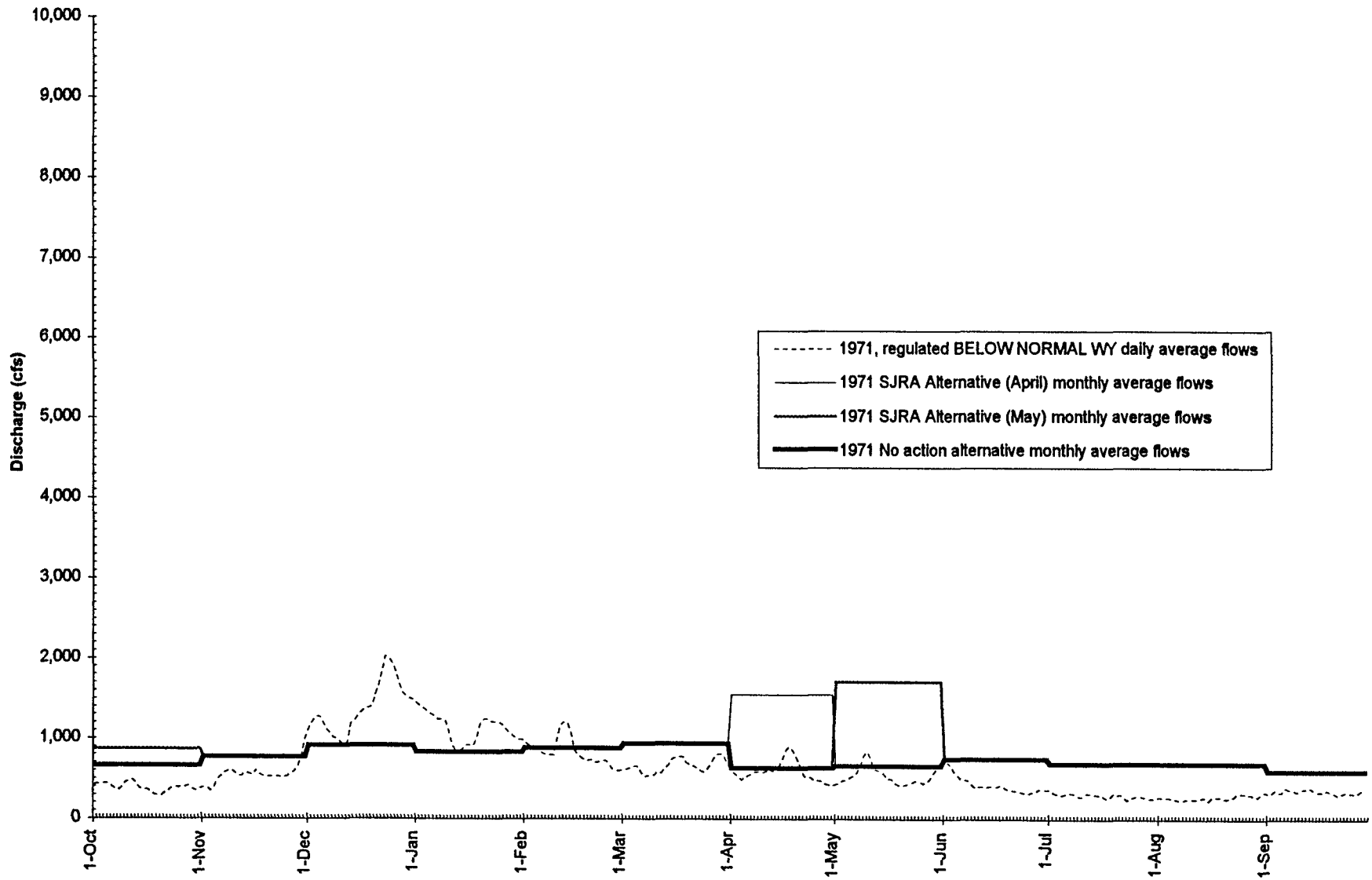

Figure 4.4-8. Annual hydrograph for the San Joaquin River near Newman, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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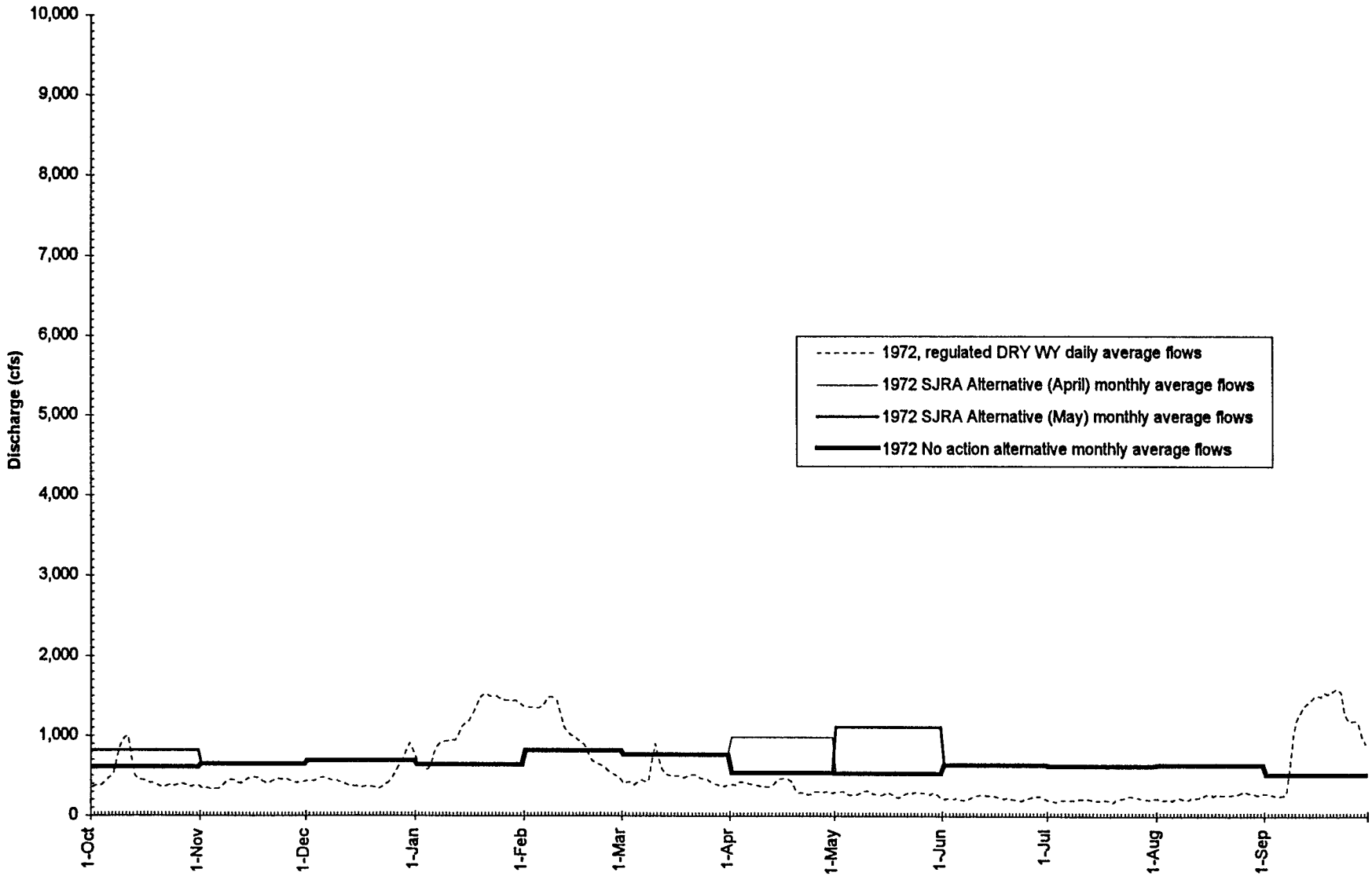

Figure 4.4-9. Annual hydrograph for the San Joaquin River near Newman, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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C-095931

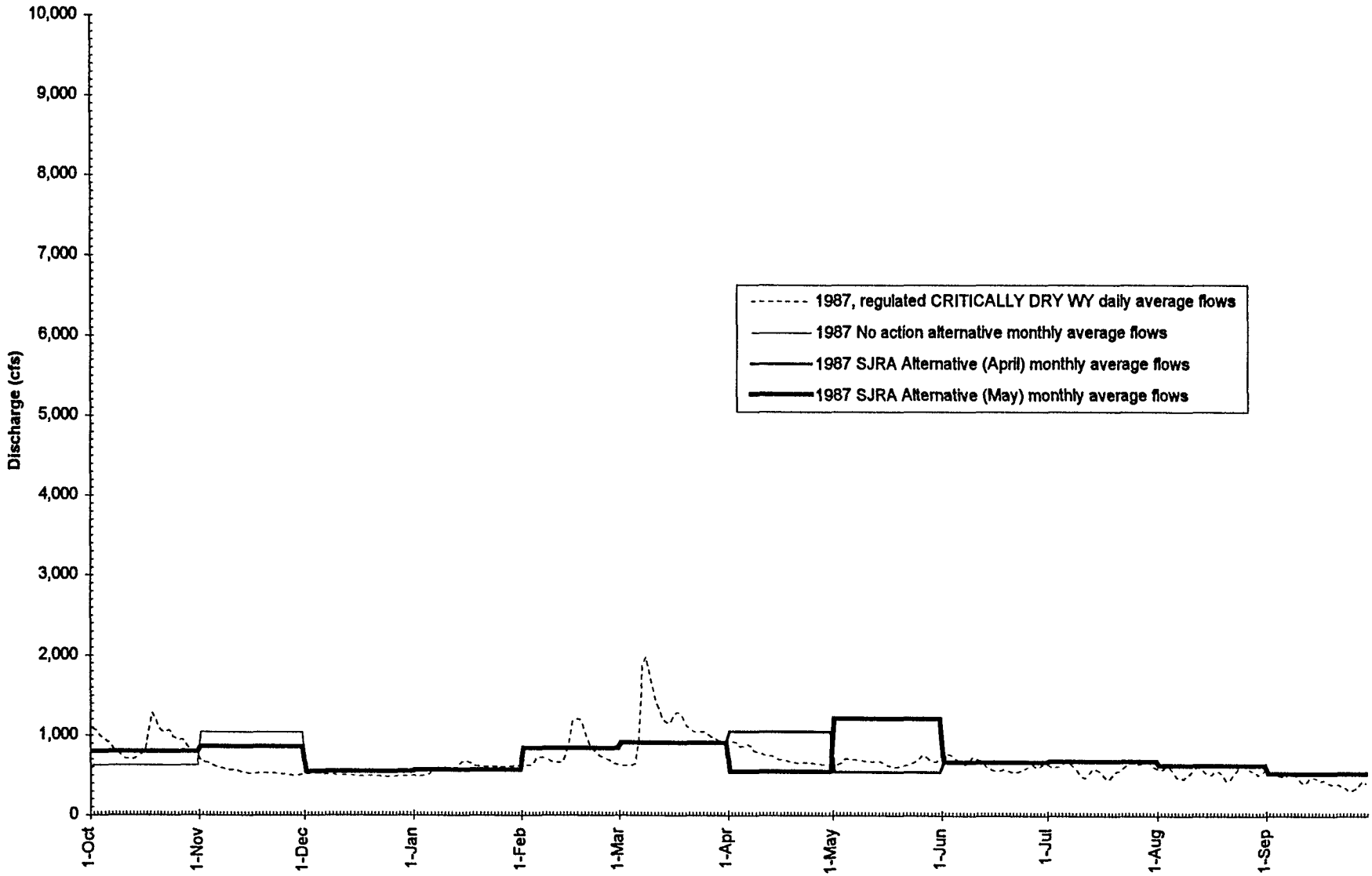

Figure 4.4-10. Annual hydrograph for the San Joaquin River near Newman, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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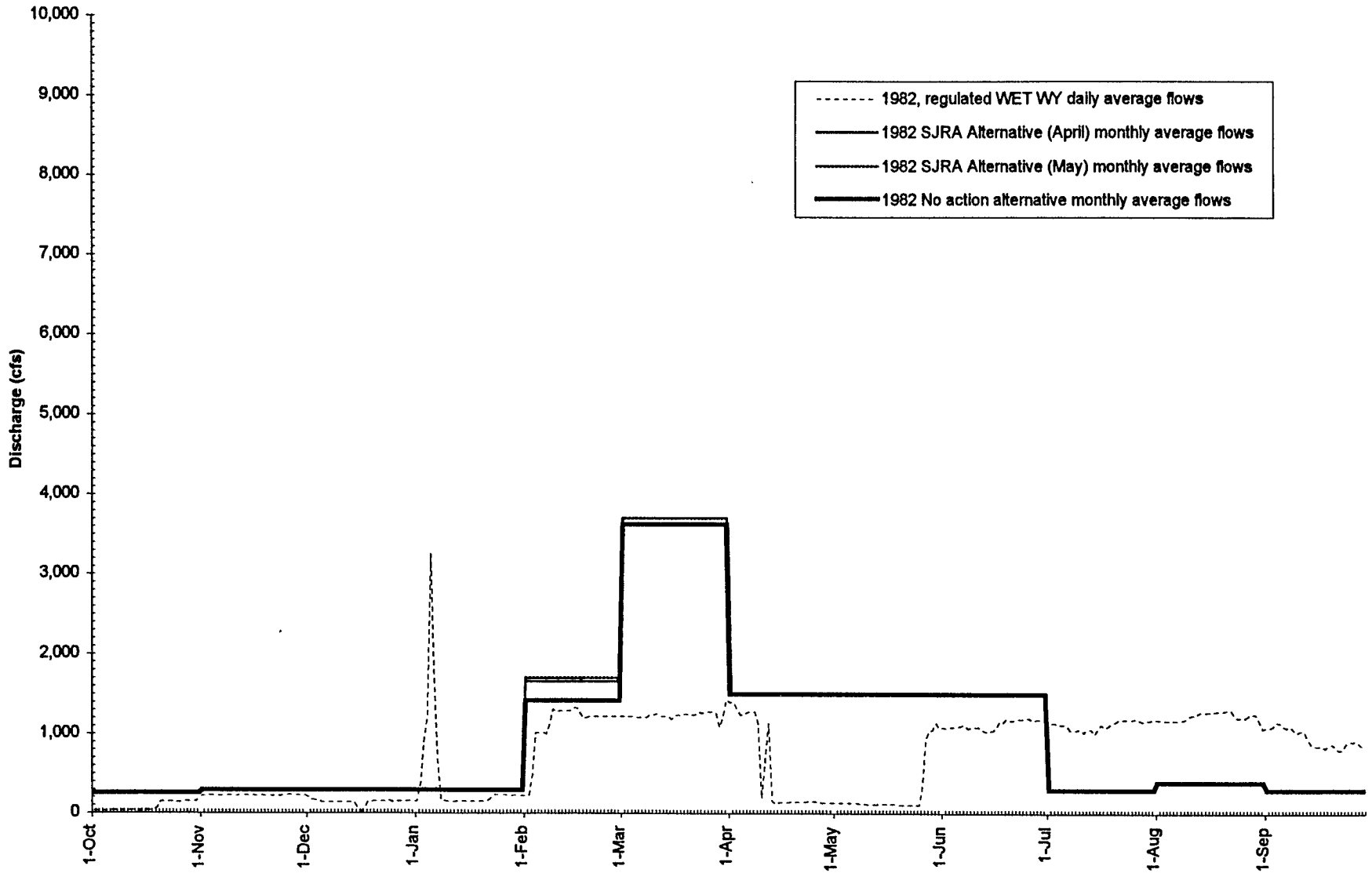

Figure 4.4-11. Annual hydrograph for the Stanislaus River below Goodwin Dam near Knight's Ferry, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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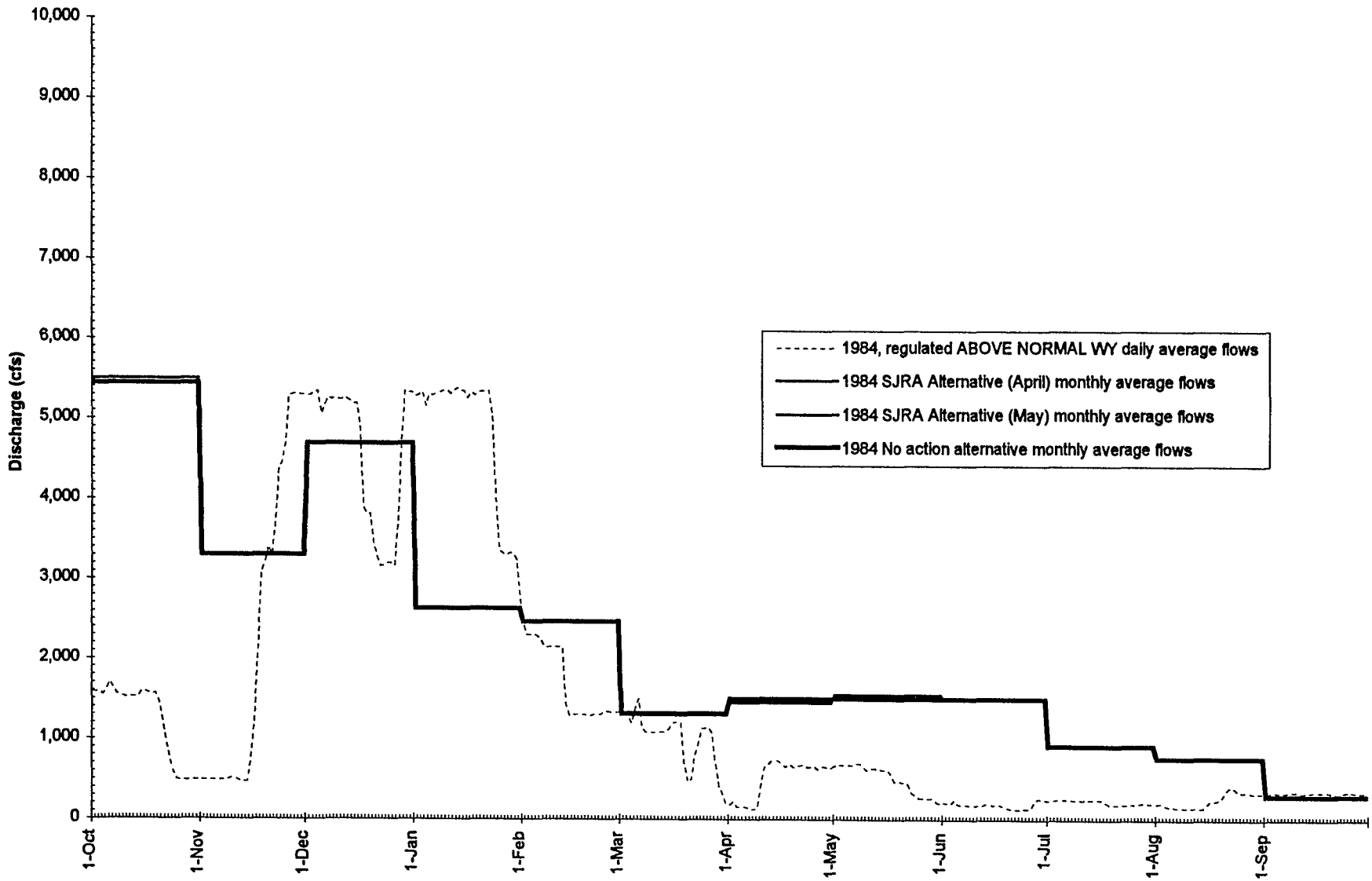

Figure 4.4-12. Annual hydrograph for the Stanislaus River below Goodwin Dam near Knight's Ferry, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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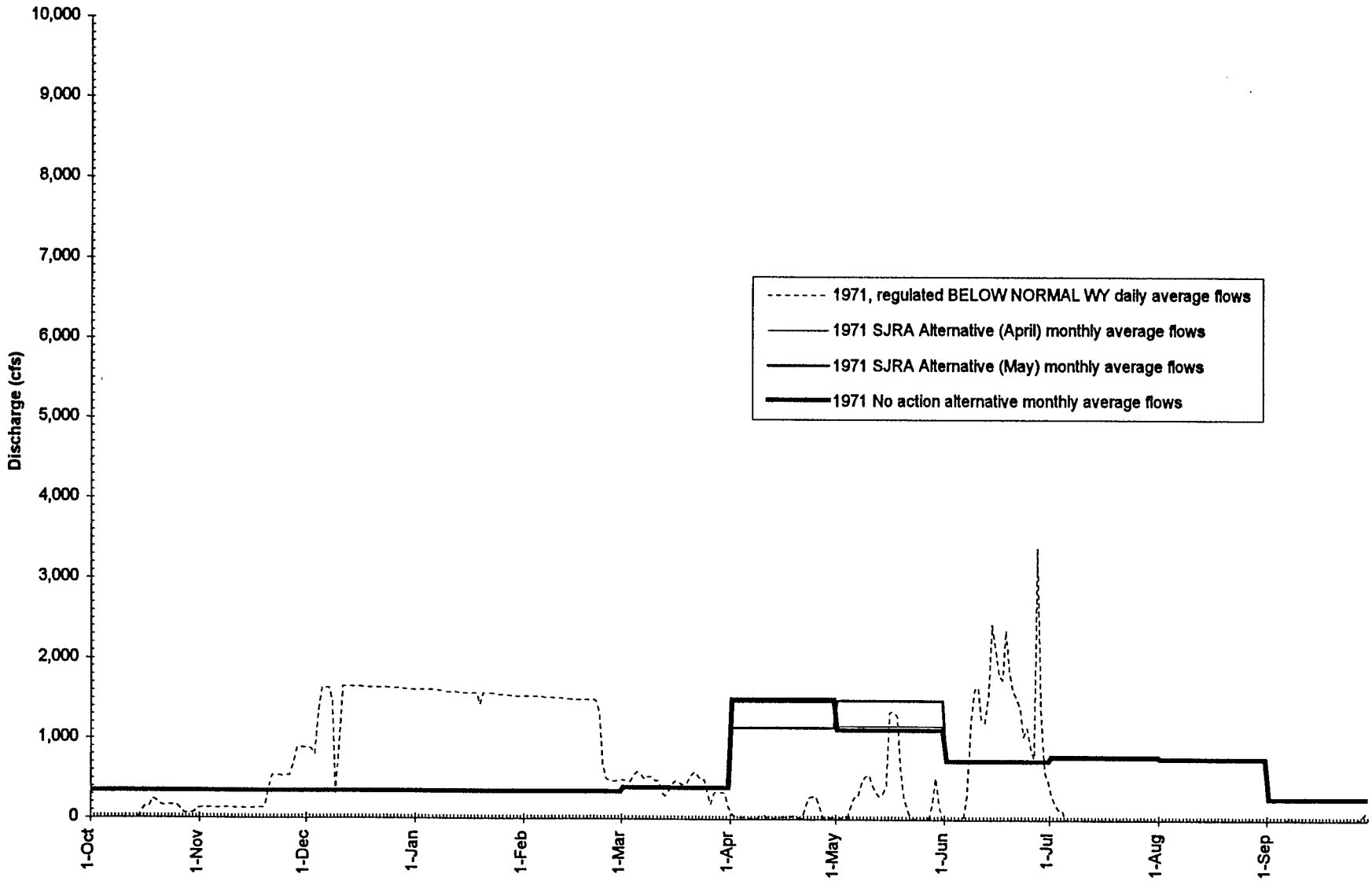

Figure 4.4-13. Annual hydrograph for the Stanislaus River below Goodwin Dam near Knight's Ferry, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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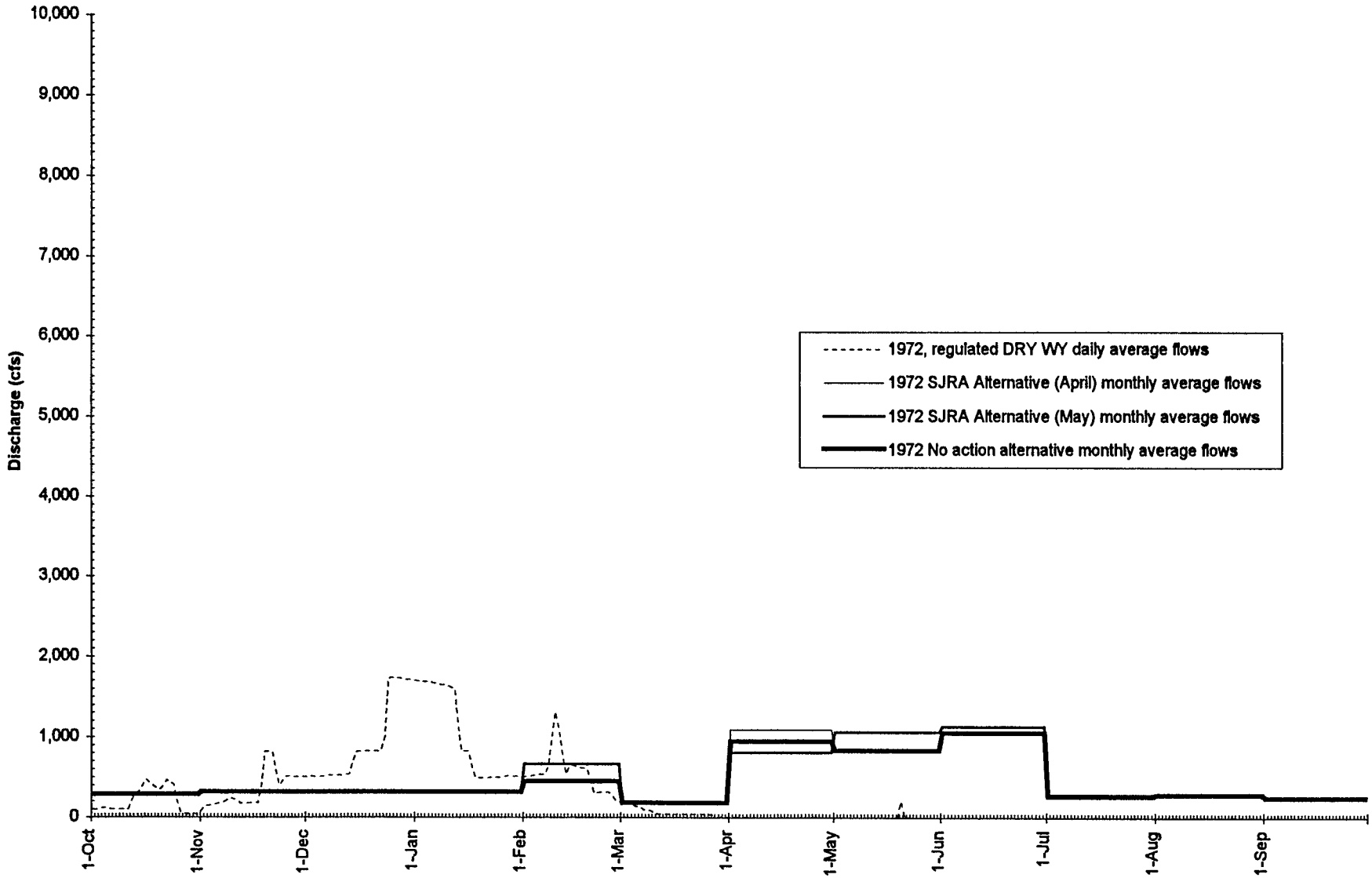

Figure 4.4-14. Annual hydrograph for the Stanislaus River below Goodwin Dam near Knight's Ferry, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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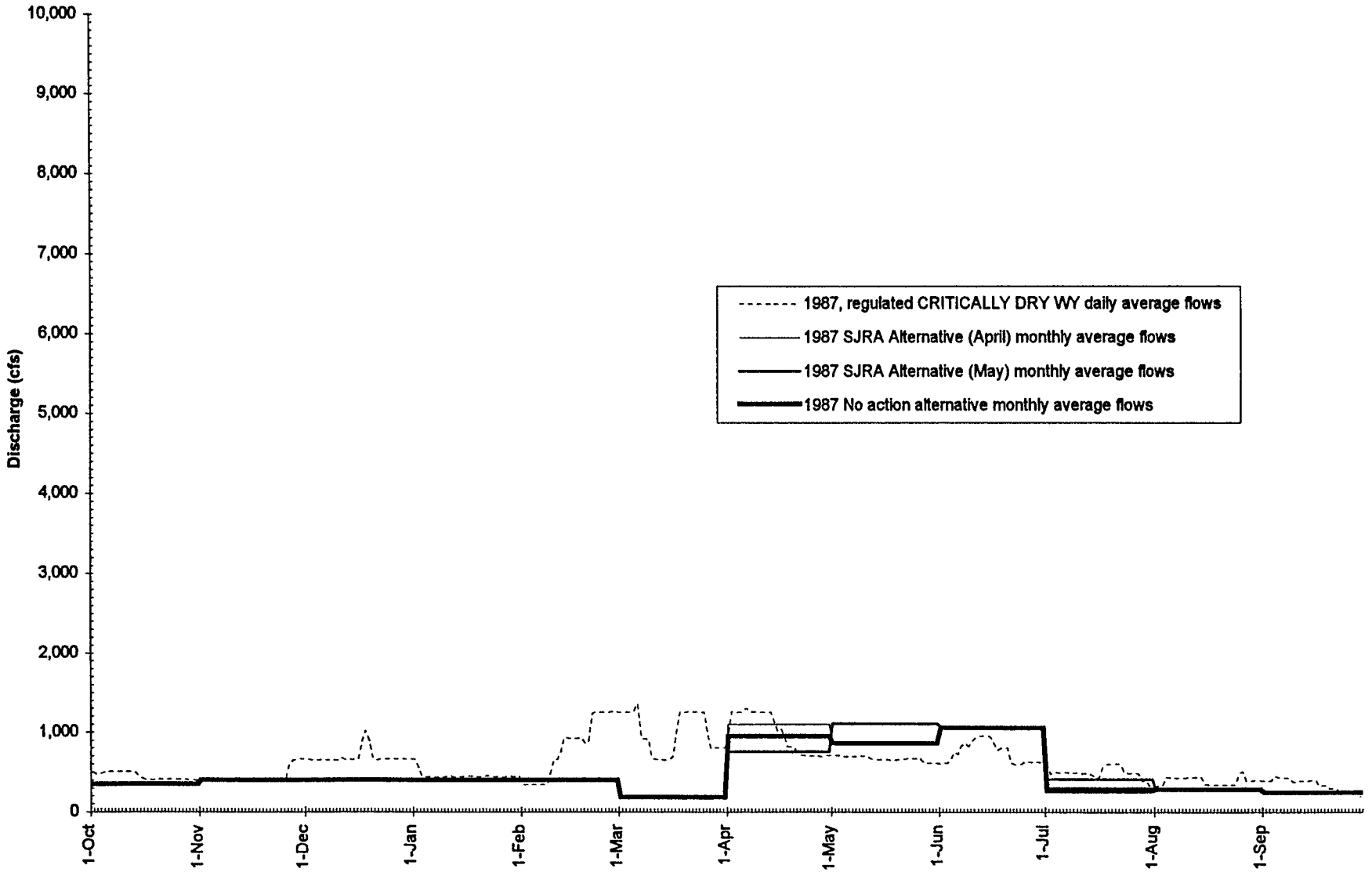

Figure 4.4-15. Annual hydrograph for the Stanislaus River below Goodwin Dam near Knight's Ferry, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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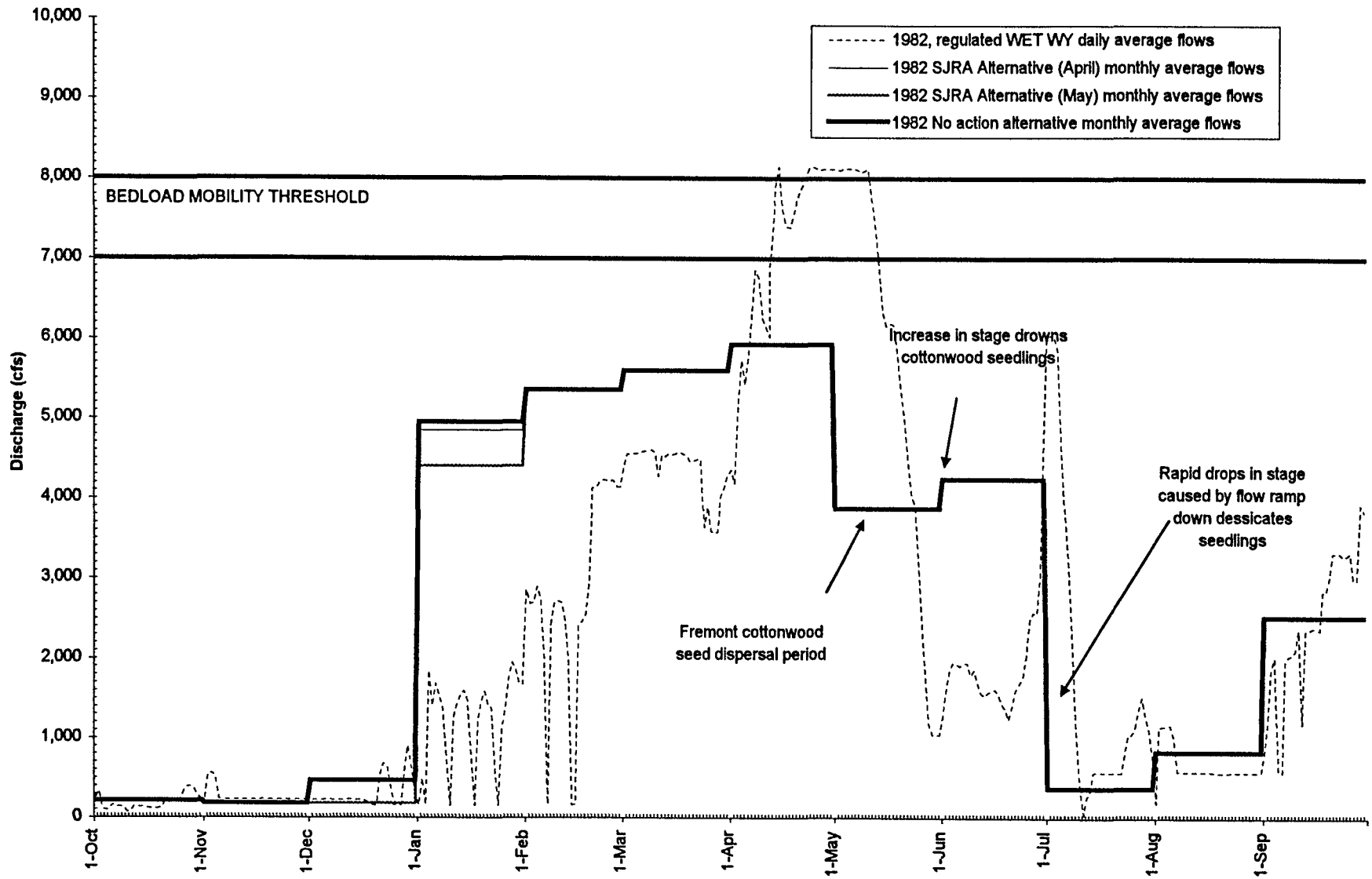

Figure 4.4-16. Annual hydrograph for the Tuolumne River near La Grange, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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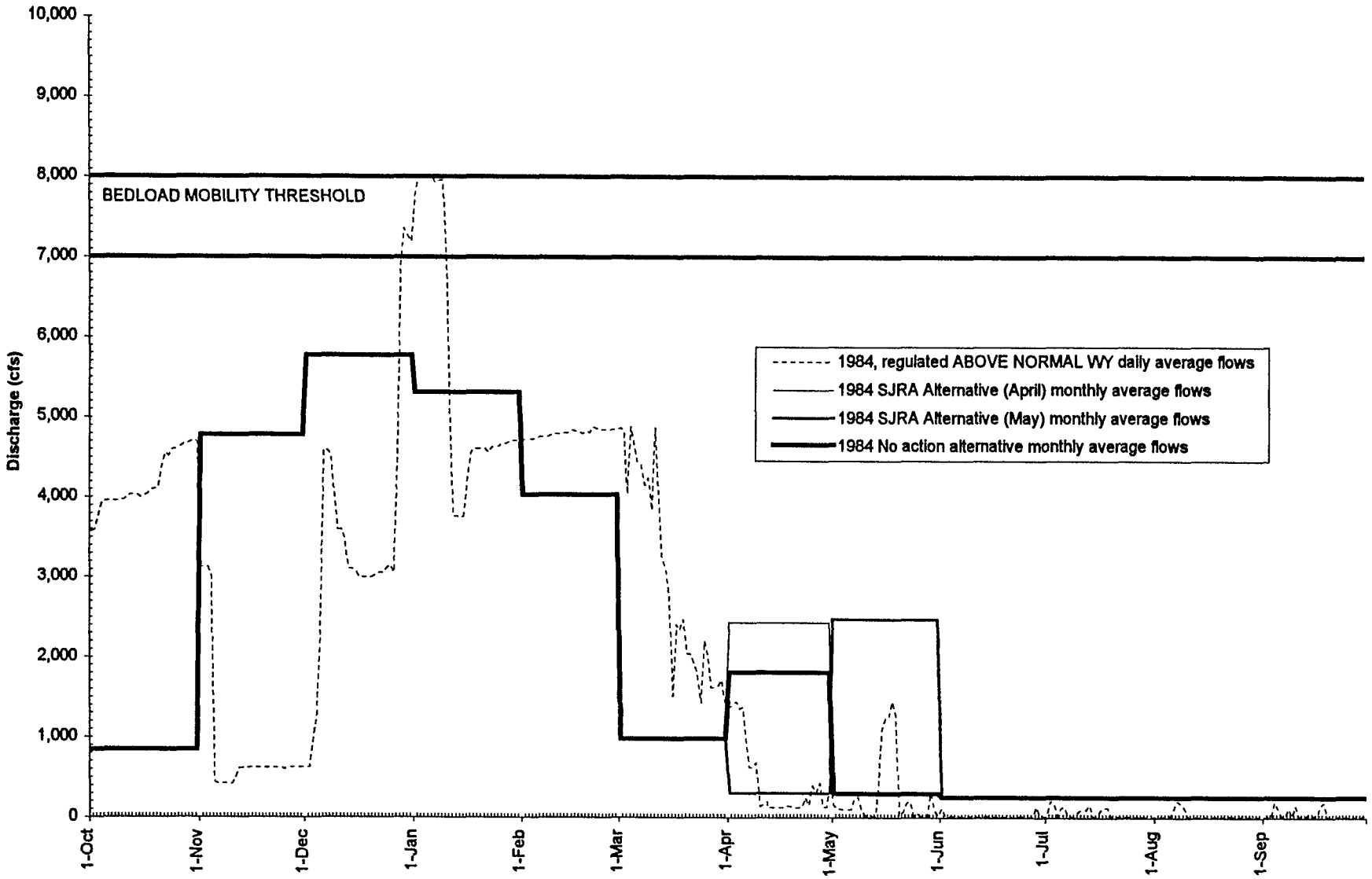

Figure 4.4-17. Annual hydrograph for the Tuolumne River near La Grange, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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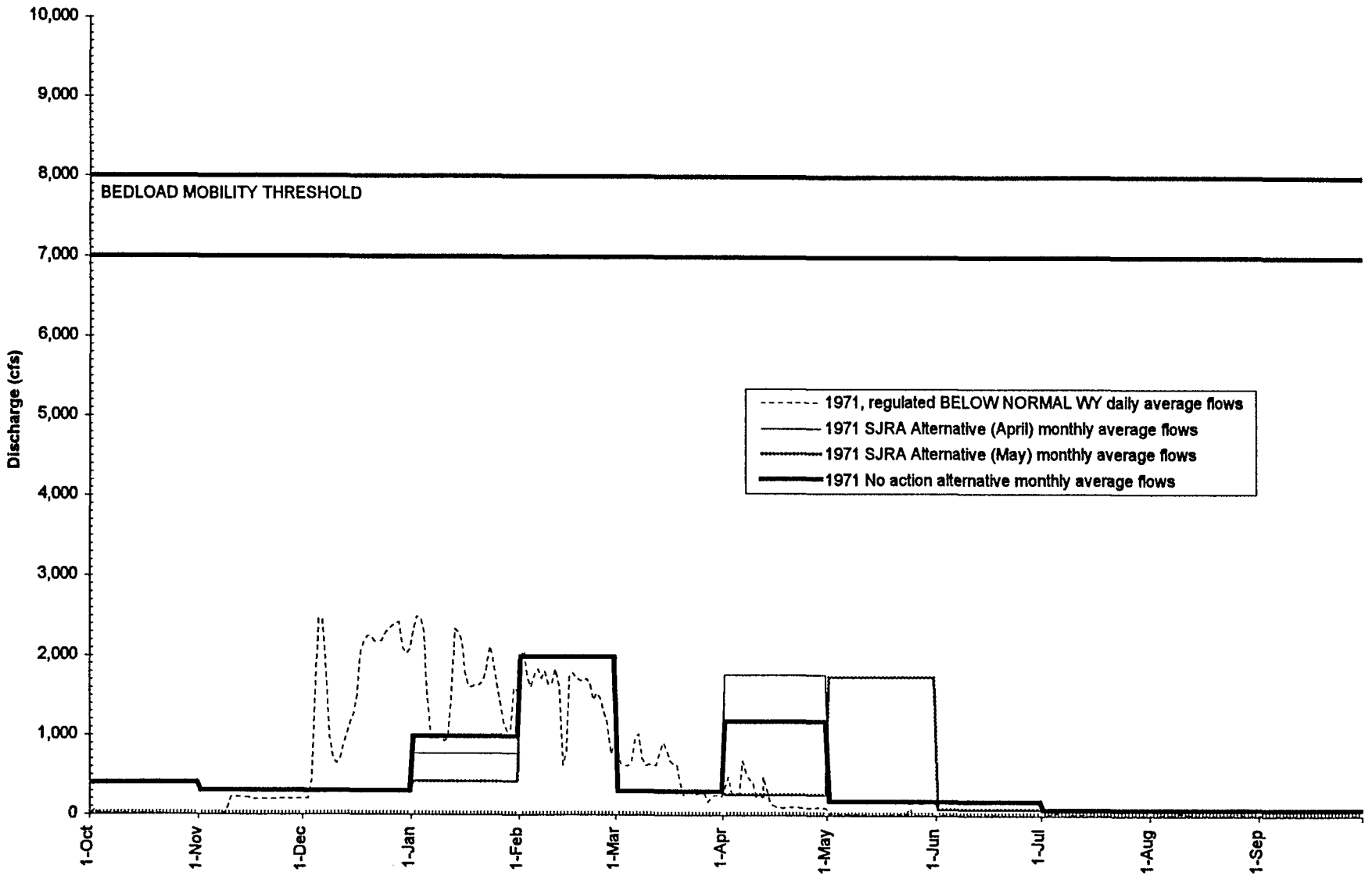

Figure 4.4-18. Annual hydrograph for the Tuolumne River near La Grange, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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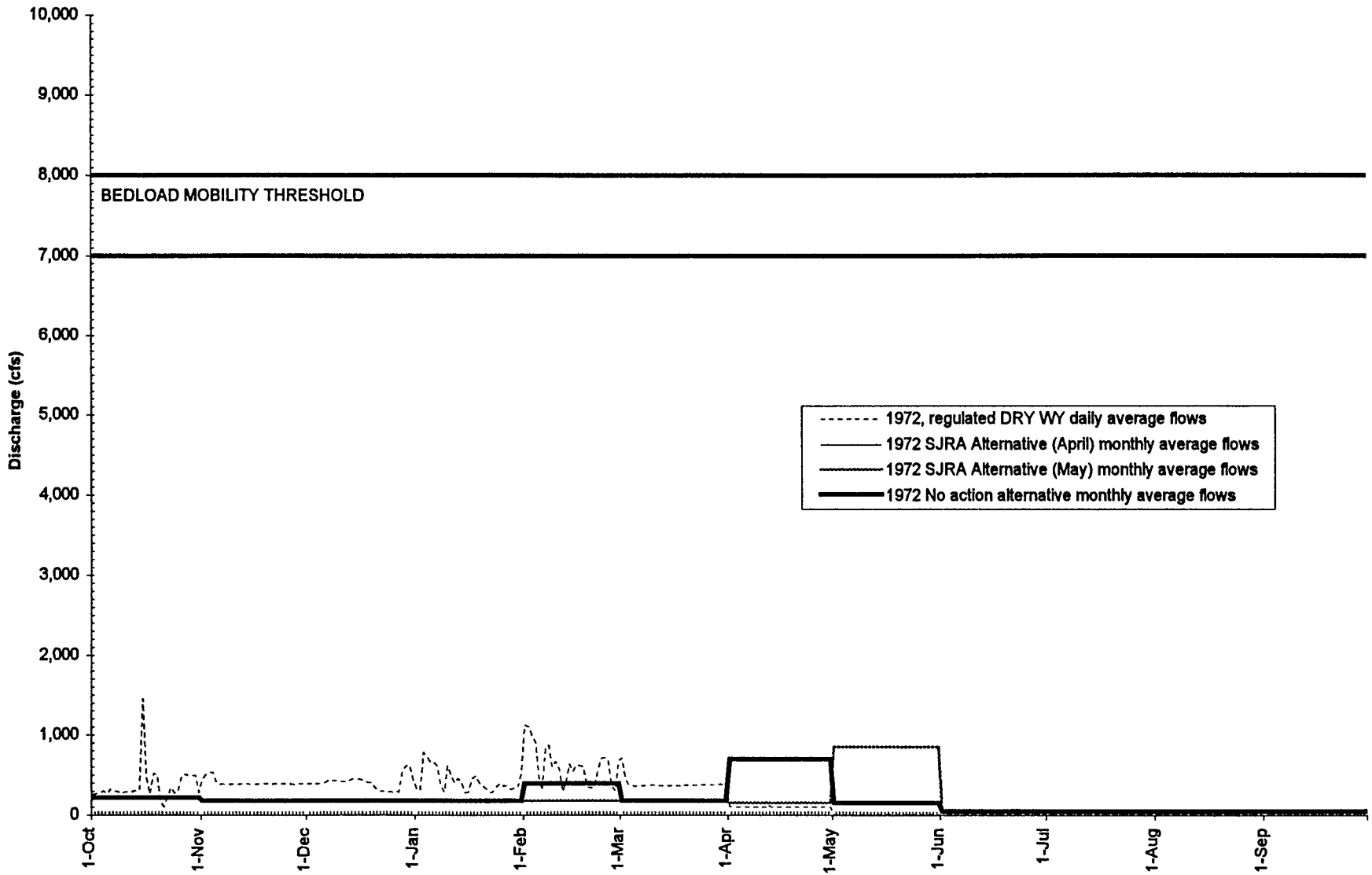

Figure 4.4-19. Annual hydrograph for the Tuolumne River near La Grange, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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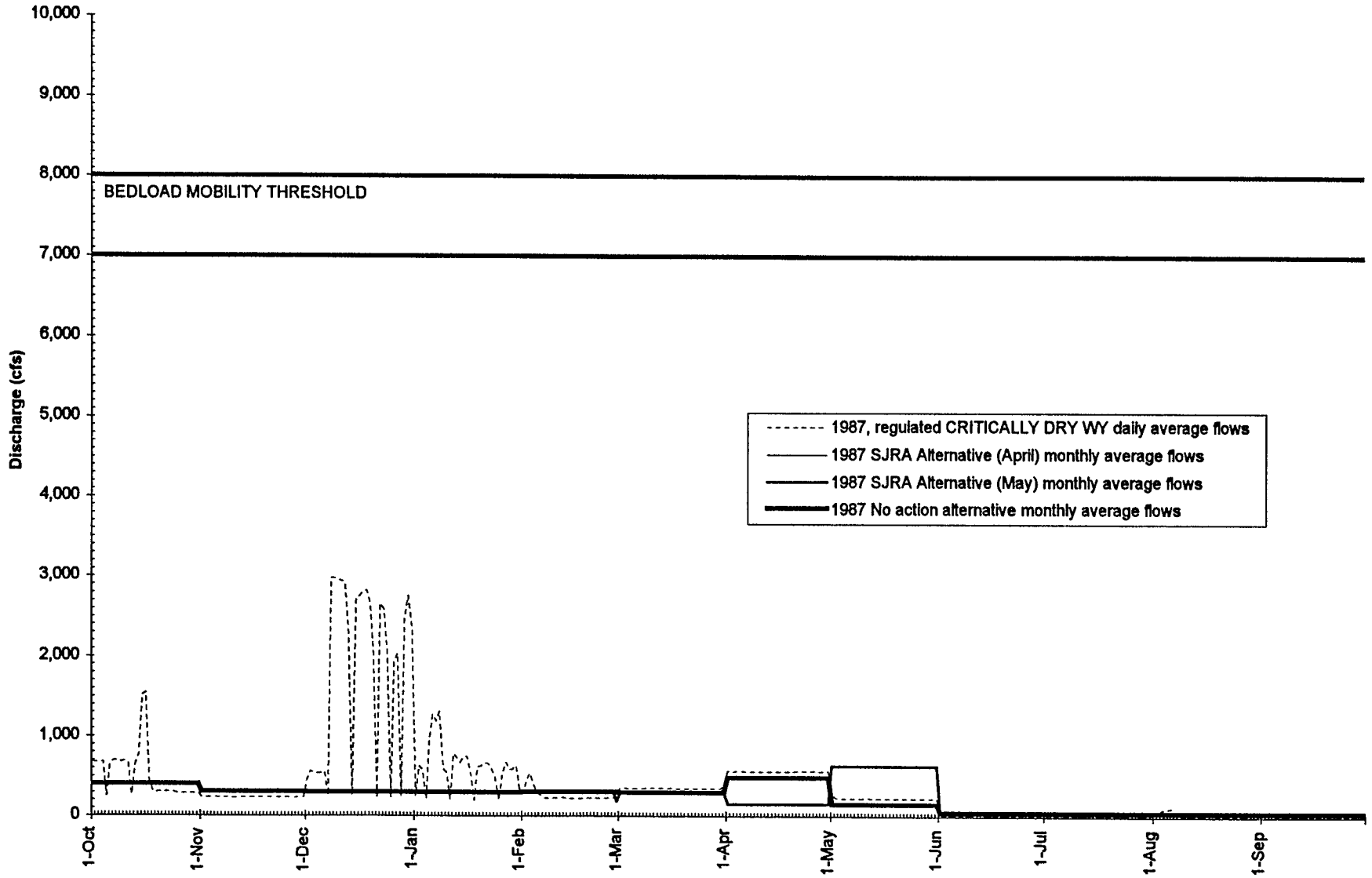

Figure 4.4-20. Annual hydrograph for the Tuolumne River near La Grange, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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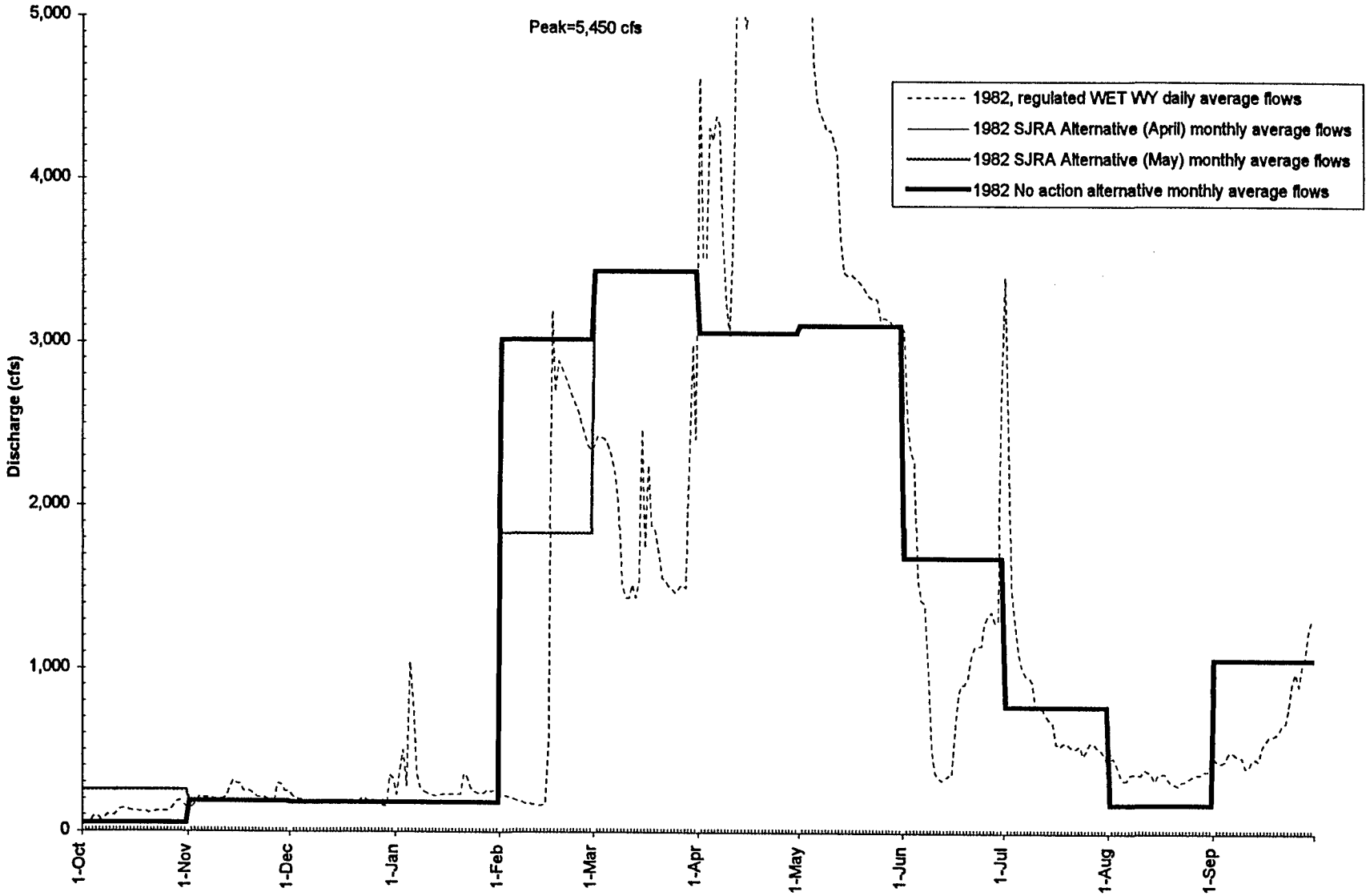

Figure 4.4-21. Annual hydrograph for the Merced River near Cressey, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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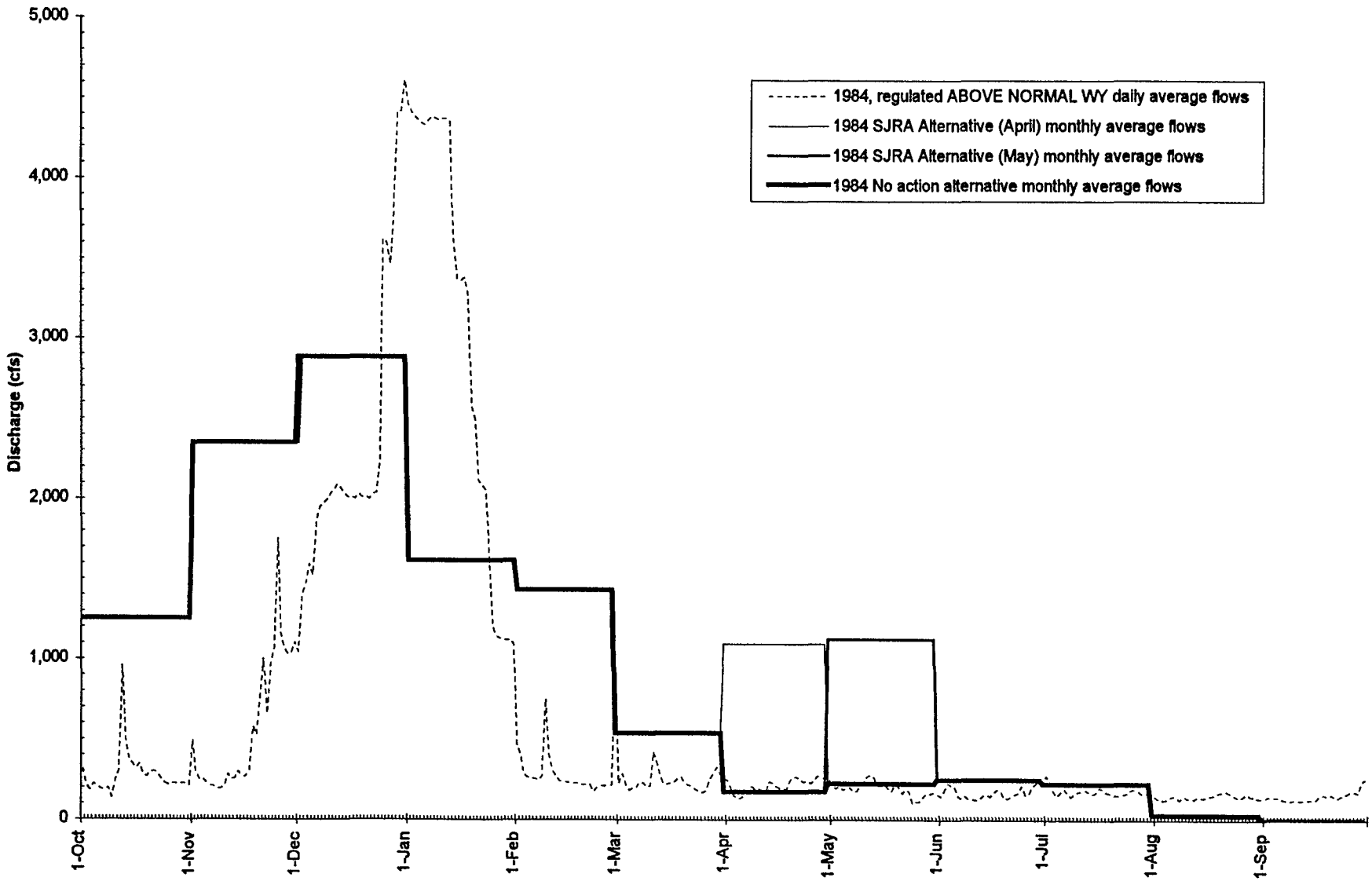

Figure 4.4-22. Annual hydrograph for the Merced River near Cressey, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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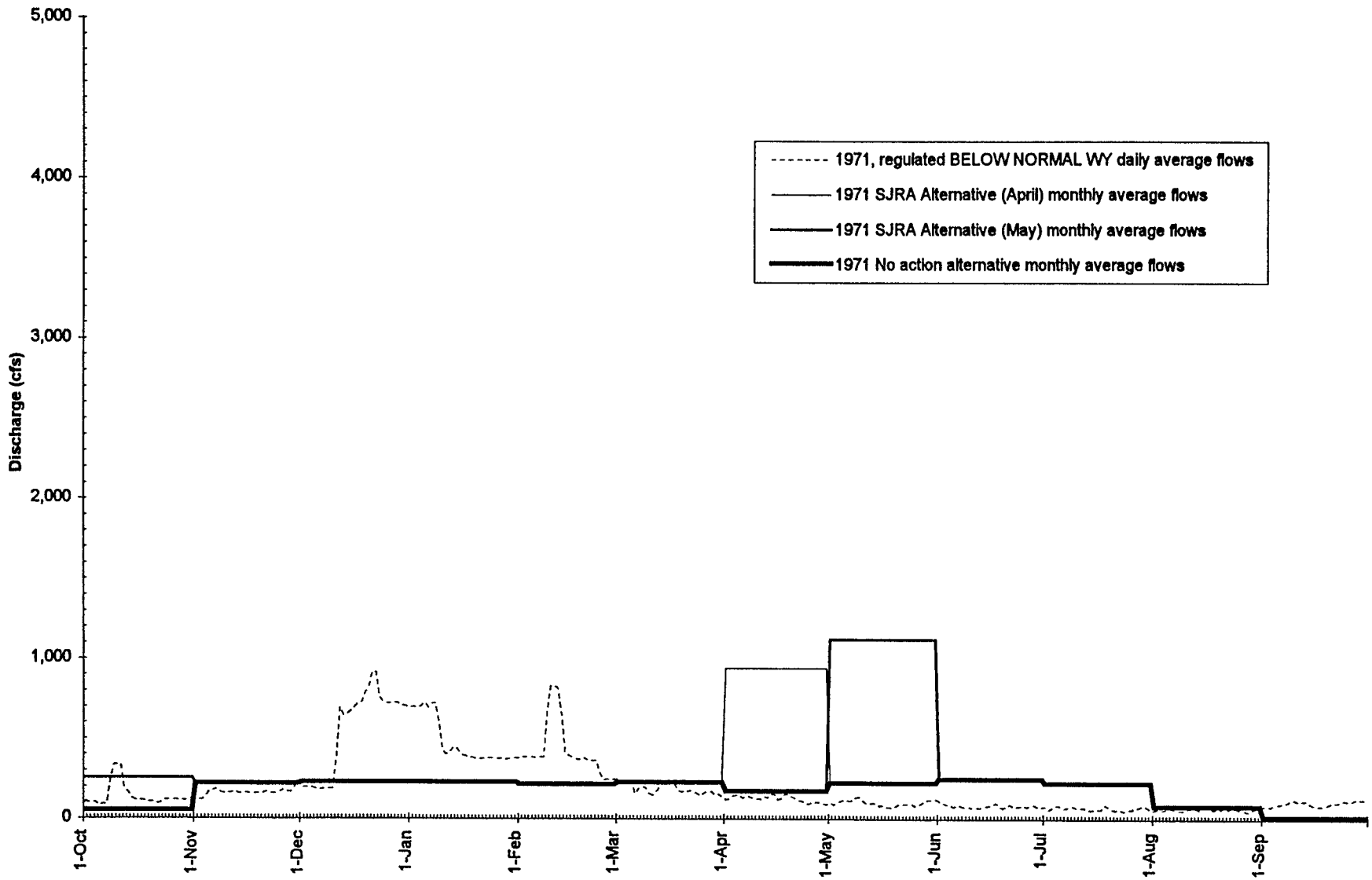

Figure 4.4-23. Annual hydrograph for the Merced River near Cressey, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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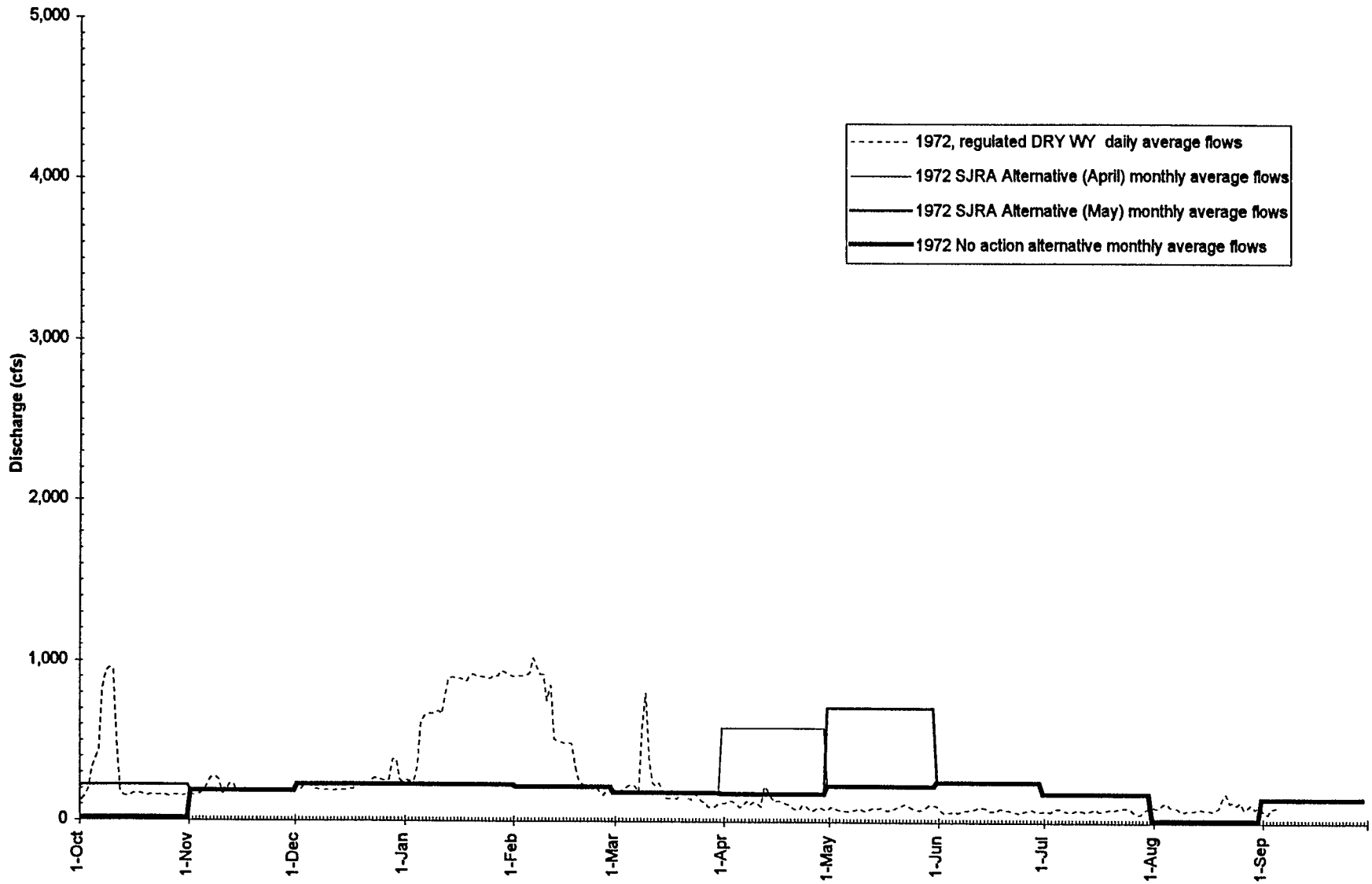

Figure 4.4-24. Annual hydrograph for the Merced River near Cressey, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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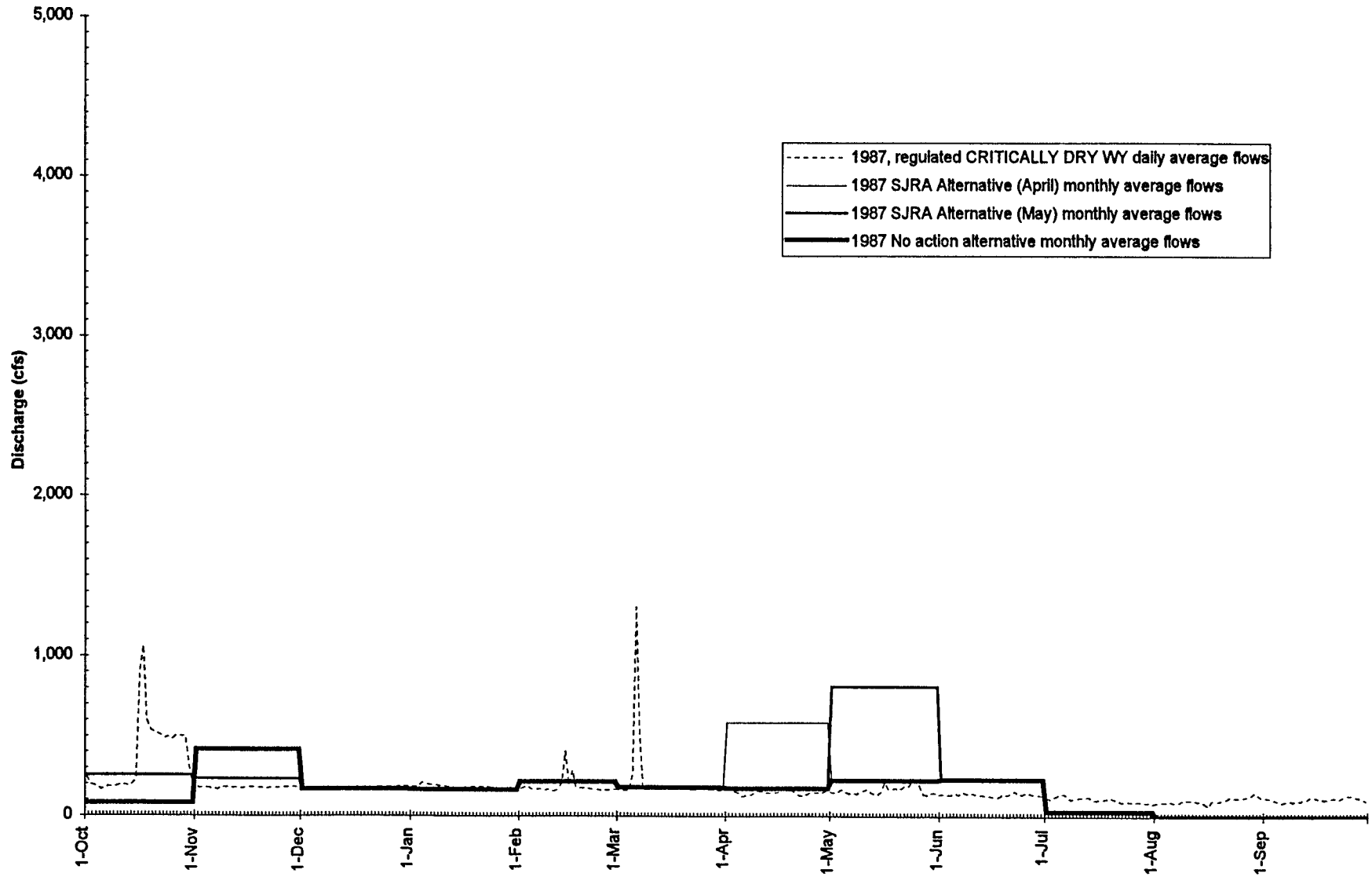

Figure 4.4-25. Annual hydrograph for the Merced River near Cressey, showing the actual measured streamflow for that year, the No Action Alternative, and the SJRA Alternative's April and May option.

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4.4-16 during the period of 1 February 1982 through 30 September 1982, all alternatives share the same discharges for this time period. Therefore each alternative is superimposed over the others and accordingly only one line is visible. Evaluation of hydrograph components reveals that each simulated water year class has the potential to cross thresholds of significance.

Using the 1982 hydrograph on the Tuolumne River as an example (Figure 4.4-16), flows would no longer exceed bedload mobility thresholds during above normal and wet years. Increases in river stage after annual cottonwood seed dispersal (drowning seedlings), and rapid flow rampdowns (dessicating seedlings) could kill cottonwoods that germinated during pulse flows.

Due to the variability in modeled vs actual flows (10 percent to 20 percent) and the annual variability in flow magnitude (based on water year classification), the potential for impacts to riparian vegetation would vary in type and degree based on the actual timing and magnitude of flow release. Because the proposed flows were simulated by monthly timesteps, they cannot be quantitatively evaluated in terms of each threshold of significance criterion.

To assess the potential impacts associated with the proposed alternative in comparison to no action, Tuolumne River discharges during water years when pulse flows occurred were compared to years when they did not. Two locations were chosen for determining the rate of stage height change, at La Grange (modeled node LGR) and at the USGS gaging station #1129000, Modesto (Figures 4.4-26 through 4.4-29). The SJRA alternative stage height levels are shown using the annual daily average peak, pulse flow peak ,and summer minimum flows in context to vegetation transects near La Grange (Figures 4.4-30 and 4.4-31) and upstream of the Modesto node at Santa Fe road, river mile 22.5 (Figures 4.4-32 and 4.4-33) on the Tuolumne River.

The evaluation of water years 1993-94 Tuolumne River pulse flows, both at La Grange and Modesto, indicate that both the No Action and the SJRA alternatives crossed thresholds of significance. Potentially negative impacts in both alternatives were mainly limited to decreases in stage height after Fremont Cottonwood seed dispersal, stage height increases after Fremont Cottonwood seed dispersal (Figures 4.4-5, 4.4-7, 4.4-8, 4.4-9,4.4-10, 4.4-12, 4.4-14, 4.4-15, 4.4-16, 4.4-22, 4.4-23), and the elimination of bedload mobility thresholds (Figure 4.4-16, Figure 4.4-17 and Figures 4.4-26 through 4.4-29). Positive impacts in both alternatives were found associated with stage height increases and decreases during narrowleaf willow seed dispersal (Figure 4.4-26, Figure 4.4-27, Figure 4.4-29).

Specific potential impacts quantified for both the No Action and the SJRA alternative are:

- Pulse flow magnitudes are not sufficient to inundate floodplains during Fremont cottonwood seed dispersal (Figure 4.4-30 through Figure 4.4-33). For both water year classes, pulse flows reach stages that are contained within the active channel (Figure 4.4-30 through Figure 4.4-33).

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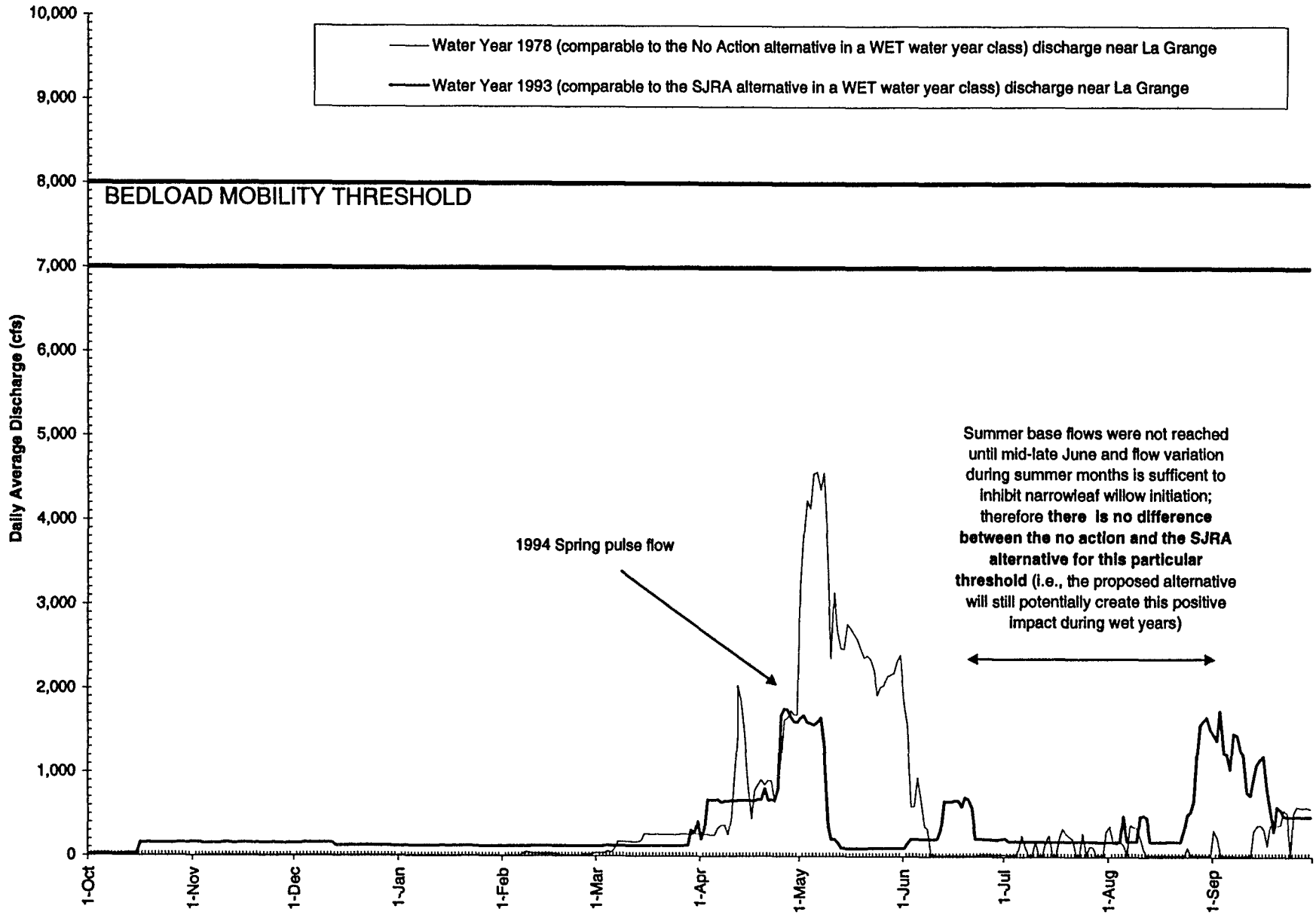

Figure 4.4-26. Water Year 1978 and 1993 annual hydrographs for the Tuolumne River near La Grange (USGS Stn#11289650).

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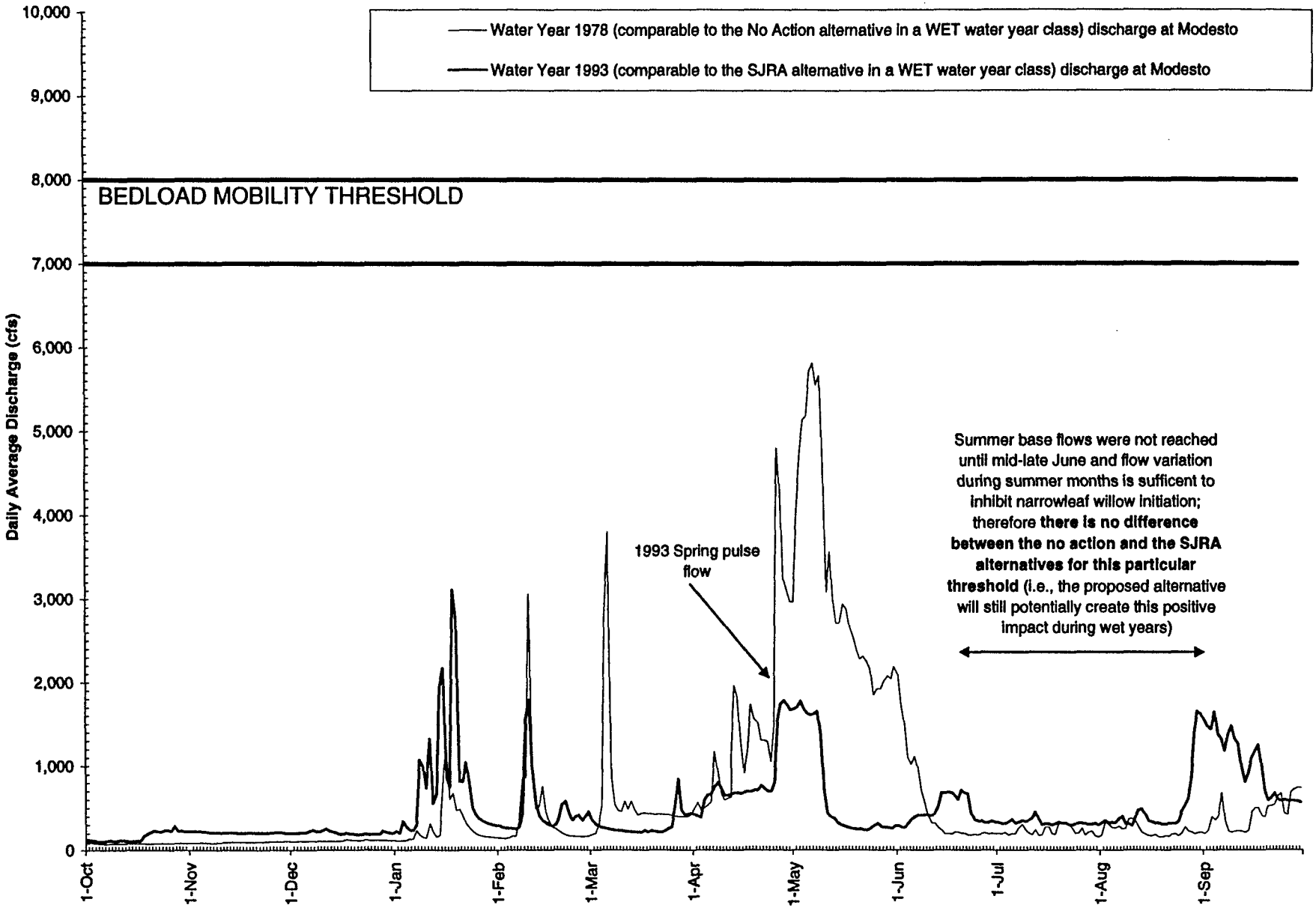

Figure 4.4-27. Water Year 1978 and 1993 annual hydrographs for the Tuolumne River at Modesto (USGS Stn# 11290000).

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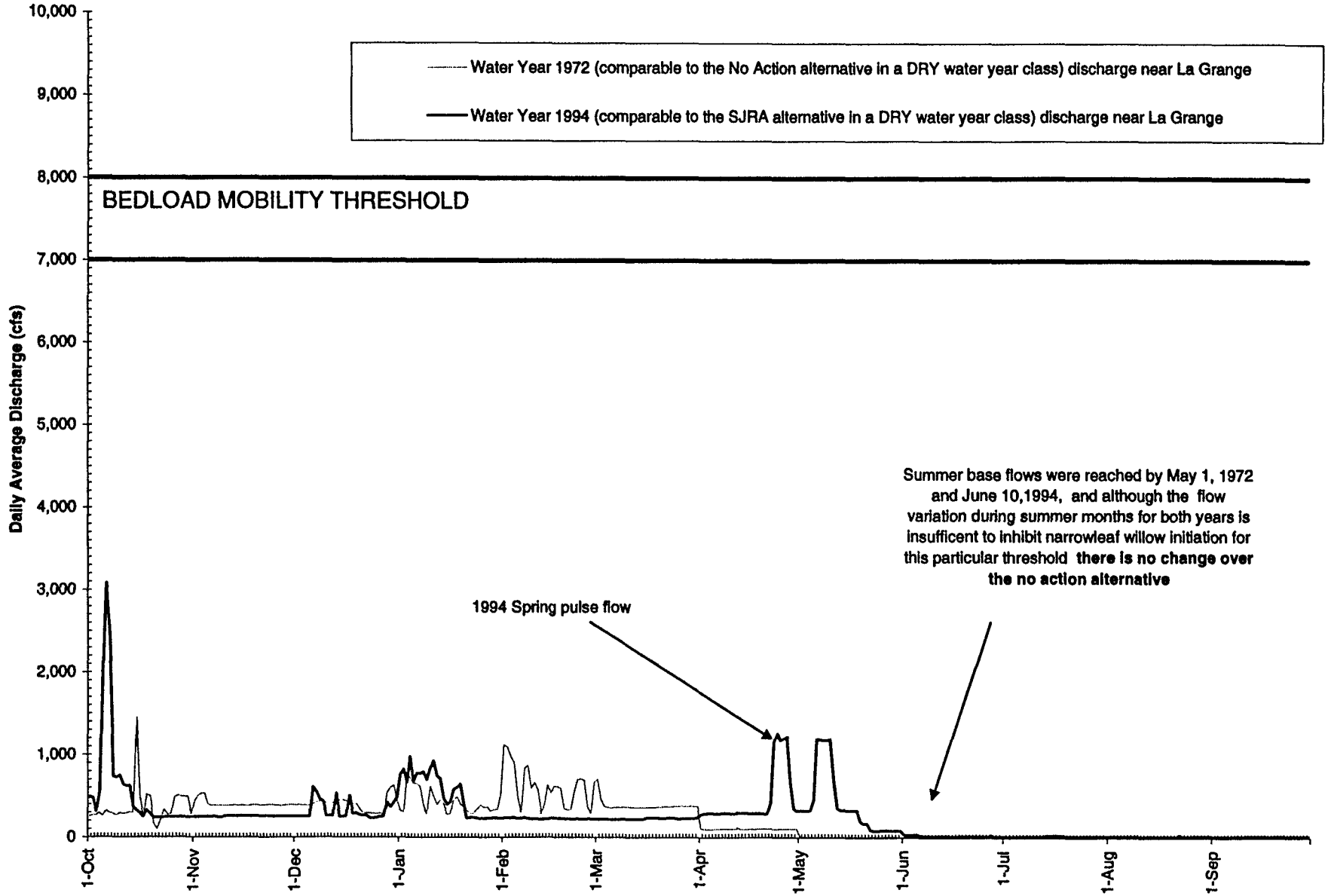

Figure 4.4-28. Water Year 1972 and 1994 annual hydrographs for the Tuolumne River near La Grange (USGS Stn#11289650).

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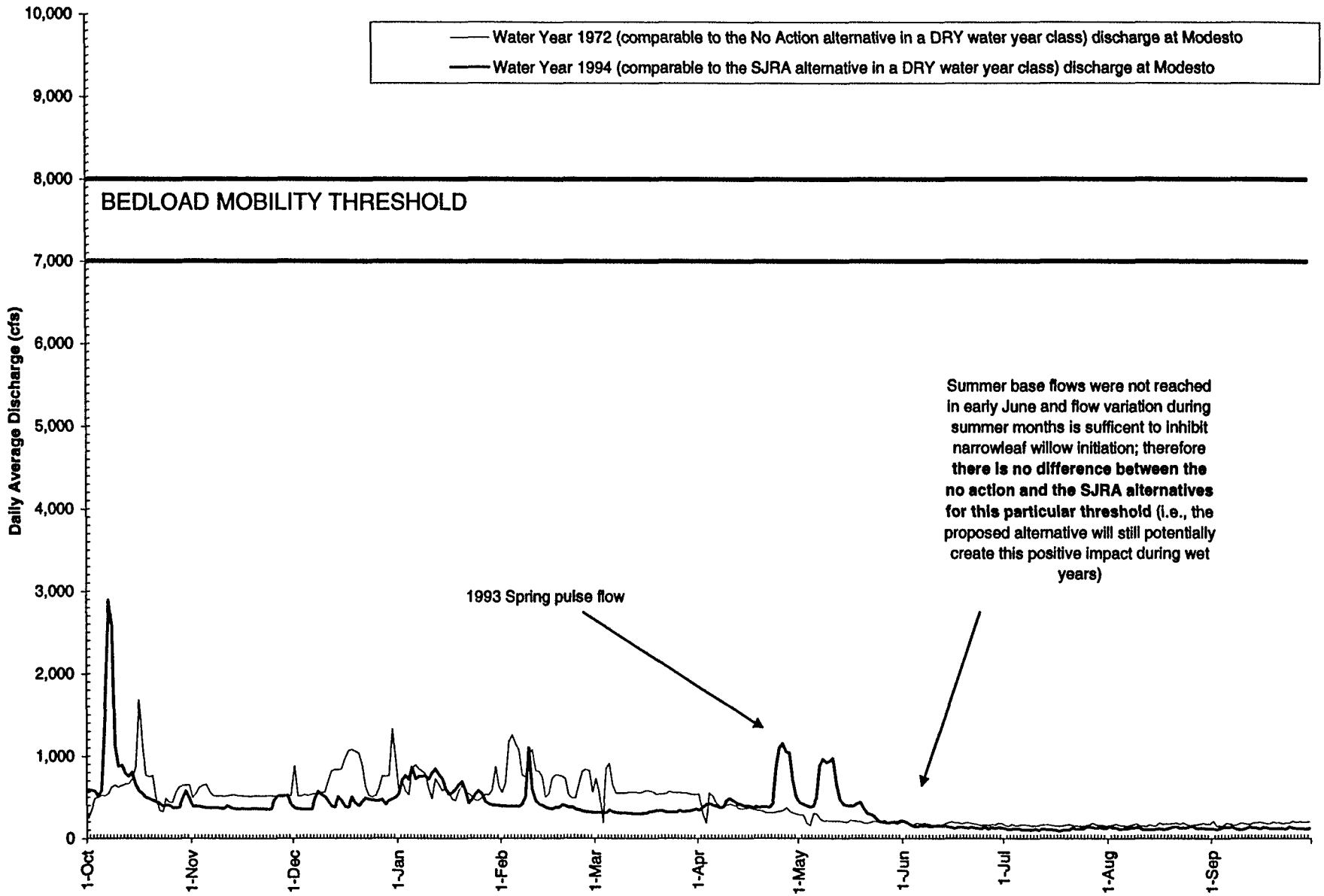

Figure 4.4-29. Water Year 1972 and 1994 annual hydrographs for the Tuolumne River at Modesto (USGS Stn# 11290000).

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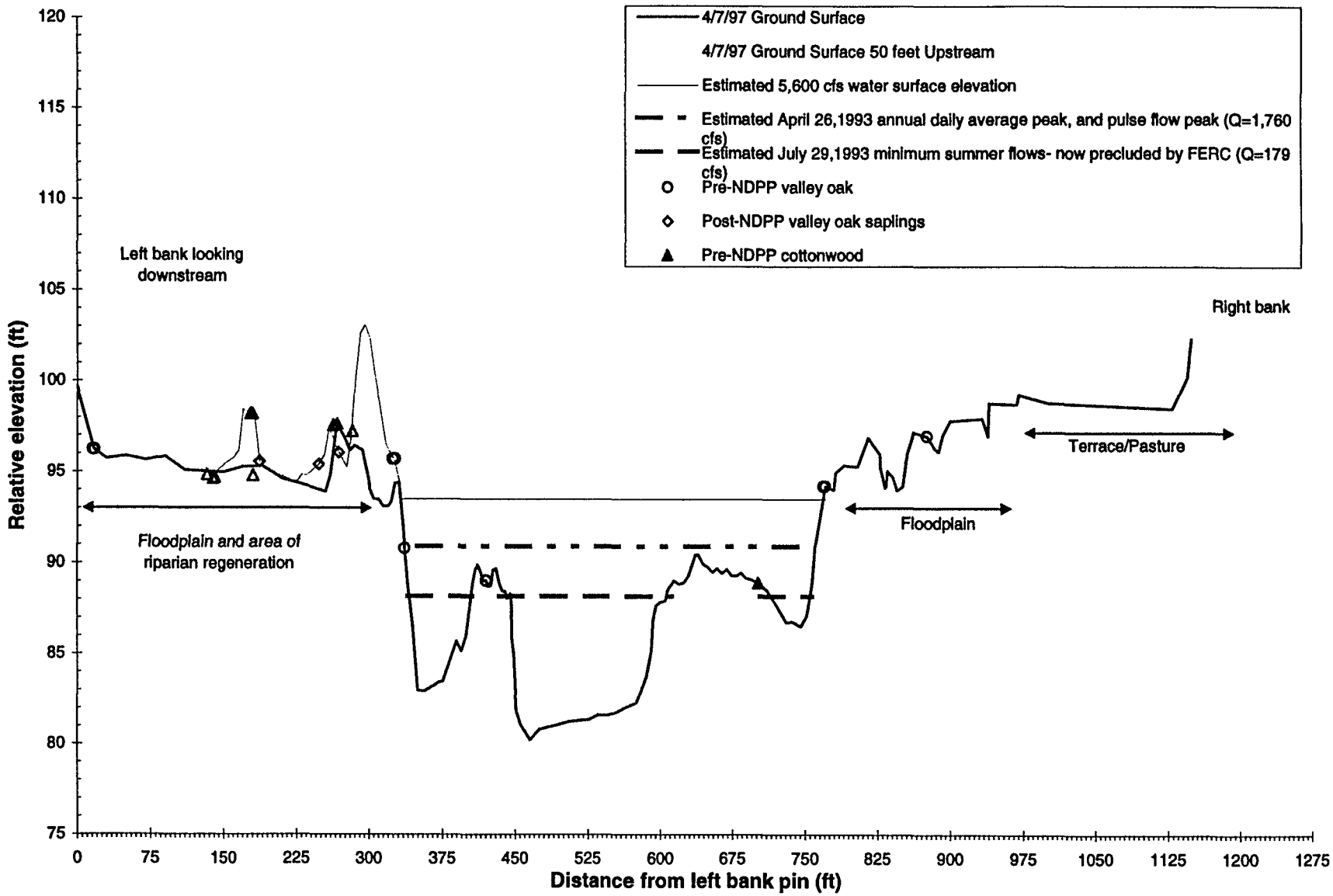

Figure 4.4-30. Tuolumne River, Basso Bridge vegetation transect, RM 47. The 5,600 cfs water surface inundates the contemporary floodplain; 1993 pulse flow peak never reach this stage. (Adapted from McBain and Trush 1998 DRAFT)

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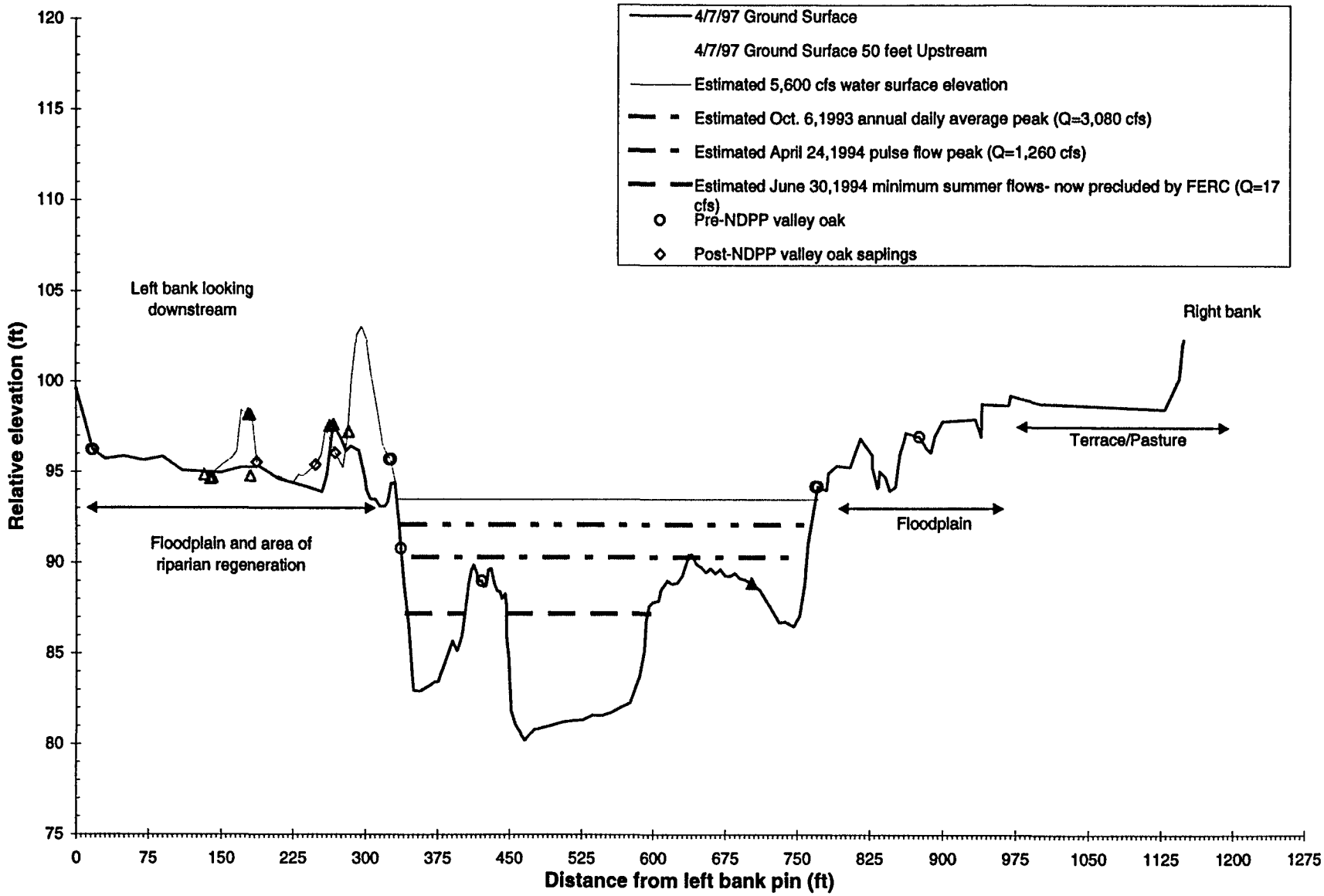

Figure 4.4-31. Tuolumne River, Basso Bridge vegetation transect, RM 47. The 5,600 cfs water surface inundates contemporary floodplains; 1994 annual, and pulse flow peaks never reach this stage. (Adapted from McBain and Trush 1998 DRAFT)

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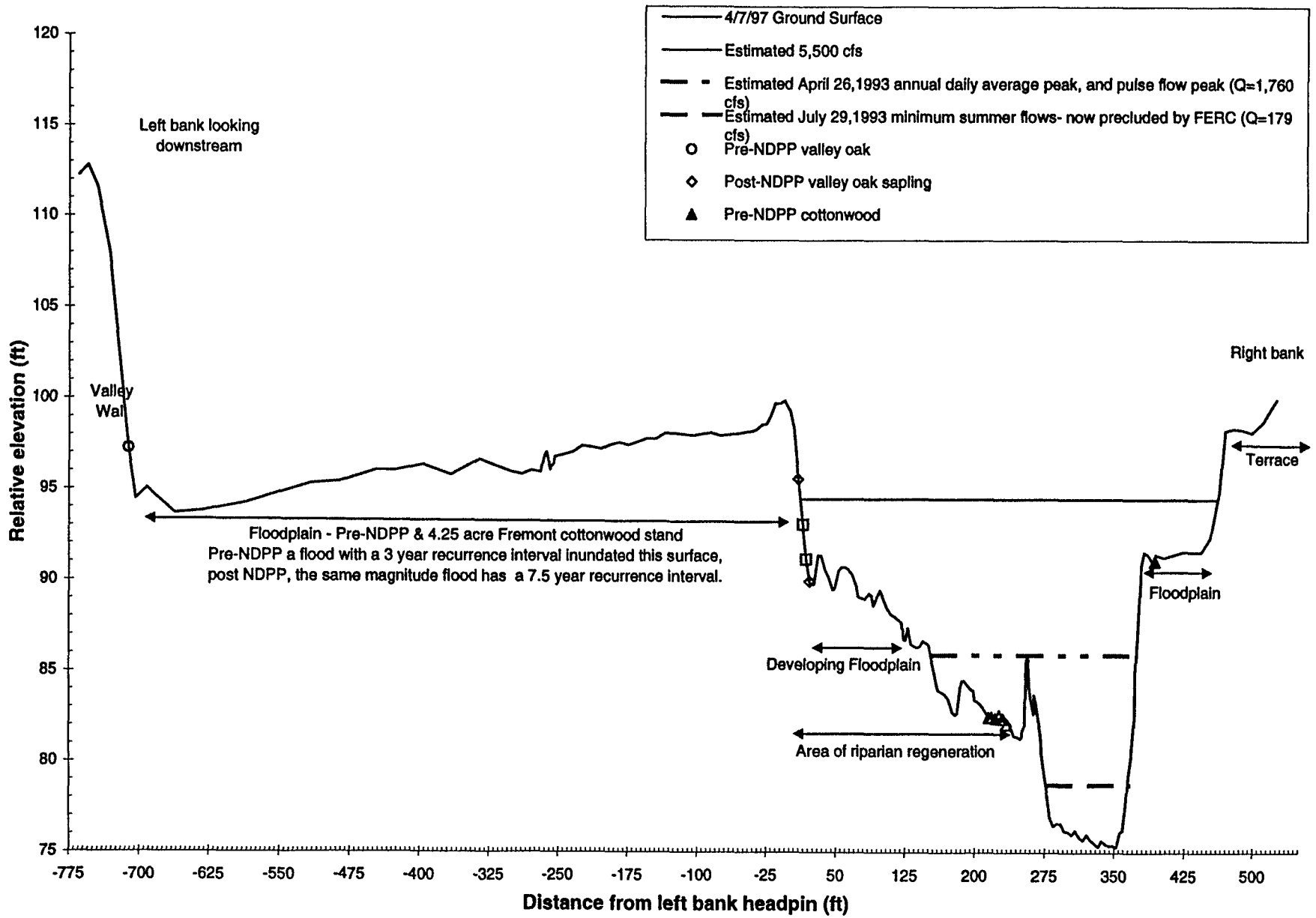

Figure 4.4-32. Tuolumne River, Santa Fe vegetation transect, RM 22.5. The 5,500 cfs water surface inundates contemporary floodplains; 1993 pulse flow peaks never reach this stage. (Adapted from McBain and Trush 1998 DRAFT)

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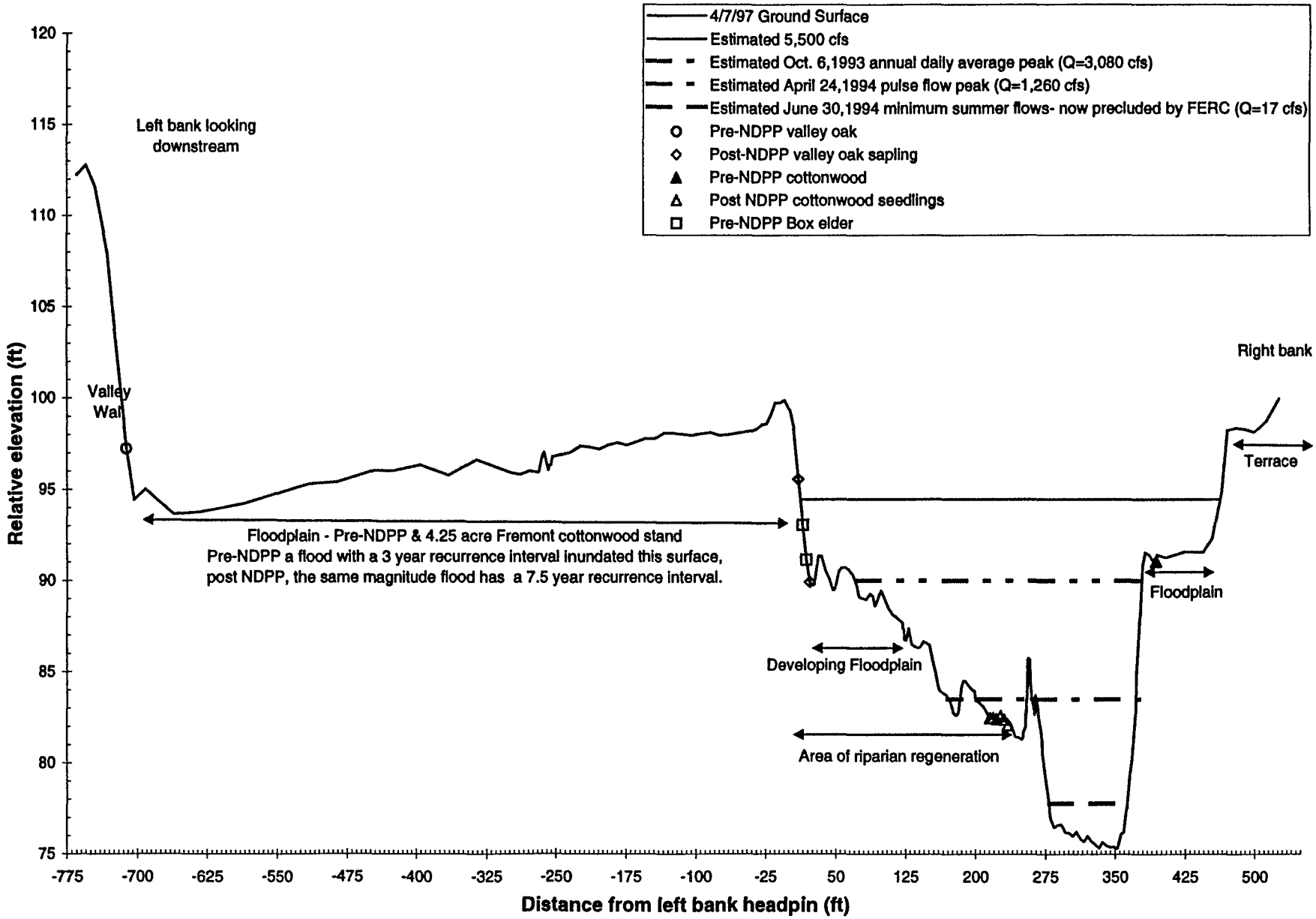

Figure 4.4-33. Tuolumne River, Santa Fe vegetation transect, RM 22.5. The 5,500 cfs water surface inundates contemporary floodplains; 1994 annual and pulse flow peaks never reach this stage. (Adapted from McBain and Trush 1998 DRAFT)

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- Modeled pulse flows have attenuated the annual peaks on the Tuolumne River such that bedload load mobility thresholds are not reached. When using prior water years data to quantify potentially significant impacts, bedload mobility thresholds were not crossed even in the wet water year class (Figure 4.4-26 and Figure 4.4-27). The lack of semi-annual bed scour means that scour related mortality of prior years narrowleaf willow cohorts is not achieved in even wet water year classes. This could potentially lead to narrowleaf willow re-establishment on recently restored/constructed sites.

- Variation in summer baseflows are inadequate at La Grange during dry water years to inhibit narrowleaf willow regeneration but are adequate for wet water years (Figures 4.4-26 and 4.4-27); however, for both water year classes summer base flow variation at Modesto is sufficient to inhibit narrowleaf willow regeneration. There is no difference between the No Action alternative and the SJRA alternative for this threshold.

The proposed flows in the SJRA alternative would not impact any relic riparian vegetation; however, vegetation series that grow within the active channel (i.e., box elder, white alder, and willows) and germinating/establishing cottonwoods could potentially be impacted. Fremont cottonwood and valley oak stands that regenerated and established prior to flow regulation (relic stands) on the San Joaquin watershed would not be affected by any component of the proposed flows, as they are not currently influenced by contemporary fluvial processes that originally influenced where these plant series grew. No net loss to established box elder, and white alder cover types is anticipated, because they are infrequently inundated for any length of time greater than 1 day and currently are associated with the break in slope between the active channel and the floodplain.

In conclusion, no rare, threatened, or endangered plant species, and no relic vegetation types would be impacted (in comparison to no action); therefore, the negative impacts are not considered "significant". The SJRA alternative also would have some beneficial impacts to riparian vegetation related to stage height increases in dry years. For the few potential negative impacts associated with the SJRA alternative, they can be mitigated using the measures identified in Section 4.4.3.1. However, these measures are not required under CEQA but rather are recommended, since the impacts are less than significant.

Alternative Action

The evaluation of the Water Right Priority System alternative did not have PROSIM, SANJASIM, and STANMOD simulated flows available. The Water Right Priority System alternative was evaluated using flows from the *Draft Environmental Impact Report for implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998), based on simulations using California Department of Water Resources Simulation (DWRSIM) model. DWR simulated discharges are

published as a monthly average of a 73-year period of record, and consider only a ten-year "critical" period of drought as a "worst-case scenario".

The ten-year critical period was included because it simulates a drought when presumably pulse flow impacts on riparian vegetation would be the greatest. The evaluation of this alternative's impacts on riparian vegetation only considers the average period of record, and the ten-year critical period. As with the SJRA, the DWR simulated flows were monthly timesteps, and in addition, were not modeled for each individual year; a 73- or ten-year average was used. Because the DWR simulated flows in monthly time steps, it was assumed that the implementation of this alternative would be similar to the SJRA alternative; therefore, the impacts associated with the Water Right Priority System alternative would be similar to the SJRA alternative and are less than significant.

4.4.2.2 Wildlife

No Action

No change to the current condition is described in Affected Environment (Section 3.4.2).

Proposed Action

As discussed in the previous section, there may be impacts to riparian vegetation with resulting impacts to wildlife habitat. Wildlife species closely integrated with the riparian community may also be impacted, although impacts specific to individuals or groups are difficult to quantify. Those TES species that are most closely linked to riparian habitat (such as Swainson's hawk, willow flycatcher, riparian woodrat, and riparian brush rabbit) are likely to be the prime candidates for impacts. For example, loss of cottonwood forest may reduce the availability of nesting sites for Swainson's hawk. Likewise, shifts in vegetation structure due to encroachment of non-native plants may reduce the habitat value for riparian woodrat or riparian brush rabbit. These could affect TES species because there may be a resulting decrease in the area of important wildlife habitat, and there may be further fragmentation of riparian corridors along project rivers.

The proposed action would have little or no affect on riparian vegetation as long as the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000-8,000 cfs on the Tuolumne River). (Flows of this magnitude would exceed the VAMP target flows and would occur under No Action). As a result, there would be no loss of habitat value for TES species, and no impact on these species.

Alternative Action

The potential impacts to wildlife associated with the alternative action are similar to those discussed for the proposed action. Impacts under this alternative are likely to be reflected in changes or shifts

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in quantity and quality of riparian habitat. However, these changes are difficult to quantify. Impacts would result in shifts in wildlife species abundance and distribution. These shifts would be potentially significant impacts if there is a significant loss of important wildlife habitat on riparian corridors due to higher flows from the greater volume of water required for the Water Right Priority System alternative. The impact on riparian habitat and species who depend on it are expected to be less than significant because a significant loss of riparian habitat is not expected.

4.4.3 Impact Summary and Mitigation of Impacts

4.4.3.1 Riparian Vegetation

Since impact evaluation was based on a surrogate model (the Tuolumne River data), mitigation measures are identified for riparian vegetation that might be impacted. Avoidance is the first step to mitigate potential impacts that could arise due to the timing of inundation, ramping rates, and bedload mobility threshold exceedence.

Impact avoidance criteria are equivalent to the thresholds of significance criteria. During the refinements in the actual operational scenarios for the proposed action, operation engineers may evaluate actual hourly and daily flow release possibilities and adjust them so they do not exceed the thresholds of significance criteria. Other impacts can be avoided as follows.

Proposed Action

- In the SJRA Alternative, the May pulse flow option is potentially the most detrimental, because in some years it could interfere with Fremont cottonwood initiation. Fremont cottonwood has been adversely impacted in the San Joaquin basin due to flow regulation, and rapid flow ramping at the end of the pulse flow would be more likely to kill seedlings that germinated during the May pulse flow period than if the pulse flow occurred in April. The modeled summer base flows reached immediately after the May pulse flow period may favor narrowleaf willow which is well known for its adverse impacts due to encroachment. Implementing the option in April, not May could mitigate these impacts. In both scenarios, summer baseflows should not exceed stage heights that were reached before May 15, because this could potentially drown Fremont cottonwood seedlings. The most likely implementation of this alternative would be for the pulse flows to begin in mid April accompanied by additional flows that would minimize rapid changes in stage (i.e., gradual flow ramping) during the receding limb. Flow ramping is part of the proposed action. If implemented to minimize large stage height change per day, impacts associated with flow ramping would be reduced. Therefore, it is recommended that a to-be-determined prescribed ramping rate be implemented in above normal and wet water year classes.

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- The opportunity for riparian expansion will increase in many of the tributaries as channel restoration projects are implemented. Newly created alluvial surfaces that provide high quality salmonid habitat could be vulnerable to narrowleaf willow establishment and eventual encroachment. Preventing or avoiding narrowleaf willow encroachment will be important in project areas where channel restoration has improved channel morphology, such as the Tuolumne River. Because of its propensity to fossilize the channel and reduce species and age diversity of riparian vegetation, narrowleaf willow dominance is undesirable. While the hydrographs of simulations of the above normal water years through the critically dry years show that the No Action and the SJRA Alternative propose stable summer base flows, on the Tuolumne River, static summer baseflows are already mandated by FERC. Where adequate soil moisture is present, stable summer flows could produce a large crop of narrowleaf willow seedlings in exposed areas. A small increase in flow in the first two weeks of August, immediately following narrowleaf willow's seed dispersal period, would minimize riparian encroachment by inundating surfaces where narrowleaf willow germinated and produce a beneficial effect on Fremont cottonwood seedlings. Inundating narrowleaf willow in early August would enhance inundation related mortality to new cohorts. If the April option of the SJRA alternative is chosen, this early August flow release should approach the stage height level of May 15, drowning narrowleaf willow seedlings while watering Fremont cottonwood seedlings on upper bar and floodplain surfaces.

- In conclusion, no rare, threatened, or endangered plant species, and no relic vegetation types would be impacted (in comparison to no action); therefore, the negative impacts are not considered "significant". The SJRA alternative also would have some beneficial impacts to riparian vegetation.

Alternative Action

- Impacts to Fremont cottonwood would be similar to the proposed action. Water provided for ramping flows would mitigate potential impacts to less than significant.

- The Water Right Priority System would also be based on FERC mandated flows in the Tuolumne River. Similar increases in stage (such as those recommended for the SJRA alternative) would prevent encroachment at restoration sites, and would mitigate to less than significant the effects of summer baseflows in these areas.

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4.4.3.2 Wildlife

Proposed Action

- Ramping flows and the April pulse flow would result in reducing potential impacts on TES wildlife species by reducing loss of important wildlife habitat and decreasing the potential for fragmentation of riparian corridors. In addition, the FERC mandated flows on the Tuolumne (assumed in both No Action and SJRA alternatives) would reduce encroachment of exotic plant species in the project area and enhance habitat quality for endemic wildlife, including TES species. The impacts to wildlife, especially TES species, would be less than significant.

Alternative Action

- Impacts to the riparian corridor would be similar to those described in the proposed action. The alternative action would result in less-than-significant impacts to wildlife, including TES species.

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4.5 AQUATIC RESOURCES

This section assesses the impacts to aquatic resources that could be affected by the proposed action and the alternative action.

4.5.1 Key Impact Issues and Evaluation Criteria

The aquatic resources within the project area have been defined in terms of existing habitats represented by unique Ecological Zones as described in Section 3.5.1. Riverine systems that provide spawning and rearing habitat, as well as passage into and out of the Delta for anadromous species of fish, form the basis for the impact analysis. Also considered are the reservoir habitats provided by the three major reservoirs in the project area. The estuarine habitats of the Delta are included only to the extent that they are impacted indirectly by the cumulative effects of the proposed project.

Indicator fish species, that occur within the project area during one or more environmentally sensitive stages of their life cycle, were chosen as important representatives of aquatic ecosystem responses to changes caused by the proposed project and its alternative. Fall-run chinook salmon were selected as the species of prime interest because water contributed by the proposed project is designated to provide protection for this species in the San Joaquin River Basin. The analysis of chinook salmon also encompasses steelhead trout, an anadromous species closely related to salmon. Other, less widely distributed species included in this analysis, are splittail and striped bass. Splittail are a native species currently proposed as a federally threatened species. Striped bass are included because of their commercial value as a game fish. The representative species selected for reservoir habitats is the largemouth bass.

The criterion used to determine the level of riverine impact associated with implementation of the project is based on average percentage changes to stream flow as compared to base conditions. Thresholds of impact significance were established as follows (see Section 4.1.2 for definitions of these categories):

• greater than +10 percent change	Beneficial
• less than ±10 percent change	Not significant
• between -11 and -25 percent change	Less than significant
• greater than -25 percent change	Potentially significant or Significant

Thresholds were derived based on the ability to accurately measure stream flow discharges to ±10 percent (USGS 1977). A change from -11 to -25 percent was considered measurable, but less than significant, because it would likely result in only minor changes in usable habitats. This is based in part on results of a study that combined weighted usable area (WUA) and stream temperatures as related to salmon habitat (EA 1993). Operational releases are not permitted to fall below established

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minimum flow requirements. For more discussion of the assessment methodology, see Appendix H, response 11 to comment 11 by NMFS.

Currently, minimum flow requirements have been established by the Federal Energy Regulatory Commission (FERC) for the Tuolumne River to protect fishery resources. For the Merced River, both the FERC license and the Davis-Grunsky contract provide minimum flow standards. Flow objectives for the Stanislaus River have been established in the New Melones Interim Plan of Operation (USBR 1997c).

The criterion for reservoir species impacts was an assessment of the percent change in water surface elevation, by water year type, of the three major reservoirs, for the months of April through July. This time period represents the optimal spawning period for largemouth bass. Water surface elevations were derived from water surface elevations vs. storage relationships for each reservoir. Average change in storage was then computed for each water year type, converted to water surface elevation, and compared to conditions. Thresholds of impact significance were established as follows:

• greater than +10 percent change	Beneficial
• less than ±10 percent change	Not significant
• between -11 and -20 percent change	Less than significant
• greater than -20 percent change	Potentially significant or Significant

Thresholds were derived based on the ability to accurately model changes in reservoir water surface elevations to ±10 percent (SWRCB 1998).

For both riverine and reservoir assessment, the no action and proposed action results from the hydrological modeling analysis (Appendix A) were used. This hydrologic analysis considered a hydrologic sequence of 71 years (1922 through 1992) and included the following range of water year types: 1) Critically Dry, 2) Dry, 3) Below Normal, 4) Above Normal, or 5) Wet. The No Action alternative represents the base case for comparing the alternatives. The 71-year period was used to evaluate the potential effects of the project over a the series of water year types, since the actual hydrology during project implementation would be unknown. Average percent changes over this 71-year hydrologic sequence were developed by water year type and used in the evaluation of the proposed project as compared with the base case.

The SWRCB (1998) results were used for an evaluation of conditions under the Water Right Priority System alternative. This analysis used a different operations model (DWRSIM) and a different base case, therefore the results were not directly comparable to those used to evaluate the proposed alternative. To evaluate the Water Right Priority System, an analysis between the SWRCB

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Alternative 2 (SWP/CVP used to meet the standards) and the alternative action (Alternative 3) was used to qualitatively determine impacts.

4.5.2 Environmental Consequences

The proposed project would provide additional stream flow largely in the form of October attraction flows and spring pulse flows. The project would provide water primarily through reservoir releases, bypass, and releases from storage. Reservoir storage would then be refilled during above normal and wet water year types, resulting in reduced stream flows (see Section 4.2 for discussion of water supply changes). The project would obtain up to 50 percent of its water from Lake McClure on the Merced River, with the majority of the remaining water coming from willing sellers on the Stanislaus, Tuolumne, and mainstem San Joaquin rivers.

4.5.2.1 Habitats and Ecological Zones

The Ecological Zones described in Section 3.5.1 contain complex relationships between the physical habitats and species assemblages found within them. These zones represent entire ecosystems that provide numerous and highly variable habitats for many species. No criterion exists to determine the significance of impacts across all of the habitats occurring within the zones on an ecosystem level. Consequentially, assessments of impacts within these zones are made through the use of indicator aquatic species. These species, which are dependent on a suite of aquatic habitats for reproduction, growth, and development, provide a link to the ecosystem level of biological organization.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Fluctuation of reservoir levels occur to the extent required to meet these flow releases. Since No Action represents the baseline, no impacts are identified for implementation of this alternative.

Proposed Action. Of the four Ecological Zones within the project area, only the San Joaquin River and East San Joaquin Basin zones are directly affected by the project. The project would provide flows in addition to those from the base case, with the Merced River experiencing the largest increases. Small reductions in flow would also occur as a result of reservoir recharge. The largest reductions in flow would occur on the Merced River in above normal and wet water year types. The proposed action would coordinate flow releases from among the three major reservoirs resulting in fluctuations of water level in the reservoirs. Because no criteria exists for assessing impacts to Ecological Zones, no determination of significance can be made.

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Alternative Action. Neither the SWRCB (1998) Alternative 3 (the Water Right Priority System) nor the Alternative 2 (comparable base case), includes a discussion of Ecological Zones, or equivalent ecosystem level components. The alternative action could result in different flow regimes and reservoir levels when compared with the base case (Alternative 2). Consequently, it is not possible to evaluate impacts at the Ecological Zone level of biological organization. However, the general changes would be similar to the proposed action in that both would provide additional flows during October and April or May, with resulting water level fluctuations occurring in major project reservoirs. No determination of significance can be made.

4.5.2.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

A list of factors that affect the distribution and abundance of aquatic resources in the project area and Delta was presented in Section 3.5.2. These factors include; 1) Natural environmental variability, 2) Water development, 3) Introduced species, 4) Food supply, 5) Harvest, 6) Pollution, and 7) Reservoirs. Of these factors, only Pollution (Water Quality) and Reservoirs, are directly impacted by the project. Reservoir issues relating to selected indicator species are discussed in Section 4.5.2.3. Changes in surface water quality are discussed in Section 4.2.2.3.

No Action. The No Action alternative results in no changes to existing conditions.

Proposed Action. Implementation of the proposed action positively benefits water quality due to increased flow at Vernalis and would, therefore, not adversely affect aquatic resources.

Alternative Action. Implementation of the alternative action positively benefits water quality due to increased flows and would, therefore, not adversely affect aquatic resources.

4.5.2.3 Indicator Species

Indicator fish species provide a link between effects on individual organisms and consequences at the population, community, and aquatic ecosystem or "ecological unit" (see Section 4.5.2.1) levels of biological organization. The assessment of impacts to selected indicator species are based on the amount of change in stream flow or reservoir levels. Changes in flow (or reservoir levels) relate directly to the amount and quality of available physical habitat for various life stages of the indicator species and hence to its population distribution, numbers, and dynamics (change in distribution and numbers through time). To transform the magnitude of change in flow to impacts, threshold values were identified for not significant, less-than-significant, and potentially significant changes (see Section 4.5.2.1). Table 4.5-1A shows the average monthly percent change in flow (cfs) by water year type for specific reaches of the San Joaquin River and its tributaries. Table 4.5-1A was created

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TABLE 4.5-1A: AVERAGE PERCENT CHANGES IN CFS FOR RIVERS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE

STANISLAUS RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	6	3	9	6	5	14	5	4	5	3	0	1	5
Above Normal	4	2	2	34	6	5	2	14	13	0	0	1	7
Below Normal	0	1	1	2	2	5	9	25	-2	0	9	0	4
Dry	48	8	8	18	7	2	13	1	-1	6	1	0	9
Critical	2	3	3	4	3	5	9	1	5	8	0	0	4
STANISLAUS RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	5	2	3	7	4	12	4	4	11	2	0	1	4
Above Normal	2	1	1	34	6	4	3	24	9	0	7	0	7
Below Normal	0	1	1	2	2	4	23	10	-2	0	1	0	4
Dry	43	8	8	18	6	2	3	12	1	1	1	0	9
Critical	2	2	2	4	3	4	3	16	4	9	0	0	4
TUOLUMNE RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	-1	1	-8	-1	-4	0	0	-1	0	-2	-1	1	-1
Above Normal	-1	0	-2	-1	-2	-5	9	-2	1	-2	-2	1	-1
Below Normal	0	1	-1	-3	0	-4	32	1	11	8	8	11	5
Dry	-2	-1	-1	-1	-4	-1	43	-2	6	4	4	6	4
Critical	1	1	-2	-2	-2	-2	6	-3	0	-2	-2	0	-1
TUOLUMNE RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	-1	1	-7	-1	-5	0	0	1	0	-2	-1	1	-1
Above Normal	-1	0	-5	-1	-4	-5	-1	22	1	-2	-2	1	0
Below Normal	0	0	-1	-5	0	-4	-5	33	11	8	8	11	4
Dry	-2	-1	-1	-1	-2	-1	1	42	7	4	4	7	5
Critical	1	1	-2	-2	-2	-2	1	11	0	-2	-2	0	0

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TABLE 4.5-1A: AVERAGE PERCENT CHANGES IN CFS FOR RIVERS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

MERCED RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2,519	-4	-7	-15	-15	-1	1	-2	-2	0	1	-2	206
Above Normal	1,835	-1	-6	-1	-5	-20	139	-11	-9	2	1	0	160
Below Normal	399	-2	0	0	-3	0	363	2	1	2	0	0	64
Dry	438	-7	0	-3	-7	0	356	2	1	1	0	0	65
Critical	3,446	-8	0	0	0	0	127	2	1	1	0	42	301
MERCED RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2,519	-4	-7	-21	-16	-1	-2	22	-9	0	1	-2	207
Above Normal	1,835	-1	-6	-3	-7	-21	-22	234	-20	2	1	0	166
Below Normal	396	-2	0	0	-3	0	-4	275	1	2	0	0	55
Dry	438	-7	0	-3	-9	0	-4	271	1	1	0	0	57
Critical	3,446	-8	0	0	0	0	-3	122	1	1	0	42	300
SJR at VERNALIS – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	11	-1	-2	-1	-3	0	1	0	0	0	0	0	0
Above Normal	10	0	-2	1	-2	-4	8	0	-1	0	0	0	1
Below Normal	11	0	0	0	0	0	27	4	0	0	3	1	4
Dry	16	-1	2	3	-1	0	35	0	0	3	1	0	5
Critical	16	-1	0	0	0	0	16	0	2	2	-1	0	3
SJR at VERNALIS – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	10	-1	-2	-3	-3	0	0	2	-1	0	0	0	0
Above Normal	10	0	-2	0	-3	-5	-1	23	-3	0	0	0	2
Below Normal	9	0	0	-1	0	0	2	30	0	0	1	0	3
Dry	15	-1	2	3	-1	0	0	39	1	1	1	1	5
Critical	16	-2	0	0	0	0	0	25	2	3	-1	0	4

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TABLE 4.5-1A: AVERAGE PERCENT CHANGES IN CFS FOR RIVERS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

SJR below TUOLUMNE – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	Novem	December	January	February	March	April	May	June	July	Augus	September	WY Average
Wet	12	-1	-3	-2	-4	0	0	0	0	0	0	0	0
Above Normal	11	0	-2	0	-3	-5	12	-3	-3	0	0	0	1
Below Normal	12	0	0	-1	-1	-1	42	0	1	1	1	1	5
Dry	10	-3	0	-1	-3	0	55	0	1	1	1	1	5
Critical	18	-2	0	0	0	0	21	0	0	0	-1	0	3
SJR below TUOLUMNE – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	Novem	December	January	February	March	April	May	June	July	Augus	September	WY Average
Wet	12	-1	-3	-4	-4	0	0	3	-3	0	0	0	0
Above Normal	11	0	-3	-1	-4	-6	-3	33	-6	0	0	0	2
Below Normal	11	0	0	-1	-1	-1	-1	47	1	1	1	1	5
Dry	10	-3	0	-1	-3	0	0	64	1	1	1	1	6
Critical	18	-2	0	0	0	0	0	33	0	-1	-1	0	4
SJR below MERCED – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)													
WY Type	October	Novem	December	January	February	March	April	May	June	July	Augus	September	WY Average
Wet	27	-3	-3	-5	-7	-1	1	-1	-1	0	0	0	1
Above Normal	23	0	-3	0	-3	-10	38	-6	-6	1	0	0	3
Below Normal	26	-1	0	0	-1	0	108	0	0	0	0	0	11
Dry	22	-4	0	-1	-3	0	119	0	0	0	0	0	11
Critical	36	-4	0	0	0	0	52	0	0	0	-1	-1	7
SJR below MERCED – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)													
WY Type	October	Novem	December	January	February	March	April	May	June	July	Augus	September	WY Average
Wet	27	-3	-3	-8	-7	-1	-1	9	-6	0	0	-1	1
Above Normal	23	0	-3	-1	-4	-10	-8	97	-12	1	0	0	7
Below Normal	24	-1	0	0	-1	0	-1	114	0	0	0	0	11
Dry	22	-4	0	-1	-4	0	-1	122	0	0	0	0	11
Critical	36	-4	0	0	0	0	-1	62	0	0	-1	0	8

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by first calculating the percent change in flow from base conditions, represented by the No Action alternative, to the proposed action. These percentages were then averaged by water year type.

Table 4.5-1B shows the average monthly flow by water year that result from modeled flows for both the April/May base case and the April/May project. These averages are provided for information purposes only and have not been used in the determination of impacts. Note that the difference between averages will not be the same number as the average of individual differences. Consequently, one cannot take the average percentage change (in flows) given in Table 4.5-1A and apply them directly to Table 4.5-1B. Conversely, percentage change in averages calculated from Table 4.5-1B will not be the same number as those given in Table 4.5-1A.

Table 4.5–2 summarizes the average water surface elevations in project area reservoirs along with the percent monthly changes for April through July by water year type.

The effects of implementing the proposed project and its alternative are evaluated using the following indicator species: chinook salmon, steelhead trout, striped bass, splittail, and largemouth bass. Consideration is given to the specific life stages (including the egg stage) which occur within each river system. The key indicator species identified for this document is the fall-run chinook salmon.

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TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE

STANISLAUS RIVER – AVERAGE CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	Septembe	WY Average
Wet	445	406	468	621	873	1467	1564	1364	1203	588	556	348	825
Above Normal	811	480	627	773	734	431	1229	899	696	620	607	265	681
Below Normal	531	300	320	341	346	242	1172	664	599	718	599	257	507
Dry	786	355	364	422	570	208	1108	666	928	689	519	252	572
Critical	174	241	241	202	209	142	612	599	714	297	283	249	330
STANISLAUS RIVER – AVERAGE CFS WITHOUT PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	Septembe	WY Average
Wet	416	397	437	573	805	1356	1502	1323	1155	579	558	339	787
Above Normal	787	476	623	707	674	417	1222	823	662	619	609	263	657
Below Normal	491	296	317	335	342	232	1110	577	608	717	561	256	487
Dry	548	325	332	351	543	206	023	662	936	659	508	253	529
Critical	173	237	236	195	203	137	558	595	687	271	283	249	319
STANISLAUS RIVER – AVERAGE CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	Septembe	WY Average
Wet	442	402	446	618	862	1465	1377	1545	1221	585	553	348	822
Above Normal	811	480	627	763	734	429	897	1291	751	616	601	265	689
Below Normal	532	299	320	340	346	239	621	1180	603	720	587	257	504
Dry	771	355	363	421	574	207	603	1094	949	693	535	253	568
Critical	174	241	241	201	209	141	538	661	722	306	283	249	330
STANISLAUS RIVER – AVERAGE CFS WITHOUT PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	Septembe	WY Average
Wet	416	397	436	558	800	1358	1330	1491	1148	577	555	338	784
Above Normal	786	475	623	706	670	417	817	1221	703	611	605	263	658
Below Normal	499	296	316	335	341	231	542	1106	612	720	578	256	486
Dry	557	325	332	350	552	205	595	1017	940	692	529	253	529
Critical	172	237	236	195	203	137	530	569	705	276	283	249	316

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TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)

TUOLUMNE RIVER – AVERAGE CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	420	496	747	2616	3626	3717	2803	2094	2429	681	502	806	1745
Above Normal	296	628	1137	1632	2170	963	1974	307	301	244	244	252	846
Below Normal	282	494	412	661	714	387	1501	179	84	81	81	84	413
Dry	341	477	262	262	656	262	1067	155	72	69	69	72	314
Critical	196	215	180	180	181	180	491	146	50	49	49	50	164
TUOLUMNE RIVER – AVERAGE CFS WITHOUT PROJECT (APRIL)													
50WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	423	493	808	2622	3739	3717	2800	2096	2429	686	505	802	1760
Above Normal	299	628	1166	1634	2233	987	1810	312	299	250	250	250	843
Below Normal	284	492	415	681	712	409	1138	177	76	75	75	76	384
Dry	347	476	265	265	668	265	752	158	67	66	66	67	289
Critical	195	212	184	184	184	184	455	150	50	50	50	50	162
TUOLUMNE RIVER – AVERAGE CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	420	496	708	2544	3510	3716	2576	2600	2289	681	502	798	1737
Above Normal	296	628	1027	1626	2038	950	589	2156	252	244	244	252	859
Below Normal	282	419	412	632	714	367	330	1350	84	81	81	84	403
Dry	341	477	262	262	656	262	268	1032	72	69	69	72	320
Critical	196	215	180	180	181	180	151	499	50	49	49	50	165
TUOLUMNE RIVER – AVERAGE CFS WITHOUT PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	423	493	763	2573	3641	3717	2577	2577	2228	686	505	795	1753
Above Normal	299	628	1100	1633	2119	979	592	1761	250	250	250	250	843
Below Normal	284	430	415	661	712	388	352	1022	76	75	75	76	381
Dry	347	476	265	265	660	265	265	729	67	66	66	67	295
Critical	195	212	184	184	184	184	150	445	50	50	50	50	161

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TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)

MERCED RIVER – AVERAGE CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	385	345	396	912	1746	2508	1976	1542	1569	646	269	519	1068
Above Normal	500	510	483	730	967	640	665	320	322	228	130	42	461
Below Normal	391	357	190	305	282	232	811	228	251	224	73	25	281
Dry	535	312	209	223	279	179	799	228	243	173	28	43	281
Critical	240	188	150	149	175	170	404	229	237	122	46	31	178
MERCED RIVER – AVERAGE CFS WITHOUT PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	215	379	439	1125	2074	2528	1974	1573	1601	643	266	524	1112
Above Normal	364	516	636	741	1148	836	441	385	404	224	129	42	489
Below Normal	240	362	190	305	297	232	175	224	249	220	73	25	216
Dry	406	376	209	231	322	179	175	224	240	172	28	43	217
Critical	50	229	150	149	175	170	177	224	235	120	46	30	146
MERCED RIVER – AVERAGE CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	383	345	396	812	1724	2501	1946	1644	1496	643	269	519	1057
Above Normal	500	509	483	696	897	623	323	1053	252	228	130	42	478
Below Normal	366	357	190	305	282	232	168	840	251	224	73	25	276
Dry	535	312	209	223	265	179	168	832	243	173	28	43	267
Critical	240	186	150	149	175	170	172	498	237	122	46	31	181
MERCED RIVER – AVERAGE CFS WITHOUT PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	215	379	439	1125	2074	2528	1974	1573	1601	643	266	524	1112
Above Normal	364	516	636	741	1148	836	441	385	404	224	129	42	489
Below Normal	240	362	190	305	297	232	175	224	249	220	73	25	216
Dry	406	376	209	231	322	179	175	224	240	172	28	43	217
Critical	50	229	150	149	175	170	177	224	235	120	46	30	146

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TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)

SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITH PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2384	2499	3948	7900	13386	15398	13756	11843	8480	3416	2456	2686	7346
Above Normal	2693	3059	4172	5858	7684	5374	7154	3584	2828	2185	2076	1639	4025
Below Normal	2161	2197	2037	2419	3273	2864	5590	2511	2172	2006	1841	1439	2543
Dry	2528	214	1781	1888	2857	1991	4259	1820	1892	1440	1271	1104	2081
Critical	1520	1532	1370	1318	1676	1621	2343	1406	1368	855	790	904	1392
SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITHOUT PROJECT (APRIL)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2189	2522	4021	8071	13759	15307	13688	11834	8463	3410	2462	2678	7367
Above Normal	2537	3060	4351	5802	7866	5578	6720	3581	2875	2188	2084	1635	4023
Below Normal	1971	2195	2035	2434	3280	2876	4415	2422	2171	2003	1793	1431	2419
Dry	2165	2179	1753	1827	2885	1994	3120	1817	1896	1407	1256	1099	1950
Critical	1330	1564	1370	1315	1676	1620	2001	1403	1342	831	797	904	1346
SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITH PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2378	2495	3866	7726	13236	15388	13311	12636	8284	3410	2453	2679	7323
Above Normal	2688	3062	4064	5810	7481	5338	5053	6675	2765	2181	2069	1638	4069
Below Normal	2137	2121	2037	2389	3272	2842	3144	4912	2180	2013	1832	1437	2524
Dry	2512	2144	1781	1887	2848	1990	2212	3823	1919	1447	1288	1107	2080
Critical	1519	1529	1369	1317	1678	1621	1671	2121	1380	866	795	904	1398
SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITHOUT PROJECT (MAY)													
WY Type	October	November	December	January	February	March	April	May	June	July	August	September	WY Average
Wet	2188	2523	3975	8007	13657	15309	13292	12484	8315	3406	2458	2671	7357
Above Normal	2532	3061	4268	5805	7753	5568	5096	5427	2866	2179	2076	1635	4024
Below Normal	1978	2135	2033	2413	3280	2855	3065	3790	2175	2005	1815	1432	2415
Dry	2175	2179	1753	1827	2885	1993	2212	2735	1906	1441	1277	1098	1957
Critical	1330	1565	1369	1313	1673	1620	1669	1675	1365	840	800	904	1344

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Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE

NEW MELONES NO-ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	1034	1049	1058	1053	1.5	0.9	-0.5
Above	1000	1013	1014	1004	1.5	0.1	-1.0
Below	1002	1007	1006	995	0.5	-0.1	-1.1
Dry	1011	1005	994	981	-0.6	-1.1	-1.3
Critical	955	945	933	923	-1.0	-1.3	-1.1
NEW MELONES PROPOSED ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	1037	1053	1062	1057	1.5	0.9	-0.5
Above	1007	1019	1020	1010	1.2	0.1	-1.0
Below	1008	1012	1012	1000	0.4	0.0	-1.2
Dry	1015	1009	998	986	-0.6	-1.1	-1.2
Critical	965	955	943	932	-1.0	-1.3	-1.2
NEW MELONES NO-ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	1035	1048	1058	1053	1.3	1.0	-0.5
Above	1003	1013	1014	1004	1.0	0.1	-1.0
Below	1005	1007	1006	995	0.2	-0.1	-1.1
Dry	1014	1006	955	981	-0.8	-1.1	-1.4
Critical	957	947	934	929	-1.0	-1.4	-1.1
NEW MELONES PROPOSED ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	1039	1052	1061	1056	1.3	0.9	-0.5
Above	1009	1018	1019	1009	0.9	0.1	-1.0
Below	1011	1012	1011	1000	0.1	-0.1	-1.1
Dry	1018	1010	999	986	-0.8	-1.1	-1.3
Critical	966	955	943	933	-1.1	-1.3	-1.1

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Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

NEW DON PEDRO NO-ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	796	804	822	825	1.0	2.2	0.4
Above	790	799	809	800	1.1	1.3	-1.1
Below	781	789	793	782	0.9	0.5	-1.3
Dry	790	792	786	774	0.3	-0.7	-1.6
Critical	750	748	742	729	-0.2	-0.9	-1.7
NEW DON PEDRO PROPOSED ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	796	809	822	825	1.1	2.2	0.4
Above	789	798	808	799	1.2	1.3	-1.1
Below	780	787	791	780	0.9	0.5	-1.3
Dry	788	790	784	772	0.2	-0.7	-1.6
Critical	749	747	741	728	-0.2	-0.9	-1.7
NEW DON PEDRO NO-ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	797	803	821	824	0.9	2.2	0.3
Above	795	797	807	799	0.3	1.3	-1.1
Below	784	787	791	781	0.4	0.5	-1.3
Dry	792	791	785	773	-0.1	-0.7	-1.6
Critical	751	747	741	728	-0.5	-0.9	-1.7
NEW DON PEDRO PROPOSED ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	797	803	821	824	0.9	2.2	0.3
Above	794	795	806	796	0.1	1.3	-1.1
Below	783	785	789	778	0.2	0.5	-1.4
Dry	790	789	783	770	-0.2	-0.7	-1.6
Critical	749	745	739	726	-0.6	-0.9	-1.7

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Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

LAKE MCCLURE NO-ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	812	845	863	856	4.1	2.1	-0.9
Above	818	848	853	838	3.7	0.7	-1.7
Below	801	824	827	809	2.8	0.4	-2.2
Dry	811	820	812	788	1.1	-1.0	-3.0
Critical	766	775	766	749	1.1	-1.0	-2.3
LAKE MCCLURE PROPOSED ACTION – APRIL							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	811	845	863	856	4.2	2.1	-0.9
Above	806	839	845	830	4.0	0.8	-1.8
Below	784	808	812	792	3.1	0.4	-2.4
Dry	794	804	795	768	1.2	-1.1	-3.4
Critical	748	758	750	731	1.3	-1.1	-2.4
LAKE MCCLURE NO-ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	812	845	863	856	4.1	2.1	-0.9
Above	817	848	853	838	3.8	0.7	-1.7
Below	801	824	827	809	2.8	0.4	-2.2
Dry	811	820	812	788	1.1	-1.0	-3.0
Critical	766	775	766	749	1.1	-1.0	-2.3
LAKE MCCLURE PROPOSED ACTION – MAY							
	ELEVATION				PERCENT CHANGE		
WY Type	April	May	June	July	Apr-May	May-Jun	Jun-Jul
Wet	811	844	863	855	4.1	2.2	-0.9
Above	809	834	846	826	3.0	1.5	-2.4
Below	789	806	810	790	2.1	0.4	-2.5
Dry	800	802	793	766	0.3	-1.1	-3.4
Critical	749	754	746	727	0.7	-1.1	-2.6

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Chinook Salmon

Various life stages of fall-run chinook salmon can be present in the San Joaquin River Basin during all months of the year, although the number of individuals may vary considerably by stream and by year. Adults enter the system in October and spawn through January, with peak spawning period in November. Typically, eggs are buried in the spawning gravels for parts of November, December, and January, with occasional occurrences in October or February. Fry (very small juvenile fish) hatch starting in January, remain in the gravels for up to 30 days, and then emerge to feed and grow in shallow, slow moving water at the edge of the river. As the fry grow and develop (a process called rearing or maturation), they remain in waters which provide sufficient types and quantities of food and in waters where they can find cover from predators. At a certain stage of growth and development, they begin a process of physiological transformation to prepare for emigration out of the river to the ocean (smoltification). The majority of smolts leave the tributaries from March to the end of June. Other juveniles that remain in the tributaries and survive the summer months can become yearling smolts in the fall or winter.

Smolts can be stimulated to leave their rearing habitat by pulse flows in the spring. Pulse flows can mimic natural storm events that increase streamflow and stimulate emigration. Pulse flows usually result in increased turbidity and lower water temperatures. Both of these factors serve to reduce the impact of predation on emigrating smolts. Additionally, pulse flows may provide the necessary means to increase the survival of chinook salmon smolts by moving them out of tributaries in years when water temperature increases during the summer months result in elimination or reduction of suitable rearing habitat. The Vernalis Adaptive Management Plan is an experimental study to determine the proper level for the pulse flows.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes fall attraction flow and spring pulse flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin and are intended to benefit adult and smolt life stages of chinook salmon. Since No Action represents the baseline, no impacts are identified for implementation of this alternative.

Proposed Action. In general, the Stanislaus, Tuolumne, and segments of the San Joaquin River (from the mouth of the Tuolumne to Vernalis) show less-than-significant changes in stream flow (Table 4.5-1A) as a result of implementing the proposed action. An exception to this general pattern occurs in October, January, and April/May. The relatively large increases in flow which occur in these reaches during October and/or April/May are viewed as beneficial impacts to fall-run chinook salmon. Increased stream flows in October benefit spawning adults migrating into the tributaries. These flows serve to attract the salmon to their natal streams. The spring pulse flow in April/May stimulates the emigration of salmon smolts out of the rivers systems toward the Delta and, eventually, the sea. The January increases occur in the Stanislaus River only and represent releases from storage of unallocated carryover for flood control purposes.

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The Merced River and San Joaquin River (below the mouth of the Merced) show the same general flow patterns. However, large percentage increases in flow are observed when implementing the proposed action (Table 4.5-1A). This results from very low base case flows during October and April/May in some water year types. The large percentage increases shown for the Merced River in October for all water year types with the proposed action are due to increases in flow from base conditions of zero cfs. For example, in October during wet water year types, base flow conditions of zero cfs existed for 2 of the 17 years. In each case, these flows were increased to 203 cfs with the proposed action. Using a minimum flow of 1 cfs to allow for computation of percent increase, each of these years results in an increase of over 20,000 percent. When these values are used over the 17 wet water year types, the *average percent change* in flow is equal to 2,519.

The alternative to this method would have been to first calculate the average monthly flow by water year type and then determine the percent change between the No Action and proposed action alternatives. This method would have resulted in the *percent change in average flow* by water year type.

The selection criteria is based on the average percent change in flow between the no action and the proposed action. This is the preferred approach, since it is tightly linked to individual flow measurements and their relative accuracy. Statistically, the differences between meaningfully paired comparisons (i.e., proposed action minus no action) have a distribution similar to the original data which can be characterized by a variance and a mean. This transformation of the data (the process of calculating differences) preserves the information contained in the original data set. Consequently, the average percent change in flow is chosen as the criterion to assess impacts. This choice maintains the close, meaningful relationship between the selected assessment criteria and individual flow measurement.

Since base case flows are so low, the increased discharge into the Merced by the proposed project is considered a beneficial impact. The increases in flow in the San Joaquin River below the Merced are also considered a beneficial impact to the salmon. With no action, the Merced River has very low instream flow requirements. Since the proposed action provides most of the additional water needed to achieve the SJRA flows by releases into the Merced River, the fishery resources of this San Joaquin River tributary should benefit the most by implementation of the project. The operating conditions at the Merced River Fish Facility would not be impacted.

The Merced River also exhibits some reductions in flow associated with the proposed action (Table 4.5-1A). These occur in January through March, April (during a May release), May (during an April release), and in June. These instream flow reductions are the result of reservoir refill operations for Lake McClure and are largest in magnitude during above normal and wet water year types (maximum change of -22 percent). However, based upon the impact threshold criteria described in Section 4.5.1.2, these reductions in flow are considered to be less-than-significant impacts.

The October attraction and spring pulse flows associated with the proposed action are potentially large, rapidly increasing flows. These could create the potential for rapid increases and decreases in river height (stage) as the flows are implemented, producing circumstances which could dewater redds in the fall (a dewatered redd is a "nest" of salmon eggs, buried in gravel, that becomes exposed to air when the stage of a river is sufficiently decreased), or strand salmon fry and smolts during the spring (stranding is when fish living in shallow-water habitats near shore are trapped in dewatered areas, or isolated in pools outside of the river channel, after a sudden decrease in the stage of a river). Another possible impact to a redd is for it to be scoured by an increase in flow large enough to cause movement of the gravel substrate. Scouring may result in the loss of eggs or fry developing within the gravels. Because of the possible magnitude of these flow changes under the proposed action, this is considered to be a potentially significant negative impact. A mitigation measure to reduce the impact to less than significant would be to control the down ramp so as to protect redds and fish within the system from dewatering and stranding. In coordination with U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (DFG), the Operations Group should develop and adopt a Best Management Practice (BMP) for supplying ramping guidelines (both up and down ramp) governing the release of attraction and pulse flows to ensure and maximize the protection of salmon. This BMP could be included in the annual operation plan. Additional water included in the SJRA from OID not specifically directed to the pulse flows could be used for ramping.

The October attraction flows may also stimulate adult salmon to enter spawning reaches where ambient water temperatures become too high after the attraction flow is reduced. The increased water temperature may result in reduced fecundity of females (fecundity is a measure of viable eggs produced by a female). The occurrence of this type of event would most likely take place in critical years when low flow releases are scheduled during November and seasonal air temperatures are high. The impact of the proposed actions on these events is likely to be less than significant based on low frequency of occurrence for these events and the modeled flow predictions for November with the proposed action that show no significant changes in flow. Existing temperature models should be used in conjunction with habitat data to predict changes in temperature and usable habitat for various life stages of salmon based on a comparison of proposed flows versus no action.

Existing records, data, and modeling efforts addressing water temperature issues for the Merced River are not sufficient at this time to allow comprehensive quantitative analysis of the potential for impacts of the proposed actions on Merced River temperatures. However, a qualitative examination of projected changes in average monthly Lake McClure water storage levels provides a useful approach for understanding better the potential for impacts on river temperatures.

The storage level of Lake McClure is a primary factor affecting the temperature of water released into the Merced River at New Exchequer Dam. Along with season of the year, annual runoff pattern, and annual air temperature variations, reservoir levels affect the temperature of water at the dam's outlet. The level of the reservoir affects the volume of cold water in the hypolimnion which forms in the deepest layers of the reservoir upon thermal stratification during the late spring, summer, and

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early fall months. Surface water warmed by the air and solar radiation during the spring and summer "floats" on top of the cooler, denser water of the hypolimnion. The depth of this warmer surface layer can vary but is generally between 15 and 30 feet deep in most California reservoirs. Once thermal stratification breaks down during the early fall months, the warmer surface and cooler hypolimnion waters mix and reservoir temperature becomes almost uniform throughout its depth and comes to a dynamic equilibrium with inflow and air temperatures until stratification reoccurs in spring.

Given this general relationship between a lake's temperature profile and depth, differences in lake level can be used as a proxy indicator for potential differences in temperature at the reservoir outlet. Figures 4.5-1 through 4.5-5 provide graphical representation of the differences in average monthly lake levels between the proposed action (April and May scenarios) and the No Project alternative. They suggest that minimal effects on the temperature of water released into the Merced River may be expected. The difference between the two proposed action operations is negligible. Differences between the proposed action (April and May scenarios) and No Project alternative are small. The magnitude of these differences vary between water year type and over the course of individual water years, but are generally less than 30 feet different in depth. Such a small difference between the alternatives, relative to total depth of the reservoir at any one time, would not be expected to have much effect on release temperature when compared to the No Project Alternative, except perhaps during the early fall months in dry and critically dry water years when total storage may be limited. The extent of such an impact on water temperature in the Merced River would be dependent on the degree of cooling provided by decreasing seasonal air temperature which dominates release temperature in affecting river temperature in the lower Merced River during the fall and early winter months.

Alternative Action. Flows for the alternative action are based on the SWRCB (1998) models (DWRSIM) previously discussed in Section 4.1.4. The aquatic resources impact analyses of the alternative action is based on percentage differences in flow between the SWRCB Alternative 3, known as the Water Right Priority System, as compared with SWRCB Alternative 2, used as comparable to the No Action alternative. By deriving the percentage change (Table 4.5-3) between the two SWRCB alternatives, the criteria developed in Section 4.5.1 can be employed to evaluate impacts and their significance. Available SWRCB data facilitates impact assessment for the major tributaries of the San Joaquin River, but not for the mainstem San Joaquin River.

For the alternative action, impacts to fall-run chinook salmon would not be significant, based on flow changes considered to be within measurement error (± 10 percent), or measurable, but less-than-significant (between -11 percent and -25 percent) changes in flow. However, some potentially significant (greater than -25 percent) changes in flow are shown to occur in the Merced River during February and in the Stanislaus River during May (Table 4.5-3) of the SWRCB defined critically dry period (May 1923 to October 1934). The Stanislaus flow reductions may be the result of pulse flows being reduced in April/May. (Note that pulse flows modeled by SWRCB can cross months, whereas the pulse flows in the proposed action occur in either April or May). Based on available information,

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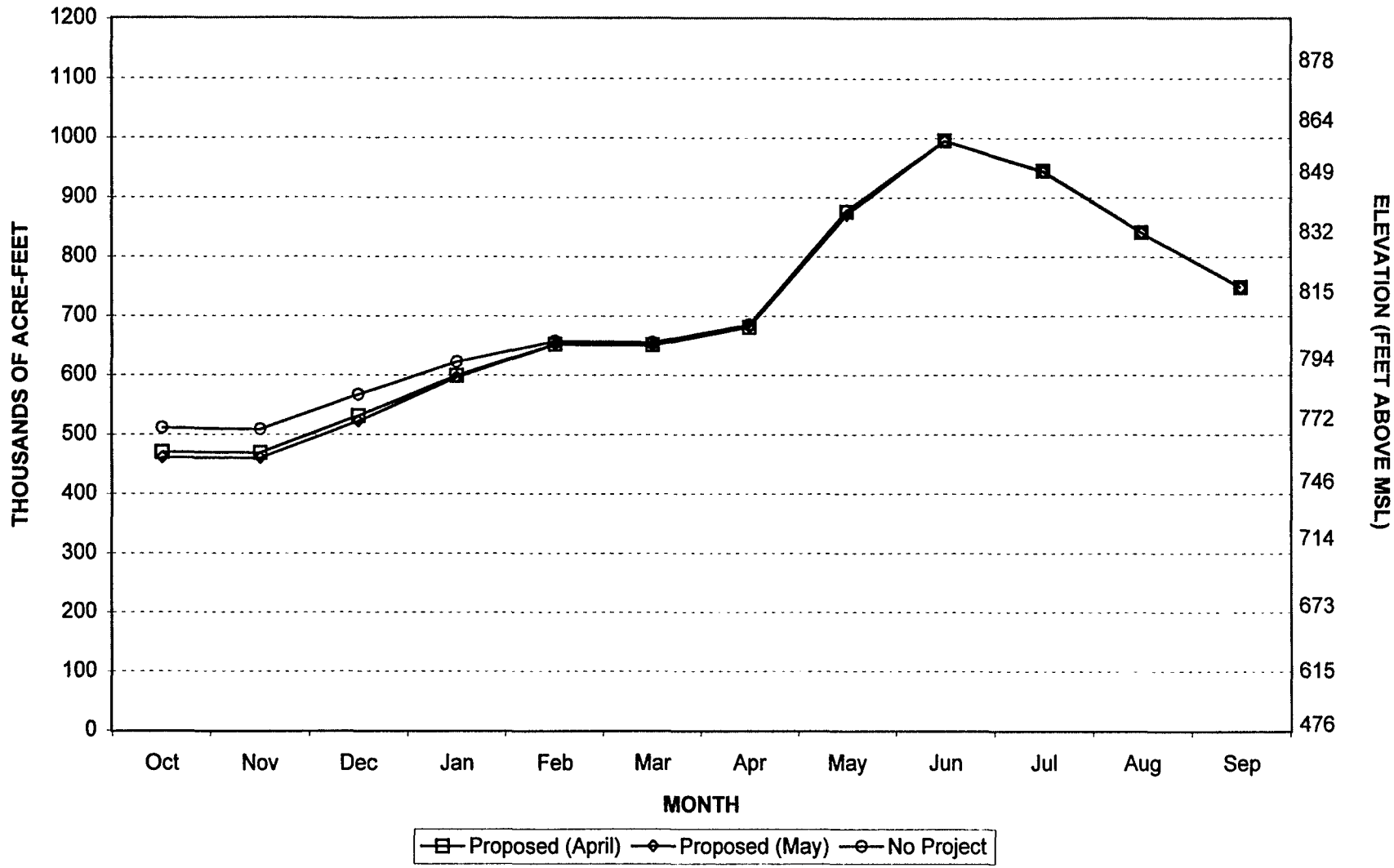

Figure 4.5-1. Average monthly Lake McClure storage levels for the "April" and "May" Proposed Actions compared to the No Project Alternative under a wet water year type regime. Water surface elevations, in feet above msl, associated with storage levels, in acre-feet, are shown on the scale to the right and are non-linear, but are provided for reference.

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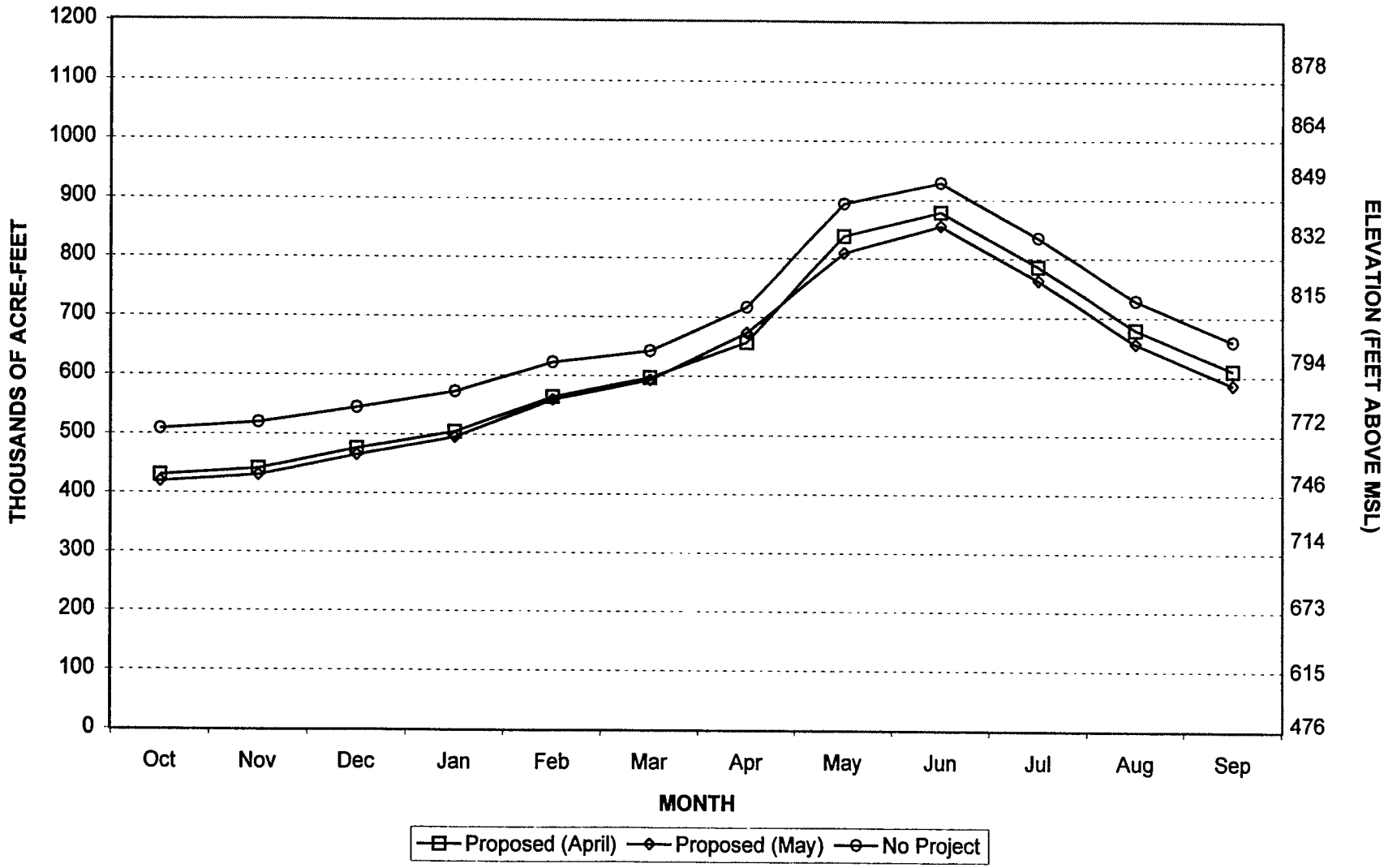

Figure 4.5-2. Average monthly Lake McClure storage levels for the "April" and "May" Proposed Actions compared to the No Project Alternative under an above average water year type regime. Water surface elevations, in feet above msl, associated with storage levels, in acre-feet, are shown on the scale to the right and are non-linear, but are provided for reference.

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Mer_taf.xls/fig 4.5-2

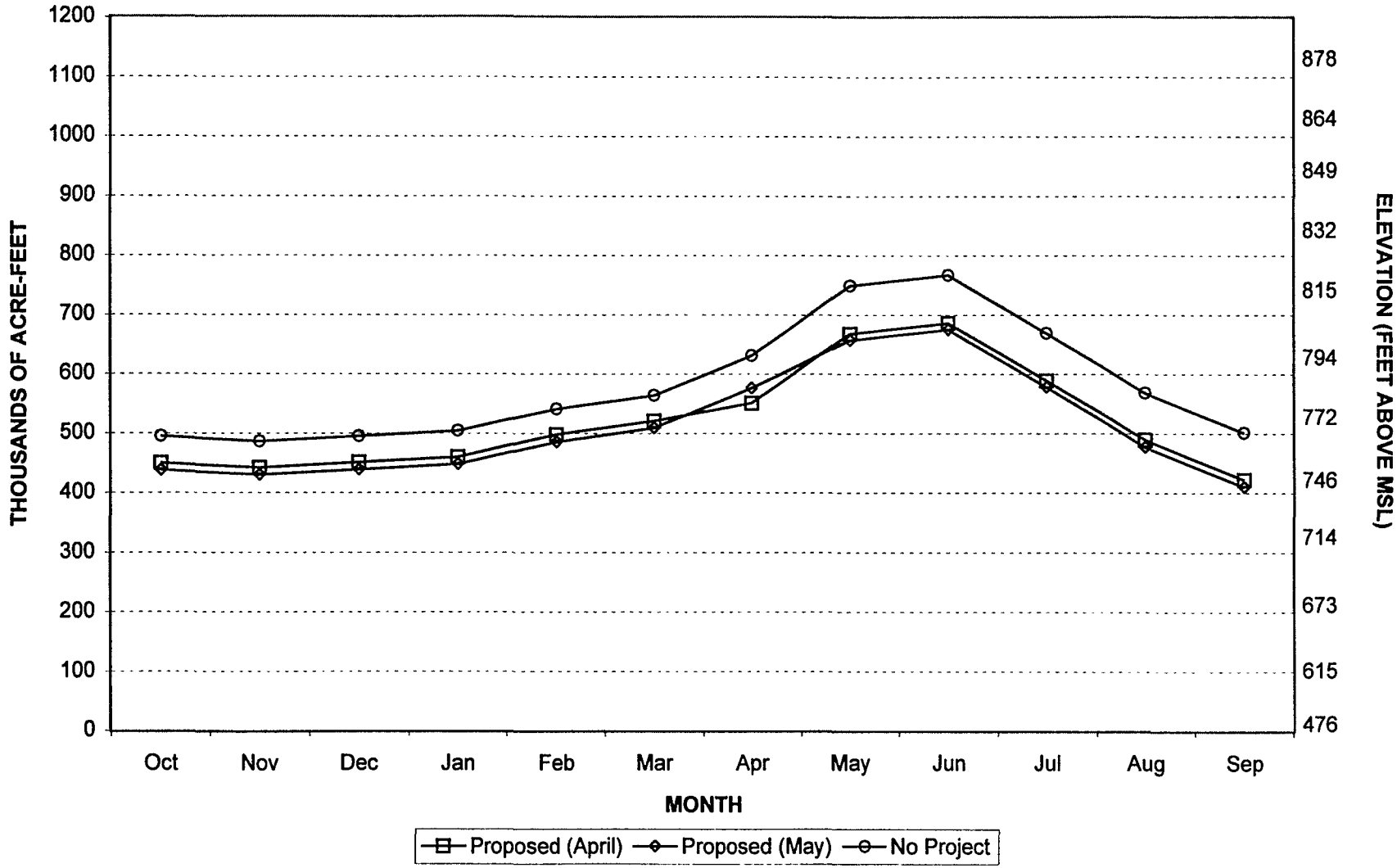

Figure 4.5-3. Average monthly Lake McClure storage levels for the "April" and "May" Proposed Actions compared to the No Project Alternative under a below average water year type regime. Water surface elevations, in feet above msl, associated with storage levels, in acre-feet, are shown on the scale to the right and are non-linear, but are provided for reference.

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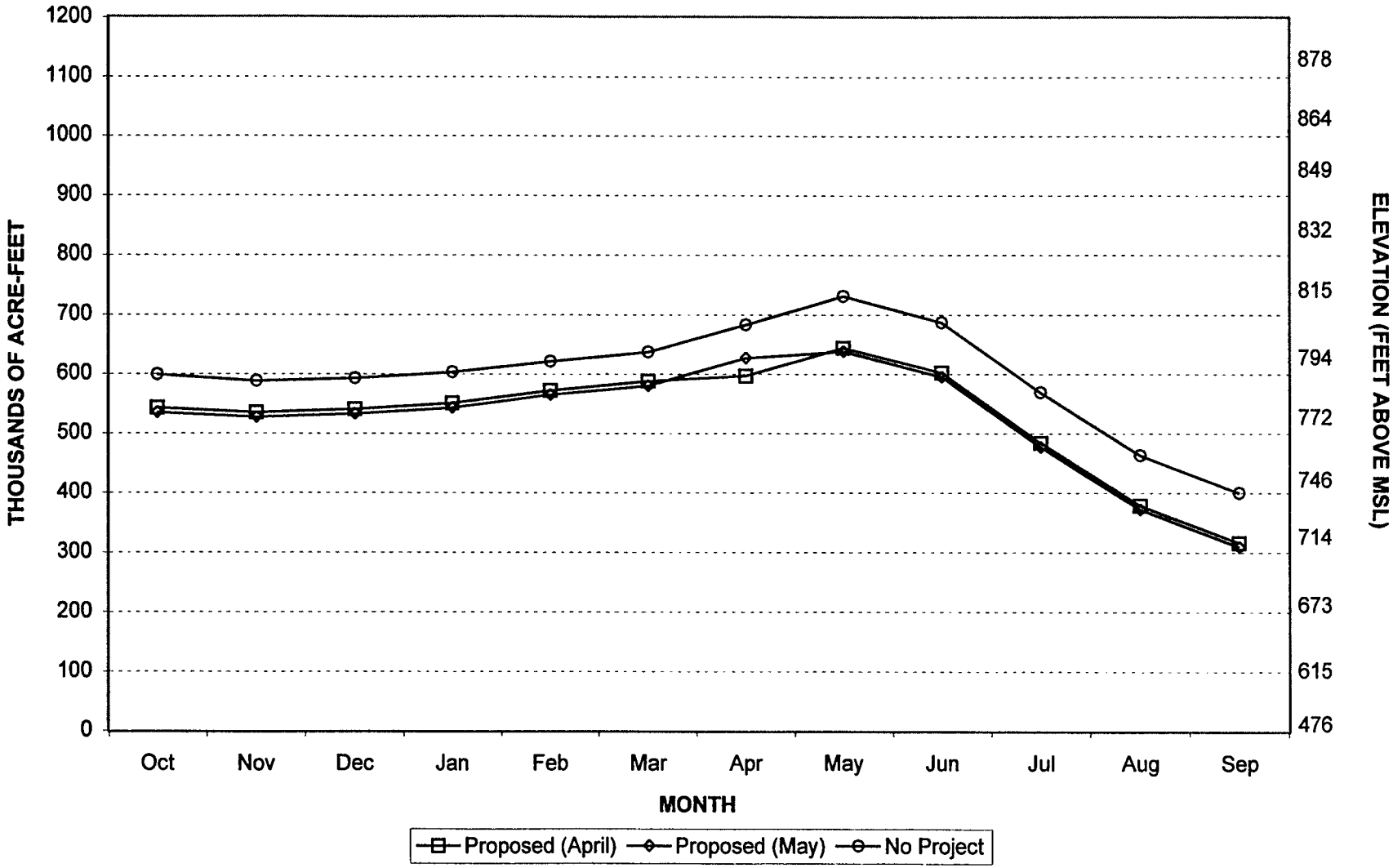

Figure 4.5-4. Average monthly Lake McClure storage levels for the "April" and "May" Proposed Actions compared to the No Project Alternative under a dry water year type regime. Water surface elevations, in feet above msl, associated with storage levels, in acre-feet, are shown on the scale to the right and are non-linear, but are provided for reference.

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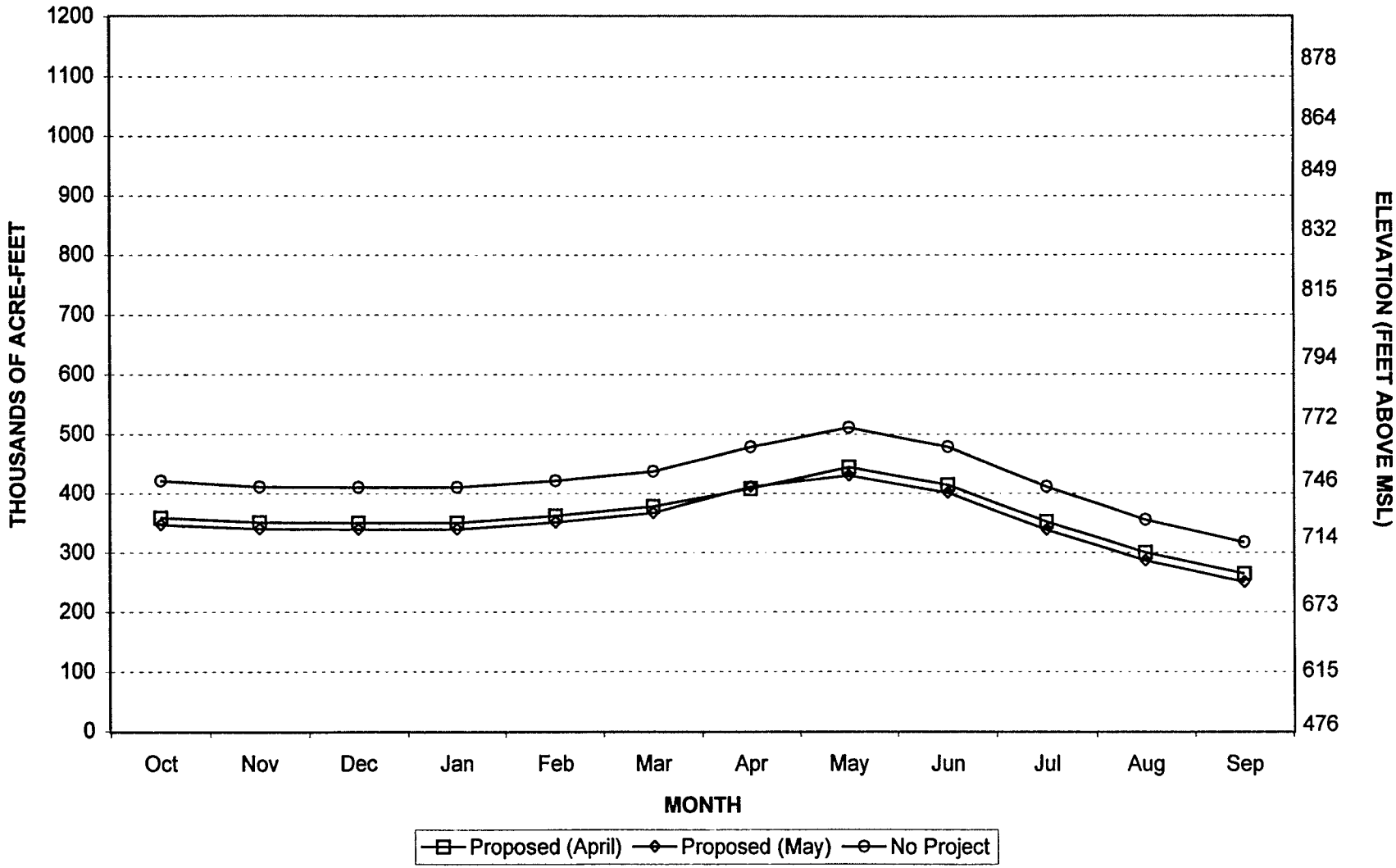

Figure 4.5-5. Average monthly Lake McClure storage levels for the "April" and "May" Proposed Actions compared to the No Project Alternative under a critical water year type regime. Water surface elevations, in feet above msl, associated with storage levels, in acre-feet, are shown on the scale to the right and are non-linear, but are provided for reference.

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Table 4.5-3: AVERAGE PERCENT CHANGE IN FLOW FOR SWRCB ALTERNATIVE 3 AS COMPARED WITH ALTERNATIVE 2 FOR MAJOR TRIBUTARIES OF THE SAN JOAQUIN RIVER OVER A 73-YEAR PERIOD AND A CRITICAL PERIOD (MAY 1928 TO OCTOBER 1934)

	October	November	December	January	February	March	April	May	June	July	August	September
Stanislaus Flow, 73 Year	14.1	3.5	7.5	15.6	28.5	11.3	-14.3	-22.0	-1.5	-9.8	0.6	0.7
Stanislaus Flow, Critical	25.9	0.0	4.4	3.6	5.0	0.0	-18.7	-27.5	23.0	50.5	50.0	7.2
Tuolumne Flow, 73 Year	0.2	0.0	-1.8	-10.7	-8.0	-3.8	-0.3	4.5	35.5	3.3	0.0	0.0
Tuolumne Flow, Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	243.6	0.0	0.0	0.0
Merced Flow, 73 Year	-5.8	-11.5	-11.4	-8.4	-14.9	-8.3	88.9	48.1	21.3	64.3	43.6	-4.6
Merced Flow, Critical	-22.3	0.0	-1.2	-17.8	-57.5	0.0	275.7	404.3	139.6	200.0	130.1	0.0

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it is not possible to determine whether mitigation would be required. The Merced flow reductions could adversely affect salmon fry at an early stage in their development when large reductions in flow would have the highest potential for stranding young fish. Possible mitigation could include adopting a BMP for ramping flow changes.

Large percentage increases in flow, that would provide potentially significant beneficial impacts occasionally occur in all rivers, mainly in the June through August period. However, no life stages of fall-run chinook salmon are known to be present in the Merced River during those months. The Merced River shows potentially beneficial increases in flow during April and May.

Steelhead Trout

Steelhead use the Stanislaus River in much the same way as fall-run chinook salmon, most of the impacts and model results discussed in the preceding section would apply to steelhead as well. The main differences between steelhead and fall-run chinook are: 1) adult steelhead begin their spawning migration slightly later than chinook and, therefore, stages of development for the eggs and juveniles will be approximately one month later than chinook; 2) adult steelhead will not necessarily die after spawning, resulting in some adults remaining in the rivers through June; and 3) young steelhead would likely remain in the rivers throughout their first summer.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases for the Stanislaus River in accordance with the New Melones Interim Plan of Operation.

Proposed Action. The proposed action would result in aquatic resources impacts similar to those previously discussed for the fall-run chinook salmon in the Stanislaus River. No significant adverse changes would result in stream flow in the Stanislaus River as a result of implementing the proposed action. Beneficial impacts to steelhead would occur in the Stanislaus as a result of flow increases in October and April/May (Table 4.5-1A). These flow increases would provide attraction flows for immigrating adults in the fall, and pulse flows to stimulate emigration of smolts in the spring.

The same potentially significant impacts resulting from rapid changes in flow that may dewater or scour redds and strand juveniles would exist for steelhead. Mitigation would be the same as that described earlier for adopting Best Management Practices for ramping guidelines for pulse flows and including those in the annual operation plan.

Because yearling steelhead may reside in the Stanislaus during summer months, the Reclamation model for stream temperatures in the Stanislaus was used to identify any potential impacts that may occur during June through September as a result of implementing the proposed action. Output from the model showing the number of years water temperatures exceeding 68° F are predicted at the mouth of the river over a 70-year period (1922-1991) indicated that the maximum percent exceedence for the months of June through September, over all water year types, was reduced with

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the proposed action (April or May) by 1.4 percent. These findings are consistent with the changes in percent flow shown in Table 4.5-1A. The impact of temperature change is less than significant.

Alternative Action. For the alternative action, impacts to steelhead would be similar to those discussed for fall-run chinook salmon with no significant, or less-than-significant impacts in the Stanislaus River during most months. Potentially significant changes in flow would occur on the Stanislaus River in May (Table 4.5-3). Based on available information, it is not possible to determine whether mitigation would be required for the Stanislaus River.

Large percentage increases in flow, showing potentially beneficial impacts, occasionally occur in the Stanislaus mainly during the summer months of June through August, during the SWRCB defined critical period.

Striped Bass

Striped bass are an introduced, anadromous species that primarily occur and spawn within the Delta and the Sacramento River Basin. Striped bass may enter the San Joaquin River Basin as adults to spawn in spring months. They typically spawn in the freshwater habitats available in the northern Delta lower reaches of the Sacramento River and the San Joaquin River below Vernalis. Striped bass eggs are buoyant and carried by the current towards the Delta. The eggs hatch within 1-2 days, and the young fry continue to be carried by currents towards the Delta.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin with no specific management of flows to benefit striped bass.

Proposed Action. The proposed action would result in increased stream flows during the spawning period in April or May that could attract spawning adults into the San Joaquin River. Beneficial impacts are expected in dry and critical water years. The potential reduction of available spawning habitat in the Merced River in above normal and wet water years would be a less than significant impact with little or no cumulative effect, due to the very low frequency of spawning in this area.

Alternative Action. The alternative action would result in increased stream flows during the spawning period only in the Merced River. In the Stanislaus and Tuolumne rivers, spawning period flow changes are mainly reductions in flow that would be less than significant, based on average percent changes of less than -25 percent and the very low frequency of spawning in these rivers.

Potentially beneficial impacts from increased flows in the summer months may occur in offsite locations (within the Delta) for maturing striped bass fry.

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Splittail

Splittail enter the San Joaquin River Basin to spawn during the winter and spring months. They require shallow, near shore areas or inundated floodplains for spawning and juvenile rearing. The young then continue to rear in these areas for a period of a few weeks up to one year (Sommer et al. 1997). They are a native species found in the lower reaches of the San Joaquin River and its major tributaries and also occur in the Delta and the Sacramento River Basin.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin with no specific management of flows to benefit splittail.

Proposed Action. The proposed action would result in beneficial impacts to splittail as a result of increased stream flows during a portion of the spawning period in April or May. Beneficial impacts are expected in dry and critical water years. The impacts of potential reduction of available spawning habitat in the Merced River in above normal and wet water years would be less than significant with little or no cumulative effect, due to the low frequency of occurrence for these events.

Alternative Action. The alternative action would result in increased stream flows during the spawning period only in the Merced River. In the Stanislaus and Tuolumne rivers, spawning period flow changes would be less-than-significant. Potentially beneficial impacts from increased flows in the summer months would occur in all rivers during the SWRCB critically dry period, benefitting maturing splittail fry.

Reservoir Species

The reservoir species selected as an indicator species for aquatic resources is the largemouth bass. Bass fishing is a very popular and economically important component of recreational use of reservoirs within the project area and throughout the state. Trophy sized largemouth bass are considered a prized gamefish. Largemouth bass spawn in April through June and eggs hatch in 5-10 days. The spawning period coincides with the period when reservoirs would be providing additional stream flows under the project. There is a possibility that reservoir levels would drop just after bass spawning and potentially impact the survival of the eggs. If reservoir levels increased after bass spawning, it would provide additional rearing habitat for the fry.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Fluctuation of reservoir levels occur to the extent required to meet these flow releases.

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Proposed Action. The proposed project would coordinate releases from reservoirs on the three major tributaries of the San Joaquin River (New Melones, New Don Pedro, and Lake McClure). The relatively small amount of water required for spring pulse flows would not cause excessive drawdown of any of the reservoirs under any water year types. Based on modeled reservoir storage, converted to water surface elevation, for the April through July period, averaged by water year type (Table 4.5-2), Lake McClure, which would likely have the most impact, would have average water surface elevation changes of three feet or less. Based on criteria established in Section 4.5.1, no significant impacts would result from the implementation of the project.

Alternative Action. The alternative action is assessed based on an analysis using SWRCB (1998) Alternative 3, the State Water Right Priority System, compared with SWRCB Alternative 2 as the base case. The assessment utilizes the SWRCB (1998) criterion of relative percentage change in Average Reservoir Habitat Index for an alternative when compared to base conditions. This criterion states that an alternative is considered significant only if the index is more than 10 percent different than the index for the base case. The three reservoirs assessed are New Melones, New Don Pedro, and Lake McClure. Results are presented below in Table 4.5-4.

Table 4.5-4: PERCENT CHANGE IN RESERVOIR HABITAT INDEX FOR SWRCB ALTERNATIVE 3 COMPARED WITH SWRCB ALTERNATIVE 2

Reservoir	Alternative 2 Index (Base Case)	Alternative 3 Index (SWRP)	Percent Change (+/-)
New Melones	253	285	+12.6
New Don Pedro	358	339	-5.3
Lake McClure	387	366	-5.4

New Don Pedro and Lake McClure show changes that are not significant (less than 10 percent). New Melones shows significant beneficial impacts (greater than 10 percent) for the State Water Right Priority System alternative action (Alternative 3).

Delta smelt and longfin smelt

These species occur exclusively in the Delta, downstream of Vernalis. As stated in the 1995 Biological Opinion for the protection of delta smelt (USFWS 1995):

> Proposed operations of the CVP and SWP provide adequate flows to transport delta smelt away from the influence of the pumps and provide productive, low-salinity rearing habitat in Suisun Bay. Flows for these purposes are needed from February to the end of June during most years. Because delta smelt are weak swimmers as larvae, they are passively transported with flows. Therefore, during the larval phases, flows of sufficient magnitude and duration are needed to transport and disperse delta

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smelt from the Delta to Suisun Bay. Bruce Herbold (EPA, pers. comm., 1994) has found a positive correlation between Delta outflow and delta smelt abundance as measured by the fall midwater trawl index when X2 is between Middle Ground Shoals and Roe Island.

The operation of the Old River Barrier is based on VAMP sampling objectives. The Service issued a Formal Endangered Species Consultation and Conference on the Proposed South Delta Temporary Barrier Project for 1996 through 2000 (USFWS 1996b). They concluded that "the proposed continuation of the Temporary Barriers Project will likely adversely affect delta smelt and Sacramento splittail, and adversely modify or destroy delta smelt critical habitat, both directly and indirectly." However, the Service also concluded that the temporary installation of the rock barriers are not likely to jeopardize the continued existence of the delta smelt and the proposed Sacramento splittail, or result in the destruction or adverse modification of critical habitat for delta smelt because the impacts are temporary in nature, there are several protective measures in place to reduce the effects of the project, and there will be overall integration of this project with CVP/SWP operations and the Operations Group (USFWS 1996b). The operational status of this fish control structure may be influenced by take limits of delta smelt at the export facilities.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Operations in the Delta would continue in accordance with the Delta Smelt Biological Opinion.

Proposed Action. The proposed action results in increased flow from the San Joaquin River into the Delta. The ratio of the total flows entering the Delta to the amount of flow exported, along with the operational status of the fish control structure at the head of Old River, determines the impacts to delta and longfin smelt. Since the operation of these facilities with project flows would be done in accordance with the 1995 Delta Smelt Biological Opinion and the 1996 temporary barriers consultation, less-than-significant impacts to delta smelt would result by implementing the proposed flow action.

Alternative Action. The alternative action results in increased flow from the San Joaquin River into the Delta, with no operational barrier at the head of Old River. The ratio of the total flows entering the Delta to the amount of flow exported determines the impacts to delta and longfin smelt. Since the operation of the export facilities would be done in accordance with the 1995 Delta Smelt Biological Opinion and the 1996 temporary barriers consultation, less-than-significant impacts to delta smelt would result by implementing the alternative action.

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4.5.3 Impact Summary and Mitigation of Impacts

4.5.3.1 Habitats and Ecological Zones

Proposed Action

- No criteria exists for assessing impacts to Ecological Zones, no determination of significance can be made. No mitigation proposed.

Alternative Action

- Not possible to evaluate impacts at the Ecological Zone level of biological organization. No mitigation proposed.

4.5.3.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

Proposed Action

- The only factor directly impacted by the project is water quality. Implementation of the proposed action positively benefits water quality and would, therefore, not adversely affect aquatic resources. No mitigation is required.

Alternative Action

- The only factor directly impacted by the project is water quality. Implementation of the alternative action positively benefits water quality and would, therefore, not adversely affect aquatic resources. No mitigation is required.

4.5.3.3 Indicator Species

Chinook Salmon

Proposed Action

- In general, the proposed action results in flow changes for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that are considered to be not measurable, or measurable with less-than-significant impacts to fall-run chinook salmon. No mitigation is required.

- During the spring (April/May) and fall (October), the proposed action results in increased flows for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that would result in beneficial impacts to emigrating salmon smolts and immigrating adults. No mitigation is required.

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- The increased flows in spring and fall may also produce potentially significant impacts to juvenile salmon and salmon redds, depending on the implementation of the flows. Sudden decreases may strand juveniles, and large magnitude changes may result in dewatering or scouring of redds. Mitigation would be to implement ramping of flows to ensure that adverse impacts are avoided, and water for ramping is included in the SJRA. With mitigation, the impact is less than significant.
- Impacts to female fecundity based on high November water temperatures following October pulse flows are likely to be less than significant based on the low frequency of occurrence of the event and modeled flow predictions that show no significant changes in flow. No mitigation is required.

- Minimal effects from reduced water levels in Lake McClure and water releases into the Merced River on the temperature in the river may be expected, except in dry and critically dry water years when total storage may be limited. The degree of cooling provided by decreasing seasonal air temperature dominates release temperature, so the project impact is less than significant.

Alternative Action

- In general, the alternative action results in changes in flow for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that result in less-than-significant impacts to salmon. No mitigation is required.

- The alternative action results in flow reductions on the Merced River in February and the Stanislaus River in May during the SWRCB defined critically dry period that result in potentially significant impacts to juvenile salmon. Mitigation could include increased smolt production from the Merced River Fish Facility.

Steelhead

Proposed Action

- Steelhead are found only in the Stanislaus River and impacts are limited to the Stanislaus River. Beneficial impacts to steelhead would occur as a result of flow increases during most months, in all water year types. No mitigation is required.

Alternative Action

- The alternative action would result in less-than-significant impacts to steelhead in the Stanislaus River during most months. No mitigation is required.

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- Flow reductions in the Stanislaus River shown to occur in May during the SWRCB defined critically dry period could result in potentially significant impacts to juvenile steelhead. Mitigation could include smolt production from the Merced River Fish Facility.

- Large percentage increases in flow occur occasionally during summer months in the Stanislaus River, primarily during the SWRCB defined critically dry period, and would be beneficial to over-summering juveniles. No mitigation is required.

Striped Bass

Proposed Action

- The proposed action would result in increased flows during the spawning period for striped bass and provide beneficial impacts, especially during dry and critical water year types. No mitigation is required.

- The potential reduction of available spawning in the Merced River during above normal and wet water year types as a result of reduced flows is a less-than-significant impact. No mitigation is required.

Alternative Action

- The alternative action would provide increased stream flows during the spawning period only in the Merced River, a beneficial impact. Flow reductions in the Stanislaus and Tuolumne rivers during the spawning period result in less-than-significant impacts to striped bass. No mitigation is required.

- Potentially beneficial impacts from increased flows in the summer months may occur in offsite locations (within the Delta) for maturing striped bass fry.

Splittail

Proposed Action

- The proposed action would result in increased flows during the spawning period for splittail and provide beneficial impacts, especially during dry and critical water year types. No mitigation is required.

- The potential reduction of available spawning in the Merced River during above normal and wet water year types as a result of reduced flows is a less-than-significant impact. No mitigation is required.

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Alternative Action

- The alternative action would provide increased stream flows during the spawning period only in the Merced River, a beneficial impact. Flow reductions in the Stanislaus and Tuolumne rivers during the spawning period result in less-than-significant impacts to splittail. No mitigation is required.

- Potentially beneficial impacts to young splittail result from increased flows that occur in the summer months in all rivers during the SWRCB defined critically dry period. No mitigation is required.

Reservoir Species

Proposed Action

- No significant impacts to largemouth bass would result from the implementation of the proposed action. No mitigation is required.

Alternative Action

- Less-than-significant impacts to reservoir habitat for New Don Pedro and Lake McClure occur as a result of the alternative action. No mitigation is required.

- Beneficial impacts to reservoir habitat for New Melones occurs as a result of the alternative action. No mitigation is required.

Delta smelt and longfin smelt

Proposed Action

- No significant impact to delta and longfin smelt would occur during the increased spring and fall pulse flows provided by the proposed action along with compliance of the 1995 Biological Opinion for the operation of the CVP and SWP.

Alternative Action

- No significant impact to delta smelt would occur during the increased flows provided by the alternative action along with compliance of the 1995 Biological Opinion for the operation of the CVP and SWP.

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4.6 LAND USE

This section evaluates the impact of the proposed action and alternative on land uses and the economy in the project area and vicinity. As described in Section 3.6, agricultural land uses and the agricultural sector of the economy are important resources in the project area and vicinity.

4.6.1 Key Impact Issues and Evaluation Criteria

With respect to land use, the primary issue is the extent to which the water from the San Joaquin River Group Authority's willing sellers (up to 137,500 acre-feet as shown in table 4.1-1) would affect agricultural land uses and, therefore, the agricultural economy in counties in the project area and vicinity. During public scoping, both San Joaquin and Stanislaus counties expressed concern over potential impacts to agricultural land uses. A related issue is whether the use of agricultural water supplies for instream flow enhancements for fish would be in conflict with public policies such as zoning and the Williamson Act which seeks to preserve agricultural lands for agricultural use. This issue of conflicts with local land use policies is addressed in Section 6.3 on local compliance requirements, while impacts to agricultural lands are evaluated here.

Evaluation criteria for determining impact thresholds of significance include the following:

- Reductions in municipal water supplies that could affect local populations;
- Permanent or long-term reduction in jobs in the agricultural sector of the economy; and/or
- Permanent or long-term reduction in agricultural acreage within the San Joaquin River area.

4.6.2 Environmental Consequences

This analysis relies on information provided by the willing sellers regarding water uses potentially affected by the proposed action. Similar information is not available for the Water Right Priority System alternative, so the analysis of this alternative is qualitative. The analysis also relies on economic information provided in Reclamation's Draft PEIS on the CVPIA and its Technical Appendix, Volume 5 (USBR 1997d, 1997i), the CALFED Draft PEIS/EIR (1998), and the SWRCB's Draft EIR on the 1995 Water Quality Control Plan (1998) in addition to information presented in Section 3.6.

4.6.2.1 Socioeconomic Impacts

Population

The concern is to what extent the resident population would experience any water shortages as a result of implementation of the project alternatives. Water shortages could constrain planned growth in the affected areas.

No Action. Under the No Action alternative, both CVP (New Melones Reservoir) and non-CVP (New Don Pedro Reservoir and Lake McClure) facilities would operate consistent with 1997 conditions. Over time, the expansion of urban development to accommodate population growth and the conversion of agricultural lands to residential and other uses would occur to the extent permitted by local zoning and county/city general plans.

Proposed Action. The proposed project does not rely on water supplies used to meet the needs of municipal customers of the willing sellers (shown previously, Table 4.1-1). Most of the available water for the proposed action (126,500 acre-feet out of the total of 137,500 acre-feet) comes from carryover storage in project area reservoirs and would not affect deliveries to irrigation customers. In future years, some of this "irrigation water" could be needed for municipal users; but the only district with municipal users at present is MID. MID's maximum contribution to the pulse flows is 11,000 acre-feet or only 3 percent of its surface water supplies. Consequently, there would be no direct or indirect adverse impact on local populations, nor would local population growth be affected.

Alternative Action. The Water Right Priority System alternative requires flows for fish to come from sources with junior appropriative rights before senior appropriative right holders are affected. The list of major San Joaquin Basin water rights is contained in the SWRCB's Draft EIR (1998, p. II-28). Water available for exports could be affected, since waters for export are junior to all in-basin water rights. However, the New Melones project is assumed to be an in-basin project. Also, San Joaquin water right holders with storage rights in New Don Pedro and Lake McClure do not have delivery reductions because, through reservoir operations, they have adequate storage to meet flow obligations plus full deliveries (SWRCB 1998, p. V-18). For those districts and water users who would be affected, the proportion who are municipal water users cannot be determined quantitatively from information presently available in the Draft EIR (SWRCB 1998). However, it is probable that there are users with junior rights who serve municipal users who would have to curtail deliveries 20 to 60 percent of the time in April-May (SWRCB 1998, Figure V-19, V-20). As a result, the impact is adverse and considered potentially significant. Increased groundwater pumping could offset reductions in surface water deliveries.

Population Density

The density of population (persons per square kilometer) would be affected if the alternatives constrained development of land for residential uses and spurred population growth as infill development on vacant parcels within the urbanized area/agency sphere of influence. Formal spheres of influence are established for cities and service districts by Local Agency Formation Commissions. These are used as urban limit lines in order to control annexations and promote the orderly expansion of urban services.

No Action. Under no action, current trends towards urbanization foster higher population density. However, the operation of existing water projects under the no action alternative assumptions does not encourage unplanned urban development.

Proposed Action. The proposed action does not affect municipal water users as explained above in Section 4.6.2.1. Consequently, there is no impact to population density.

Alternative Action. Based on Section 4.6.2.1 above, municipal users would likely be affected. If municipal supplies were constrained, population growth would be constrained in that new development would not be able to get water connections. However, the impact on population density would be insignificant, because densities under constrained growth would remain stable.

4.6.2.2 Regional Economy and Employment

The economic importance of agriculture to the communities of the Sacramento Valley, Delta and San Joaquin Valley is greater than just the gross value of farm products or the number of direct farm-related jobs. There are two ways in which the agricultural industry impacts local and regional economies.

- First, direct economic activity is what is required to produce and harvest a crop: several products, goods, and services. Prior to harvest this includes seed, fertilizer, water, equipment, fuel, and labor. Once the crop has been harvested, it needs to be transported, stored, processed, packaged, and marketed.

- The second way in which the agricultural industry affects the economy is through distribution of the income obtained through the initial direct economic activity. Farm and farm-related incomes may be spent on food, housing, and other consumer items. Therefore, every unit of direct economic activity results in a multiplier effect (secondary economic activity) which can range from 1.8 to 4, with a general average of 2.7.

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For example, a total farm income of $8,397,000,000 for the San Joaquin River Region in 1992 is worth about $22,671,900,000 in related economic activity assuming a multiplier of 2.7. (CALFED 1998)

Reductions in water deliveries to agriculture could lead to reduced farm production which generally results in the hiring of fewer workers. The following analysis evaluates the effect of reducing water deliveries to irrigation customers on the regional economy.

No Action. With no reductions in surface water deliveries, irrigated agriculture in the willing sellers' service areas would continue to rely primarily on surface water from carryover storage and from diversions. Changes in farm production and related economic activity would occur due to other economic factors such as the change in demand for agricultural products. The structure of the regional economy would be similar to existing conditions, 1992-1995, depending on the source of data.

Proposed Action. The proposed action relies on willing sellers; and OID, SSJID, and Merced ID together could provide up to 104,500 acre-feet of water that otherwise could be made available for irrigation uses. If deliveries are reduced, any subsequent impacts on total jobs from reduced farm production would be less than-significant, because (1) this full amount of water would be needed in only a few years (short term), and (2) the potential impact would be substantially avoided through the use of groundwater to substitute for reduced surface water supplies to irrigate agriculture.

Alternative Action. The SWRCB does not provide a detailed economic analysis of Flow Alternative 3 in the DEIR (SWRCB 1998). Potential output and income losses could be significant. However, with similar assumptions of no land fallowing and the use of groundwater to replace surface water supplies, the economic impacts would be similar to the proposed action, i.e., less than significant.

4.6.2.3 Agricultural Land Use

Agricultural land use can be described for this analysis as irrigated acreage, but it is also described by its cropping pattern (see Table 3.6-6).

No Action

For the Authority's six willing sellers, Table 4.6-1 shows total acres and the number of irrigated acres currently within each district. Under the No Action alternative, most of the irrigated acreage would continue in agricultural use. With the overall trend in the Valley towards development of agricultural land near urban centers for residential, commercial, and industrial uses, some of this acreage could be lost to agriculture over the 1999-2010 period. The No Action alternative assumes that prime farmland including land under Williamson Act contracts would not be urbanized.

Table 4.6-1: AGRICULTURAL LAND USE IN WILLING SELLER DISTRICTS

Willing Seller	Land Area (acres)	Irrigated Area (acres)	Percent Irrigated (acres)
Exchange Contractors	240,000	225,562	94.0
Oakdale ID	72,345	62,000	85.7
South San Joaquin ID	71,112	62,000	87.2
Modesto ID	108,000	64,000	59.2
Turlock ID	192,000	149,000	77.6
Merced ID	140,000	98,000	70.0
Total for All Districts	823,457	660,562	80.2

Proposed Action

The districts that would potentially reduce deliveries to irrigation customers are OID, SSJID, and Merced ID (Table 4.1-1). These districts together contain 222,000 irrigated acres, 34 percent of the total irrigated acres (660,562 acres) within the service areas of the Authority's willing sellers).

When irrigation water is reduced, farmers have several options: (1) obtain alternative sources of supply to supplement reduced surface water allocations; (2) increase water use efficiency including the reduction in deep percolation; and (3) match land use and cropping patterns to available water supplies through a combination of fallowing and shifts in crop type (SWRCB 1998). A cropping pattern is the share of acres within a region planted to individual crops or categories of crops, including fallowed land. Cropping patterns are important to agricultural and regional economics (see Table 3.6-8). If total irrigation water supplies are reduced and groundwater substitution does not occur, farmers can change their cropping patterns by fallowing a portion of their lands receiving irrigation water, by planting crops that require less irrigation water, or by adopting conservation measures that reduce irrigation losses. All of these measures affect farm profits (USBR 1997i).

- Option 1: The most probable option for the San Joaquin River Area is to replace surface water deliveries with groundwater. Farmers may pump groundwater directly or purchase groundwater from other suppliers. If the 104,500 acre-feet of potential reduced water deliveries to farmers in the San Joaquin River Area are offset by groundwater supplies, then there would be no significant impact to crops produced (either cropping pattern or productivity of the land) or to the amount of irrigated acreage. The weighted average cost of groundwater ranges from $30-$80 per acre-foot in the San Joaquin River Region, while surface water's weighted average price is $20-$85 per acre-foot (CALFED 1998). Use of

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groundwater or use of carryover storage would be the most likely outcomes for replacing the irrigation water diverted into the San Joaquin River system, and the overall adverse impact to agriculture would be less than significant.

- Option 2: The Authority's willing sellers are currently practicing water use efficiencies through the implementation of conservation measures that are responsible for providing some of the water proposed for diversion into the San Joaquin River system. Irrigation efficiencies by farmers are also being practiced. An additional measure that may be implemented over the long term is Merced ID's conjunctive use project to store surface water in underground aquifers.

- Option 3: Changes in cropping patterns, including land fallowing, are not expected as a direct or indirect result of the curtailed water deliveries in the San Joaquin River Area. Located in Merced County, Merced ID is the largest provider of surface water under the proposed action. All of its irrigated acreage would be affected by reduced deliveries in the short term if the full allotment of 67,500 acre-feet was required. Reduced deliveries could adversely affect almond production in the short term, depending on hydrologic conditions (Van Camp 1998, personal communication). Over the long term, Merced ID's conjunctive use project would replace the delivery shortage and mitigate a potentially significant impact to agricultural production in Merced County to a less-than-significant level.

Alternative Action. Agricultural land uses for the Water Right Priority System alternative are likely to be similar to the proposed action. The SWRCB's DEIR assumed that water right holders in the San Joaquin Basin would pump groundwater if their diversions were curtailed. The above described analysis of the proposed action is based on information from the willing sellers who indicate their irrigation customers are unlikely to withdraw land from production. Rather, farmers would use groundwater to maintain crop production and minimize production losses. Other water right holders for the alternative action would likely include some farmers who would reduce production. In the absence of more definitive data, the impact is assumed to be adverse and potentially significant.

4.6.3 Impact Summary and Mitigation of Impacts

4.6.3.1 Socioeconomic Impacts

Population and Population Density

Proposed Action

- There is no adverse impact on local populations, and local population growth would not be affected. No mitigation is necessary.

- There is no impact to municipal users, so there is no impact to population density. No mitigation is required.

Alternative Action

- Users with junior rights who serve municipal water users would have to curtail deliveries 20 to 60 percent of the time in April-May, a potentially significant impact. Mitigation measures such as conservation and greater efficiencies may be applied to partially reduce the impact, but not sufficiently to reduce the impact to less than significant.

- The effect on population density is less than significant, because densities under constrained growth would remain stable.

Regional Economy and Employment

Proposed Action

- Impacts on jobs from reduced farm production in some years would be substantially avoided through the use of groundwater to substitute for any surface water delivery reductions. The impacts are less than significant.

Alternative Action

- Job losses would be less than significant. Potential output and income losses could be significant but mitigated through measures to reduce surface water losses to irrigated agriculture, i.e., groundwater substitution, conjunctive use, conservation, and tailwater recovery.

Agricultural Land Use

Proposed Action

- The potential reduction of 104,500 acre-feet of the Authority's water to irrigation customers could adversely affect cropping patterns and productivity. However, most of this surface water would be replaced by groundwater, including conjunctive use water, or come from surface water supplies (carryover storage), and the adverse impact on agriculture would be less than significant.

- Reduced deliveries by Merced ID could adversely affect agricultural production in the short term, but this decline in productivity would be mitigated through a conjunctive use project and by groundwater pumping by individual farmers. After mitigation, the impact would be less than significant.

Alternative Action

- Some farmers may change their cropping patterns and reduce crop production, a potentially significant impact. Mitigation measures include alternative sources of water (including groundwater) to offset declines in surface water deliveries.

4.7 CULTURAL RESOURCES

The affected environment section for cultural resources was divided into the San Joaquin River Region and Sacramento-San Joaquin Delta in order to best describe the prehistoric and historic conditions of the project area and vicinity. This cultural resources impact section focuses specifically on the project reservoirs and rivers in order to determine whether or not there are any existing cultural resources that could potentially be impacted by the proposed and alternative actions. The reservoirs evaluated are New Melones, New Don Pedro, and Lake McClure. The rivers assessed are the San Joaquin, Stanislaus, Tuolumne, and Merced rivers.

4.7.1 Impact Issues and Evaluation Criteria

In this section cultural resource impact issues are assessed for both reservoirs and rivers that could be affected by the proposed project. The main effect relates to the protection or exposure of cultural resources due to altered reservoir levels or river flows. There are no construction or land altering activities associated with the proposed and alternative actions, which are typically the activities that could potentially impact cultural resources. No key issues regarding cultural resources were identified during the public scoping phase of this project.

4.7.1.1 Reservoirs

Cultural resources could potentially be affected only if the water level in the reservoirs due to the project fluctuates above or below the levels due to normal operations. This would happen under the proposed project. Changes in reservoir elevation can both protect and expose cultural resources. Depending on the type of resource and where it is located in the pool, a reservoir level which covers the resource may be considered beneficial. Alternately, a reservoir level which exposes a cultural resource may subject the resource to damage from erosion, wave action, wet/dry cycles, or destruction from vandalism.

Reservoir levels also affect recreation use, which can, in turn, affect cultural resources. Changes in the reservoir levels which increase recreation use may potentially impact cultural resources. Higher water levels tend to attract more visitors, and the potential for vandalism to cultural sites is increased. However, lower reservoir levels may not protect cultural resources because some recreationists, such as off-highway vehicle (OHV) users, may damage exposed resources.

Recreation opportunity thresholds are based on water depths (or water elevation levels) of the reservoirs. Critical depths occur when boat ramps are no longer operational, causing marinas to close, or when campgrounds or picnic areas are limited by the small surface area of the reservoir available for recreation. These critical levels were established for each reservoir in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of the reservoirs. Elevation

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levels (water depths) were calculated for this EIS/EIR from the area and capacity tables for each reservoir and the Reclamation model storage capacity output.

For cultural resources identified in the affected environment (see sections 3.7.1, 3.7.2, and 3.7.3), reservoir elevations calculated from reservoir storage levels in the Reclamation model have a level of uncertainty. Due to the nature of the hydrological input data and the use of average monthly operations, the model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered insignificant for the purposes of cultural resources impact evaluations.

4.7.1.2 Rivers

Cultural resources could potentially be affected by the flows in the rivers. Any cultural resources identified in the affected environment would occur at a known elevation. These elevations could be calculated from rating tables for each river based on the Reclamation model.

Streamflows also affect recreation use, which can, in turn, affect cultural resources. Changes in the streamflows which increase recreation use may potentially impact cultural resources by increasing vandalism to cultural sites. Streamflows determine the recreation opportunity thresholds in the rivers. Critical flows occur when either boating or swimming activities are either optimal or are not available (due to too little water or too rapidly flowing water). These critical flows were established for each river in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of recreational facilities along the rivers, rafting guides, and fishing guides. As with the reservoir analyses, the river flow analyses are based on the Reclamation model output.

For any cultural resources identified in the affected environment (see sections 3.7.1, 3.7.2, and 3.7.3), the river flows calculated from the Reclamation model have a level of uncertainty. Due to the nature of the hydrological input data and the use of average monthly operations, the model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered insignificant for purposes of cultural resources evaluation.

4.7.2 Environmental Consequences

4.7.2.1 Reservoirs

If a cultural resource is identified, elevations of the reservoir resulting from the proposed action can be calculated using the area and capacity tables for each reservoir. The proposed reservoir storage is based on the Reclamation model storage capacity output. Again, if a cultural resource is identified in the affected environment, the Water Right Priority System alternative also would be compared to the base case. The Water Right Priority System alternative is compared to the proposed project

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qualitatively for each reservoir because this alternative was not modeled using Reclamation's modeling system. Rather the basis for analyses of this other alternative is the SWRCB's hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions. Of concern to the cultural resources impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

New Melones Reservoir

No Action. The New Melones Reservoir area was an area used extensively by prehistoric people. The reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled (USBR 1997d). Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir.

Proposed Action. During the peak recreation season, the proposed project does not have any significant impacts on reservoir levels except during the critical water years at the lowest reservoir elevations. The proposed action benefits recreation by increasing the levels of the reservoir in the critical water years. Cultural resources potentially could be impacted with this increase in recreation use associated with the proposed action, but the effect is less-than-significant because it occurs only in critical water years with the lowest reservoir levels.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for New Melones Reservoir does decrease the frequency of occurrences with which the elevation exceeds critical thresholds, but the impact is not significant. In a critical period (represented in the modeling for the period 1928 through 1934), the Water Rights System Priority alternative is significantly different from Alternative 2 by decreasing the frequencies for the most extreme thresholds. This action could increase recreation use and thus increase the potential for impacts to cultural resources.

New Don Pedro Reservoir

No Action. The New Don Pedro Reservoir area was an area used extensively by prehistoric people. Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir. Construction of the New Don Pedro Dam was completed in 1971, and it is unlikely that there were any surveys for cultural resources performed prior to construction.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on reservoir levels. The proposed project would affect the

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reservoir levels, but these levels are not out of the range that could occur during normal operation of the reservoir. There is no impact to cultural resources (that could be present) from any change in recreation use.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for New Don Pedro Reservoir does not differ significantly from Alternative 2 during the entire period of record, but in the critical years, the alternative has a negative impact at both 720 ft. and 780 ft. MSL. The lower reservoir levels could increase recreation use by OHV users and possibly expose cultural resources (that could be present). The increase in potential for impacts to cultural resources, however, is considered less than significant because it only occurs in critical years.

Lake McClure

No Action. The Lake McClure area was an area used extensively by prehistoric people. Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir. Construction of the New Exchequer Dam was completed in 1967, and it is unlikely that there were any surveys for cultural resources performed prior to construction.

Proposed Action. During the peak recreation season, the proposed project does not have any significant impacts on reservoir levels during all water years. The proposed action would not impact cultural resources.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for Lake McClure does not differ significantly from Alternative 2 during the entire period of record and in the critical years. There would be no impact to cultural resources.

4.7.2.2 Rivers

Cultural resources could potentially be affected by the flows in the rivers. Any cultural resources identified in the affected environment would occur at a known elevation. These elevations could be calculated from rating tables for each river based on the Reclamation model. Again, if a cultural resource is identified in the affected environment, the Water Right Priority System alternative also would be compared to the base case.

Streamflows also affect recreation use, which can, in turn, affect cultural resources. Changes in the streamflows which increase recreation use may potentially impact cultural resources by increasing vandalism to cultural sites.

San Joaquin River

No Action. The San Joaquin River was an area used extensively by prehistoric people. The river crosses through Fresno, Madera, San Joaquin, and Stanislaus counties. These counties have over 5,000 recorded prehistoric sites, and the counties range from 2 to 5 percent surveyed for cultural resources. In addition, historic resources related to early agricultural activities may exist in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have an impact on cultural resources.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for the San Joaquin River has adverse impacts when compared to Alternative 2 for both the critical flows and for the optimal ranges. These impacts to recreation are insignificant for all except the 500 cfs critical flow when the frequency of occurrence of flows above the threshold is increased. It is unknown how recreation use would be affected above this infrequent flow; therefore, the impact of this short-term event on cultural resources is considered to be less-than-significant.

During critical periods, the Water Right Priority System alternative has a significant beneficial effect for recreation on the San Joaquin River by increasing the frequency of flows in the optimal boating range and decreasing the frequency of occurrences of flows below the critical threshold for swimming. In addition, the alternative action decreases the frequency of occurrences of flows in the optimal range for canoeing during critical periods, which is a significant adverse impact. Increasing or decreasing recreation opportunities has the potential to adversely impact cultural resources but only during infrequent critical periods. The impact is less-than-significant.

Stanislaus River

No Action. The Stanislaus River also was an area used by prehistoric people. The river crosses through Calaveras, Tuolumne, and Stanislaus counties. These counties have well over 1,200 recorded prehistoric sites, and the counties range from 3 to 15 percent surveyed for cultural resources. In addition, historical resources, such as mining-related structures, railroad grades, dams, and other structures, may exist in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have any significant impact on recreation use and, consequently, would not have any impacts on cultural resources.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Stanislaus River is no different than Alternative 2 for the critical flows. For the entire period the frequency of occurrences of flows in the optimal range for the upper reach would be significantly beneficial with the Water Right Priority System alternative and would be beneficial, but not significant, in the lower reach. During critical periods the frequency of occurrences of flows is increased significantly in the optimal range for the lower reach and is decreased, but not significantly, in the upper reach. Increasing recreation use in most years on the Stanislaus River has the potential to adversely impact cultural resources, a potentially significant impact.

Tuolumne River

No Action. The Tuolumne River also was an area used by prehistoric people. The river crosses through Tuolumne and Stanislaus counties. These counties have over 280 recorded prehistoric sites, and the counties range from 3 to 10 percent surveyed for cultural resources. In addition, there may be historical resources, such as mining-related structures, railroad grades, dams, and other structures, in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Tuolumne River is not significantly different than Alternative 2 for both the critical flows and for the optimal ranges. Thus, the alternative action would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

Merced River

No Action. The Merced River also was an area used by prehistoric people. The river crosses through Mariposa and Merced counties. These counties have well over 1,100 recorded prehistoric sites, and the counties range from 2 to 5 percent surveyed for cultural resources. In addition, historical resources, such as mining-related structures, railroad grades, dams, and other structures, may exist in the proximity of the river.

Proposed Action. During the peak recreation season, the proposed project does have significant impacts on streamflows in critical, dry, and below normal years. The proposed action beneficially impacts recreation by decreasing the frequency of critical low flows for boating. Cultural resources

potentially could be impacted indirectly with the increase in recreation use, but the effect of the project on cultural resources would be less-than-significant with higher flows offsetting impacts from increased use.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Merced River is not significantly different than Alternative 2 for both the critical flows and for the optimal range. Thus, the alternative action would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

4.7.3 Impact Summary and Mitigation of Impacts

4.7.3.1 Proposed Action

Reservoirs

- Recreation use at New Melones Reservoir may increase in critical water years at the lowest reservoir elevations as a result of the proposed action. This increase in recreational use could potentially impact cultural resources by increasing artifact collection or vandalism. This potential impact is considered less than significant, and no mitigation is necessary.

- At both New Don Pedro Reservoir and Lake McClure, reservoir levels do not change significantly; therefore, recreation use is not affected. There is no indirect impact on cultural resources. No mitigation is necessary.

Rivers

- There are no adverse impacts to cultural resources at the San Joaquin, Stanislaus, or Tuolumne rivers. No mitigation is necessary.

- As a result of the proposed action, the frequency of streamflows below the critical threshold are significantly decreased on the Merced River in critical, dry, and below normal years. This could potentially increase recreation use, which may potentially impact cultural resources: however, the potential impacts are considered to be less than significant. No mitigation is necessary.

4.7.3.2 Alternative Action

Reservoirs

- Recreation use at New Melones Reservoir may increase in critical water years at the lowest reservoir elevations. This action could potentially impact cultural resources by increasing artifact collection or vandalism. This potential impact is considered less than significant, and no mitigation is necessary.

- As a result of the alternative action, frequency of occurrences of lower reservoir levels at New Don Pedro Reservoir during critical water years at the lowest elevations is increased. More area of the reservoir pool would be exposed, which could potentially increase recreational use of these exposed areas and adversely impact cultural resources. The impact is less than significant because it would occur only in critical years.

Rivers

- As a result of the alternative action, the frequency of occurrence of flows for recreation on the San Joaquin River above the 500 cfs threshold is increased, which is an infrequent adverse impact. It is unknown how recreation use would be affected above this flow, a short term effect; therefore the impact on cultural resources is considered to be less than significant.

- During critical periods, the alternative action has a significant beneficial effect for recreation on the San Joaquin River by increasing the frequency of flows in the optimal boating range and decreasing the frequency of occurrences of flows below the critical threshold for swimming. In addition, the alternative action decreases the frequency of occurrences of flows in the optimal range for canoeing during critical periods, which is a significant adverse impact. Increasing or decreasing recreation opportunities has the potential to impact cultural resources. The impact is less than significant, since it could occur infrequently.

- As a result of the alternative action, flows for recreation during the entire period on the Stanislaus River are beneficially impacted in the optimum range in the upper reach. During critical water years, the flows for recreation in the optimum range of the lower reach are beneficially impacted. Increasing recreation opportunities in most years has the potential to impact cultural resources. The impact is potentially significant. Mitigation may include surveying for the location of sensitive resources and implementing controls on recreation use if this use threatens identified resources.

Mitigation measures will vary according to ownership of the reservoirs. CEQA provides the principal state policy for the protection of prehistoric and historic archeological resources. A public agency

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following the Federal clearance process under the NHPA or NEPA may use the documentation prepared under the federal guidelines in place of documentation necessary for CEQA. For the CVP reservoirs, any cultural resource research will need to meet federal standards, which will in turn satisfy the CEQA guidelines.

The federal agency responsible for operation of the reservoir should ensure that NRHP-eligible resources potentially affected by the proposed action will be treated. Preservation, rehabilitation, restoration, and stabilization are common treatments for architectural properties.

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4.8 RECREATION

In this section impacts to recreation are assessed for both reservoirs and rivers that could be affected by the proposed project. The proposed flow objectives are compared to the existing conditions as described in the affected environment. In addition, the Water Right Priority System alternative is compared to both the base case and the proposed project. The reservoirs evaluated are New Melones, New Don Pedro, and Lake McClure. The rivers assessed are the San Joaquin, Stanislaus, Tuolumne, and Merced rivers. There would be no impacts to recreation in the conveyance facilities, wildlife refuges, hunting clubs, or in the Sacramento-San Joaquin Delta as a result of the proposed project.

4.8.1 Impact Issues and Evaluation Criteria

No key issues regarding recreation were identified during the public scoping phase of this project. The main effect that the proposed project could potentially have on recreation relates to reservoir levels and flow of water in the rivers. Recreational use is affected by the amount and timing of water levels and releases.

4.8.1.1 Reservoirs

Recreation opportunity thresholds are based on water depths (or water elevation levels) of the reservoirs. Critical depths occur when boat ramps are no longer operational, causing marinas to close, or when campgrounds or picnic areas are limited by the small surface area of the reservoir available for recreation. These critical levels were established for each reservoir in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of the reservoirs. Elevation levels (water depths) were calculated for this EIS/EIR from the area and capacity tables for each reservoir and the Reclamation model storage capacity output.

Due to the nature of the hydrological input data and the use of average monthly operations, Reclamation's model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered to be insignificant.

4.8.1.2 Rivers

Streamflows determine the recreation opportunity thresholds in the rivers. Critical flows occur when either boating or swimming activities are either optimal or are not available (due to too little water or too rapidly flowing water). These critical flows were established for each river in the CVPIA

Draft PEIS (1997d) and were based on information provided by the operators of recreational facilities along the rivers, rafting guides, and fishing guides. As with the reservoir analyses, the river flow analyses are based on the Reclamation model output.

Due to the nature of the hydrological input data and the use of average monthly operations, Reclamation's model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered to be insignificant.

4.8.2 Environmental Consequences

The projected reservoir storage capacity and flow figures were obtained from the Reclamation model results. The Water Right Priority System alternative is compared to the proposed project qualitatively for each reservoir because this alternative was not modeled using Reclamation's modeling system. Rather the basis for analyses of this other alternative is the SWRCB's hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions. Of concern to the recreation impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997c) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

4.8.2.1 Reservoirs

The peak recreation seasons vary, but typically the majority of use occurs between Memorial Day and Labor Day. The recreation impact analysis, therefore, considers the water surface elevations of the reservoirs at the end of month for May and September. The frequency of occurrence when the reservoir falls below the critical elevations is summarized both in terms of numbers of months of occurrence, and in terms of percentages (Tables 4.8-1 through 4.8.-3). A frequency which is lower than the base case would indicate a beneficial effect of the proposed project. The entire 71-year period of record is examined as well as each of the water year types: critical, dry, below normal, above normal, and wet (Tables 4.8-1 through 4.8.-3).

New Melones Reservoir

The results for New Melones Reservoir from Reclamation's model are summarized in Table 4.8-1. Explanatory notes for the table appear on the page following the table.

Table 4.8-1: RECREATION IMPACT ASSESSMENT FOR NEW MELONES RESERVOIR

		Frequency that Reservoir is Below Critical Threshold Elevation							
		850 ft		860 ft		880 ft		900 ft	
Without Project - May	**Total Months**	Total	%	Total	%	Total	%	Total	%
All Years	71	1	1.4	2	2.8	2	2.8	4	5.6
Critical	15	1	6.7	2	13.3	2	13.3	4	26.7
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
With Project - May		Total	%	Total	%	Total	%	Total	%
All Years	71	1	1.4	1	1.4	2	2.8	2	2.8
Critical	15	1	6.7	1	6.7	2	13.3	2	13.3
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
Without Project-September		Total	%	Total	%	Total	%	Total	%
All Years	71	4	5.6	4	5.6	5	7.0	10	14.1
Critical	15	4	26.7	4	26.7	5	33.3	7	46.7
Dry	11	0	0.0	0	0.0	0	0.0	1	9.1
Below Normal	12	0	0.0	0	0.0	0	0.0	1	8.3
Above Normal	14	0	0.0	0	0.0	0	0.0	1	7.1
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
With Project - September		Total	%	Total	%	Total	%	Total	%
All Years	71	2	2.8	2	2.8	4	5.6	5	7.0
Critical	15	2	13.3	2	13.3	4	26.7	5	33.3
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0

Notes:

<850 ft. MSL - last boat ramps inoperable (old roads at Mark Twain, Parrot's Ferry, and Old Town recreation areas)
<860 ft. MSL - last official boat ramp inoperable (Glory Hole), limited lake surface area, decline in campground and picnicking use
<880 ft. MSL - marina closes
<900 ft. MSL - decline in beach use

No Action. At the beginning of the summer in May, the base case shows that beach use is impaired about 26.7 percent of the time during a critically dry year. During critical years, the marina would be closed 13.3 percent of the time, while limited lake surface area, boat ramps, and campground/picnicking use would be adversely affected as well. The last boat ramp would be inoperable 6.7 percent of the time. For all other year types, there are no adverse effect on recreation uses at New Melones Reservoir. By September, beach use declines in all year types with the most restricted activity occurring (46.7 percent) in a critical year. Only in critical years does the surface water elevation drop below 850 ft, and this occurs for 26.7 percent of the end of summer months.

Proposed Action. In May the proposed project does not differ at all from the base case for all of the water years considered. In September the proposed project benefits recreational use by decreasing the frequencies with which the water depth falls below critical thresholds. During critical water years, this project benefit is significant for the most extreme thresholds (850 ft. MSL and 860 ft. MSL).

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the comparison. During the peak recreation season, the Water Right Priority System alternative for New Melones Reservoir does decrease the frequency of occurrences with which the water depth falls below critical thresholds, but the impact is not significant. In a critical period (1928 through 1934), the Water Right Priority System alternative is significantly different from SWRCB's Alternative 2 by decreasing the frequencies for the most extreme thresholds (850 ft. MSL and 860 ft. MSL) from 32 percent to 0 and 34 percent to two percent, respectively. These impacts are beneficial.

New Don Pedro Reservoir

The results for New Don Pedro Reservoir from the Reclamation's model are summarized in Table 4.8-2.

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Table 4.8-2: RECREATION IMPACT ASSESSMENT FOR NEW DON PEDRO RESERVOIR

		Frequency that Reservoir is Below Critical Threshold Elevation							
		600 ft		630 ft		720 ft		780 ft	
Without Project - May	**Total Months**	Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	4	5.6	22	30.1
Critical	15	0	0.0	0	0.0	4	26.7	12	80.0
Dry	11	0	0.0	0	0.0	0	0.0	2	18.2
Below Normal	12	0	0.0	0	0.0	0	0.0	5	41.7
Above Normal	14	0	0.0	0	0.0	0	0.0	2	14.3
Wet	19	0	0.0	0	0.0	0	0.0	1	5.3
With Project - May		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	4	5.6	24	33.8
Critical	15	0	0.0	0	0.0	4	26.7	13	86.7
Dry	11	0	0.0	0	0.0	0	0.0	3	27.3
Below Normal	12	0	0.0	0	0.0	0	0.0	5	41.7
Above Normal	14	0	0.0	0	0.0	0	0.0	2	14.3
Wet	19	0	0.0	0	0.0	0	0.0	1	5.3
Without Project-September		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	12	16.9	42	59.2
Critical	15	0	0.0	0	0.0	9	60.0	15	100.0
Dry	11	0	0.0	0	0.0	1	9.1	11	100.0
Below Normal	12	0	0.0	0	0.0	2	16.7	10	83.3
Above Normal	14	0	0.0	0	0.0	0	0.0	6	42.9
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
With Project - September		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	12	16.9	43	60.6
Critical	15	0	0.0	0	0.0	9	60.0	15	100.0
Dry	11	0	0.0	0	0.0	1	9.1	11	100.0
Below Normal	12	0	0.0	0	0.0	2	16.7	10	83.3
Above Normal	14	0	0.0	0	0.0	0	0.0	7	50.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0

Notes:

<600 ft. MSL - last boat ramp inoperable (Fleming Meadow), marina closes (Fleming Meadows)
<630 ft. MSL - marina closes (Moccasin Point)
<720 ft. MSL - some boat ramps inoperable (Moccasin Point and Blue Oaks), limited lake surface area, and decline in campground and picnicking use
<780 ft. MSL - decline in beach use

No Action. At the beginning of the summer in May, the base case shows that beach use is impaired, ranging from 80.0 percent of the time (critically dry year) to 5.3 percent of the time (wet year). During critical years, the boat ramps at Moccasin Point and Blue Oaks would be inoperable 26.7 percent of the time. For all other year types, there are no adverse effects on boat ramp operation at New Don Pedro Reservoir. By September, beach use declines in all year types except wet with the most restricted activity occurring (100.0 percent) in both critically dry and dry years. During critical, dry, and below normal years, the boat ramps at Moccasin Point and Blue Oaks would be inoperable, ranging from 9.1 to 60.0 percent of the time.

Proposed Action. For both May and September months, the proposed project does not differ significantly from the base case for all the water years considered. The proposed project slightly increases the frequencies with which the reservoir falls below critical thresholds, but these increases are at the highest elevation (780 ft. MSL) and are not significant impacts.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for New Don Pedro Reservoir does not differ significantly from the SWRCB's Alternative 2 during the entire period of record; but in the critical years, the alternative has a negative impact at both 720 ft. and 780 ft. MSL. This impact is less than significant, because some boat ramps would still be operable.

Lake McClure

The results for Lake McClure from the Reclamation's model are summarized in Table 4.8-3.

Table 4.8-3: RECREATION IMPACT ASSESSMENT FOR LAKE MCCLURE

		Frequency that Reservoir is Below Critical Threshold Elevation							
		590 ft		600 ft		630 ft		650 ft	
Without Project - May	**Total Months**	Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	0	0.0	0	0.0
Critical	15	0	0.0	0	0.0	0	0.0	0	0.0
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
With Project - May		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	0	0.0	0	0.0
Critical	15	0	0.0	0	0.0	0	0.0	0	0.0
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
Without Project-September		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	0	0.0	1	1.4
Critical	15	0	0.0	0	0.0	0	0.0	1	6.7
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0
With Project - September		Total	%	Total	%	Total	%	Total	%
All Years	71	0	0.0	0	0.0	0	0.0	0	0.0
Critical	15	0	0.0	0	0.0	0	0.0	0	0.0
Dry	11	0	0.0	0	0.0	0	0.0	0	0.0
Below Normal	12	0	0.0	0	0.0	0	0.0	0	0.0
Above Normal	14	0	0.0	0	0.0	0	0.0	0	0.0
Wet	19	0	0.0	0	0.0	0	0.0	0	0.0

Notes:

<590 ft. MSL - last boat ramps inoperable (northern Barrett Cove and Piney Creek)
<600 ft. MSL - limited lake surface area and marina closes
<630 ft. MSL - boat ramp closes (southern Barrett Cove)
<650 ft. MSL - boat ramp closes (McClure Point)

No Action. At the beginning of the summer in May, the base case shows that for all water years all the boat ramps are operable. By September, in critical water years, only the boat ramp at McClure Point is inoperable 6.7 percent of the time.

Proposed Action. For both May and September, the proposed project does not differ significantly from the base case for all the water years considered. On average, reservoir levels are lower with the project (see Table 4.2-8 for end of the year storage), but the levels do not reach critical elevations during the recreation season. The proposed project slightly decreases the frequencies with which the reservoir water levels fall below critical thresholds in critical water years in September, but this decrease is at the highest elevation and is not a significant impact.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for Lake McClure does not differ at all from the SWRCB's Alternative 2 during the entire period of record and in the critical years. The alternative action would have no impact on the base case.

4.8.2.1 Rivers

The peak recreation seasons vary by river, but typically the majority of use occurs between Memorial Day and Labor Day. This recreation impact analysis, therefore, considers the river flows during the peak season from May through September. The frequency of occurrence when the river flows are between or below the critical flows is summarized both in terms of numbers and in terms of percentages (Tables 4.8-4 through 4.8-7).

When a critical flow threshold above or below which flow-related recreation activities are impaired, a frequency of occurrence higher than the base case indicates a negative impact, and a frequency lower than the base case indicates a beneficial impact. However, when the optimal flow is stated as a range, the reverse is true. A frequency of occurrence that is higher than the base case indicates a beneficial impact, while a frequency of occurrence lower than the base case indicates a negative impact. The entire 71-year period of record is examined as well as each of the water year types: critical, dry, below normal, above normal, and wet.

The projected river flow figures were obtained from the Reclamation model. The Water Right Priority System alternative is compared to No Action qualitatively for each river because the basis for the analyses is a different set of model results, i.e., output reported in the SWRCB's Draft EIR (SWRCB 1997, 1998). The Reclamation model includes the New Melones Interim Plan of Operation which has been in effect for over a year (USBR 1997c).

San Joaquin River

The results for the San Joaquin River from the Reclamation's model are summarized in Table 4.8-4.

Table 4.8-4: RECREATION IMPACT ASSESSMENT FOR THE SAN JOAQUIN RIVER

		Frequency that River is Between or Below Critical Flow Thresholds							
		> 500 cfs		300-500 cfs		200-300 cfs		<300 cfs	
Without Project - May through September	Total Months	Total	%	Total	%	Total	%	Total	%
All Years	355	301	84.8	52	14.6	2	0.6	2	0.6
Critical	75	29	38.7	44	58.7	2	2.7	2	2.7
Dry	55	52	94.5	3	5.5	0	0.0	0	0.0
Below Normal	60	58	96.7	2	3.3	0	0.0	0	0.0
Above Normal	70	67	95.7	3	4.3	0	0.0	0	0.0
Wet	95	95	100.0	0	0.0	0	0.0	0	0.0
With Project - May through September		Total	%	Total	%	Total	%	Total	%
All Years	355	305	85.9	47	13.2	2	0.6	2	0.6
Critical	75	33	44.0	40	53.3	2	2.7	2	2.7
Dry	55	53	96.4	2	3.6	0	0.0	0	0.0
Below Normal	60	58	96.7	2	3.3	0	0.0	0	0.0
Above Normal	70	67	95.7	3	4.3	0	0.0	0	0.0
Wet	95	95	100.0	0	0.0	0	0.0	0	0.0

Notes:

>500 cfs - unknown recreational opportunities
300-500 cfs - optimal flow range for all boating activities
200-300 cfs - optimal range of canoeing flows
<300 cfs - below optimal flows for swimming

No Action. Critical flows for the San Joaquin River occur above 500 cfs and below 300 cfs. During all water years the river has flows above 500 cfs, ranging from 38.7 percent of the time in critically dry years to 100.0 percent of the time in wet years. Flows are below 300 cfs only in critical years (2.7 percent of the time). The optimal range for all boating activities is between 300 and 500 cfs, and this range is achieved during all but wet years, ranging from 3.3 percent of the time (below normal years) to 58.7 percent of the time (critical years). Canoeing flows are optimized between 200 and 300 cfs, and this range is only achieved during critical years (2.7 percent of the time).

Proposed Action. With the project, the frequency of occurrence of flows above 500 cfs is slightly increased, but the impact is insignificant. Occurrence of flows below 300 cfs is exactly the same

with or without the project. The occurrence of optimal flow ranges for boating is decreased slightly with the project, but the impact is insignificant. There is no difference between the project and the base case for the flows between 200 and 300 cfs.

Alternative Action. During the peak recreation season for all water years, the Water Right Priority System alternative for the San Joaquin River increases the flows above 500 cfs more than 12 percent of the time when compared to Alternative 2. This change exceeds the evaluation criteria (10 percent), but since the recreation opportunities are unknown above this threshold, the impact would be considered potentially significant.

During the critically dry water years, the Water Right Priority System alternative would provide more flows in the optimal range for all boating and less flows in the optimal range for canoeing. In addition, flows below the critical threshold for swimming would decrease, thus providing a beneficial impact. The alternative action would provide both beneficial and adverse impacts; therefore, the overall impact to recreation would be considered less than significant during critically dry water years.

Stanislaus River

The Reclamation model's results for the Stanislaus River are summarized in Table 4.8-5.

Table 4.8-5: RECREATION IMPACT ASSESSMENT FOR THE STANISLAUS RIVER

		Frequency that River is Between or Below Critical Flow Thresholds							
		700-800 cfs		<300 cfs		700-2,000 cfs		<700 cfs	
Without Project - May through September	Total Months	Total	%	Total	%	Total	%	Total	%
All Years	355	25	7.0	127	35.8	123	34.6	231	65.1
Critical	75	2	2.7	46	61.3	10	13.3	65	86.7
Dry	55	1	1.8	22	40.0	25	45.5	30	54.5
Below Normal	60	10	16.7	16	26.7	21	35.0	39	65.0
Above Normal	70	6	8.6	25	35.7	25	35.7	45	64.3
Wet	95	6	6.3	18	18.9	42	44.2	52	54.7
With Project - May through September		Total	%	Total	%	Total	%	Total	%
All Years	355	31	8.7	122	34.4	140	39.4	214	60.3
Critical	75	2	2.7	44	58.7	13	17.3	62	82.7
Dry	55	3	5.5	22	40.0	29	52.7	26	47.3
Below Normal	60	11	18.3	16	26.7	25	41.7	35	58.3
Above Normal	70	8	11.4	23	32.9	29	41.4	41	58.6
Wet	95	7	7.4	17	17.9	44	46.3	50	52.6

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Notes:

700-800 cfs	- optimal flow range for all boating activities on the lower reach
<300 cfs	- below minimum flows for all boating activities on the lower reach
700-2,000 cfs	- optimal flow range for all boating activities on the upper reach
<700 cfs	- below minimum flows for all boating activities on the upper reach

No Action. Critical flows for the Stanislaus River occur below 300 cfs on the lower reach of the river and below 700 cfs on the upper reach. Flows are below 300 cfs in all water years, ranging from 18.9 percent of the time during wet years to 61.3 percent of the time in critical years. During all water years the river has flows below 700 cfs, ranging from 54.7 percent of the time in wet years to 86.7 percent of the time in critically dry years. The optimal range for boating activities on the lower reach is between 700 and 800 cfs, and this range is achieved during all years, ranging from 1.8 percent of the time (dry years) to 16.7 percent of the time (below normal years). Boating flows on the upper reach are optimized between 700 and 2,000 cfs, and this range is achieved during all years, ranging from 13.3 percent of the time in critical years to 45.5 percent of the time in dry years. Flows below Goodwin Dam would not exceed 1,500 cfs except for flood flows. The No Action alternative has flows above 1,500 cfs 14 months during the recreation season during above normal and wet years (8.5 percent of the time).

Proposed Action. Critical flows for the Stanislaus River occur below 300 cfs in the lower reach of the river and below 700 cfs in the upper reach. With the project the occurrences of flows below 300 cfs on the lower reach and 700 cfs on the upper reach are slightly decreased (beneficial impacts), but these impacts are not significant. Again, the flows below Goodwin Dam would not exceed 1,500 cfs except for flood flows. With the project there would be flows above 1,500 cfs 17 months during the recreation season during above normal and wet years (10.3 percent of the time). The occurrence of optimal flow ranges for boating is increased slightly in the both the lower and upper reaches, but again the impacts are insignificant.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Stanislaus River is no different than Alternative 2 for the critical flows (300 cfs in the lower reach and 700 cfs in the upper reach). For the entire period, flows in the optimal range for the upper reach (700 to 2,000 cfs) are significantly beneficial with the Water Right Priority System alternative, and are beneficial, but not significant, in the lower reach (700 to 800 cfs). During critical periods, flows are increased significantly in the optimal range for the lower reach and are decreased, but not significantly, in the upper reach.

Tuolumne River

The results from Reclamation's model for the Tuolumne River are summarized in Table 4.8-6.

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Table 4.8-6: RECREATION IMPACT ASSESSMENT FOR THE TUOLUMNE RIVER

		Frequency that River is Between or Below Critical Flow Thresholds							
		400-700 cfs		200-600 cfs		<500 cfs		<150 cfs	
Without Project - May through September	**Total Months**	Total	%	Total	%	Total	%	Total	%
All Years	355	20	5.6	115	32.4	267	75.2	152	42.8
Critical	75	9	12.0	13	17.3	73	97.3	60	80.0
Dry	55	4	7.3	0	0.0	44	80.0	44	80.0
Below Normal	60	0	0.0	0	0.0	48	80.0	48	80.0
Above Normal	70	0	0.0	56	80.0	56	80.0	0	0.0
Wet	95	7	7.4	46	48.4	46	48.4	0	0.0
With Project - May through September		Total	%	Total	%	Total	%	Total	%
All Years	355	17	4.8	112	31.5	264	74.4	152	42.8
Critical	75	9	12.0	10	13.3	70	93.3	60	80.0
Dry	55	0	0.0	0	0.0	44	80.0	44	80.0
Below Normal	60	0	0.0	0	0.0	48	80.0	48	80.0
Above Normal	70	0	0.0	56	80.0	56	80.0	0	0.0
Wet	95	8	8.4	46	48.4	46	48.4	0	0.0

Notes:

400-700 cfs - optimal flow range for all boating activities
200-600 cfs - optimal flow range for swimming
<500 cfs - below minimum flows for power boating
<150 cfs - below minimum flows for canoeing and kayaking

No Action. Critical flows for the Tuolumne River occur below 500 cfs for power boating and below 150 cfs for canoeing and kayaking. Flows are below 500 cfs for all water years, ranging from 48.4 percent of the time during wet years to 97.3 percent of the time in critical years. Flows are below 150 cfs in critical, dry, and below normal years, all 80 percent of the time. The optimal range for all boating activities is between 400 and 700 cfs, and this range is achieved in critical, dry, and wet years at 12.0, 7.3, and 7.4 percent of the time, respectively. Swimming flows are optimized between 200 and 600 cfs, and this range is achieved during critical, above normal, and wet years at 17.3, 80.0, and 48.4 percent of the time, respectively.

Proposed Action. There is no difference between the project and the base case for the flows below 500 cfs. Flows below 150 cfs are slightly improved during critical years, but this beneficial impact is not significant. The optimal flow ranges for boating for swimming are slightly decreased with the project, but the impact is not significant.

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Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Tuolumne River is not significantly different from Alternative 2 for both the critical flows (500 cfs and 150 cfs) and for the optimal ranges (400 to 700 cfs and 200 to 600 cfs).

Merced River

Reclamation model's results for the Merced River are summarized in Table 4.8-7.

Table 4.8-7: RECREATION IMPACT ASSESSMENT FOR THE MERCED RIVER

		Frequency that River is Between or Below Critical Flow Thresholds			
		< 500 cfs		50-200 cfs	
Without Project - May through September	**Total Months**	Total	%	Total	%
All Years	355	293	82.5	80	22.5
Critical	75	75	100.0	14	18.7
Dry	55	55	100.0	14	25.5
Below Normal	60	60	100.0	10	16.7
Above Normal	70	62	88.6	17	24.3
Wet	95	41	43.2	25	26.3
With Project - May through September		Total	%	Total	%
All Years	355	259	73.0	80	22.5
Critical	75	67	89.3	14	18.7
Dry	55	45	81.8	14	25.5
Below Normal	60	50	83.3	10	16.7
Above Normal	70	56	80.0	17	24.3
Wet	95	41	43.2	25	26.3

Notes:
<500 cfs - below minimum flows for all boating activities
50-200 cfs - optimal flow range for swimming

No Action. Critical flows for the Merced River occur below 500 cfs for all boating activities. Flows are below 500 cfs during all water years, ranging from 43.2 percent of the time (wet years) to 100.0 percent of the time (critical, dry, and below normal years) . The optimal range for swimming is between 50 and 200 cfs, and this range is achieved during all water years, ranging from 16.7 percent of the time in below normal years to 26.3 percent of the time during wet years.

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Proposed Action. With the project there is an decrease in frequency of flows below the threshold that is significant in critical, dry, and below normal years. Above normal and wet years are not significantly different with the project. The optimal flow range is between 50 and 200 cfs for swimming. With the project there is no change or no impact on recreation.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Merced River is not significantly different from Alternative 2 for both the critical flows (500 cfs) and for the optimal range (50 to 200 cfs). There is no impact on recreation.

4.8.3 Impact Summary and Mitigation of Impacts

4.8.3.1 Reservoirs

Proposed Action

- There are no adverse impacts to recreational use at any of the reservoirs. No mitigation is necessary.
- As a result of the proposed action, New Melones recreationists would benefit from increased reservoir levels during critical years in September. No mitigation is necessary.

Alternative Action

- As a result of the alternative action, New Melones recreationists would benefit from increased reservoir levels during critical years. No mitigation is necessary.
- As a result of the alternative action, there is an adverse impact to recreational use at Lake Don Pedro during critical water years. Both beach use and the operation of some boat ramps would be negatively impacted. Some boat ramps would still be operable, however, so this impact is less than significant.
- There are no impacts for Lake McClure as a result of the alternative action. No mitigation is necessary.

4.8.3.2 Rivers

Proposed Action

- There are no significant impacts to river flows for recreationists for either the San Joaquin, Stanislaus, or Tuolumne rivers from the proposed action. No mitigation is required.

- With the project, there is a significant decrease in the frequency of flows below the critical threshold for boating activities during critical, dry, and below normal years on the Merced River. This impact is beneficial, and no mitigation is necessary.

Alternative Action

- With the alternative action, flows are increased above the critical threshold on the San Joaquin River in all water years. However, because the recreational opportunities are unknown above this flow level, the impact would be potentially significant. Until recreation opportunities can be determined and evaluated, the impact is unavoidable.

- During critically dry water years, the alternative action would provide additional flows for all boating activities and fewer flows for canoeing. In addition, there would be more flows in the optimal range for swimming. The alternative action, therefore, would provide both beneficial and adverse impacts. The overall impact to recreation would be considered less than significant.

- On the upper reach of the Stanislaus, there is a significant increase in the frequency of flows in the optimal range for boating for all years. During the critical years only, the frequency of occurrences of flows in the optimal range in the lower reach is also significant. These beneficial impacts do not require mitigation.

- There are no significant adverse impacts to river flows for recreationists for either the Tuolumne or Merced rivers from the alternative action. No mitigation is required.

4.9 ENERGY PRODUCTION

The production of electricity from falling water is a significant source of energy in the study areas. Major factors that influence hydrogeneration operations include upstream water regulation, downstream water needs, applicable license permit requirements, and electricity demands (which fluctuate according to the time of the year, weather conditions, and the economics of the energy market). Upstream releases from reservoirs are dependent on not only on upstream water sources (principally from snow melt), and the nature and extent of droughts, but also minimum downstream streamflow requirements, downstream flow fluctuation restrictions, and water quality requirements (USBR 1997d). In addition, downstream water needs are dependent on irrigation needs, water rights agreements, and other water supply contracts.

4.9.1 Key Impact Issues and Evaluation Criteria

This section of the EIS/EIR examines the issues associated with potential power production from reservoir releases to meet the project purpose. Power consumption from activities such as pumping are not addressed in this EIS/EIR because the proposed action does not call for any significant amount of pumping of water over what already occurs under existing conditions to deliver surface water and groundwater. There is the potential for indirect impacts to groundwater pumping to occur, but the energy consumption to accomplish this is not a significant issue. The key issue is to what extent the early release of water (to meet project objectives) would affect hydroelectric power production.

Hydroelectric generation projects typically start with an upstream water source, such as a storage reservoir. The electricity is generated in the powerhouse, which may be located at the reservoir or downstream. The amount of energy generated depends on the difference in elevation between the water in the reservoir and the powerhouse. Thus, the higher the elevation of the water in the storage reservoir, the greater the potential for power production.

In the competitive, deregulated energy market, electric utilities take all reasonable measures to maximize the value of their hydroelectric power production. Power produced during peak energy demand period is more valuable than that produced during lower demand periods. Because hydropower is a low cost energy source that can be turned on and off quickly, utilities generally employ it to meet peak loads. In California, these peak loads typically occur in the summer when maximum groundwater pumping, industrial, and air conditioning demands occur. When water is released in the spring to maintain river flows, less water is available in the summer to provide peak hydropower generation. Reductions in a hydroelectric plant's ability to meet peak load requirements accelerates the need for additional peaking resources and increases the utility costs (McCann 1994, cited in SWRCB 1998).

4.9.2 Environmental Consequences

The proposed action and alternative require higher flows in the spring than occur at present. Model results show that achieving these flows often requires a shift in reservoir releases from the summer to the spring.

The projected reservoir storage capacity and flow figures were obtained from the Reclamation model results. The Water Right Priority System alternative is compared to the No Action alternative qualitatively for each reservoir, because this alternative was not modeled using Reclamation's modeling system. Rather the basis for analyses of this other alternative is the SWRCB's hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions (see earlier discussion in Section 4.2, Surface Water). Of concern to the energy impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997c) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

4.9.2.1 Reservoirs

The changes in water storage based on the proposed action from the No Action alternative were averaged for both the April and May Reclamation model values. These differences in storage were then compared to the average storage capacity of each reservoir, and a percent change was calculated (Tables 4.9-1 through 4.9-3).

New Melones Reservoir

No Action. The storage capacity of New Melones Reservoir is 2,420,000 acre-feet. In the summer months, the storage levels average 1,455,000 acre-feet and range from 114,000 acre-feet to 2,420,000 acre-feet under existing conditions. Summer releases from New Melones Reservoir average 634 cfs and range from 255 cfs to 2,382 cfs.

The average annual generation for New Melones Reservoir and power plant is 385 Gigawatt Hours (GWH). The average annual generation from the Stanislaus River Basin is 1,946.15 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the New Melones plant produces roughly 20 percent of the power in the Stanislaus River Basin this represents less than one percent of the state's total power production.

Proposed Action. Based on an average of the April and May releases from the Reclamation's model, the proposed action affects total reservoir storage (Table 4.9-1). With the project action, the storage in the peak power producing months is increased, from 1.8 percent to 7.6 percent. Increasing the storage increases the potential for power production, and thus is a beneficial impact.

Table 4.9-1: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR NEW MELONES RESERVOIR*

		With Project Changes in Average Storage During Summer Months					
		June		July		August	
Year Type	No Action Average Storage (TAF)	Average (TAF)	%	Average (TAF)	%	Average (TAF)	%
All	1,455.3	48.4	3.3	47.1	3.2	46.3	3.2
Critical	866.6	65.6	7.6	63.4	7.3	63.0	7.3
Dry	1,309.9	38.3	2.9	37.1	2.8	36.3	2.8
Below Normal	1,423.2	47.5	3.3	46.8	3.3	44.7	3.1
Above Normal	1,500.4	53.0	3.5	52.2	3.5	51.7	3.4
Wet	1,991.1	37.9	1.9	36.6	1.8	36.0	1.8

*April and May releases averaged.
Note: TAF = thousand acre feet

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way in the absence of directly comparable data. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the no action comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, but this only represents 0.3 percent of the power production in the Stanislaus River Basin. The overall adverse impact is less than significant.

New Don Pedro Reservoir

No Action. The storage capacity of New Don Pedro Reservoir is 2,030,000 acre-feet. In the summer months, the storage levels average 1,507,000 acre-feet and range from 578,000 acre-feet to 2,030,000 acre-feet under existing conditions. Summer releases from New Don Pedro Reservoir average 401 cfs and range from 50 cfs to 5,577 cfs.

The average annual generation for New Don Pedro Reservoir and power plant is 618.4 GWH. The average annual generation from the Tuolumne River Basin is 2,443.63 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the New Don Pedro plant produces roughly 25 percent of the power in the Tuolumne River Basin, this represents only 1.1 percent of the state's total power production.

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Proposed Action. Based on an average of the April and May releases from the Reclamation's model, the proposed action affects total reservoir storage (Table 4.9-2). With the project action, the storage in the peak power producing months is decreased, from 0.0 percent to -1.6 percent. Decreasing the storage decreases the potential for power production at New Don Pedro but only slightly, and thus is a less-than-significant adverse impact.

Table 4.9-2: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR NEW DON PEDRO RESERVOIR*

		With Project Changes in Average Storage During Summer Months					
		June		July		August	
Year Type	No Action Average Storage (TAF)	Average (TAF)	%	Average (TAF)	%	Average (TAF)	%
All	1,507.4	-13.7	-0.9	-13.5	-0.9	-13.4	-0.9
Critical	1,006.3	-13.9	-1.4	-13.7	-1.4	-13.8	-1.4
Dry	1,391.6	-22.4	-1.6	-22.3	-1.6	-22.4	-1.6
Below Normal	1,459.3	-21.0	-1.4	-21.2	-1.5	-21.6	-1.5
Above Normal	1,647.5	-18.2	-1.1	-17.9	-1.1	-17.1	-1.0
Wet	1,897.1	-0.5	0.0	-0.2	0.0	-0.1	0.0

*April and May releases averaged.
Note: TAF = thousand acre feet

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's no project alternative in a qualitative way. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, and it only represents 0.2 percent of the power production in the Tuolumne River Basin. Overall, the adverse impact is less than significant.

Lake McClure

No Action. The storage capacity of Lake McClure is 1,024,000 acre-feet. In the summer months, the storage levels average 701,000 acre-feet and range from 142,000 acre-feet to 1,024,000 acre-feet under existing conditions. Summer releases from Lake McClure average 355 cfs and range from zero to 3,573 cfs.

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The average annual generation for Lake McClure and power plant is 316.1 GWH. The average annual generation from the Merced River Basin is 406.75 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the Lake McClure plant produces roughly 78 percent of the power in the Merced River Basin, this represents less than one percent of the state's total power production.

Proposed Action. Using an average of the April and May releases from the Reclamation's model, the proposed action affects total reservoir storage (Table 4.9-3). With the project, the water storage in the peak power producing months is decreased, from -0.1 percent to -17.0 percent. Decreasing the storage significantly decreases the potential for power production. Decreases greater than 10 percent occur in critical, dry, and below normal years for June, July, and August; this is a potentially significant adverse impact.

Table 4.9-3: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR LAKE MCCLURE*

		With Project Changes in Average Storage During Summer Months					
		June		July		August	
Year Type	No Action Average Storage (TAF)	Average (TAF)	%	Average (TAF)	%	Average (TAF)	%
All	701.3	-55.6	-7.9	-54.5	-7.8	-53.4	-7.6
Critical	414.8	-70.5	-17.0	-66.3	-16.0	-62.2	-15.0
Dry	573.3	-89.0	-15.5	-88.5	-15.4	-87.8	-15.3
Below Normal	667.8	-86.0	-12.9	-85.6	-12.8	-85.1	-12.7
Above Normal	830.5	-61.6	-7.4	-61.1	-7.4	-60.8	-7.3
Wet	927.4	-0.9	-0.1	-0.8	-0.1	-0.9	-0.1

*April and May releases averaged.
Note: TAF = thousand acre feet

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, and only represents 1.4 percent of the power production in the Merced River Basin. The overall adverse impact is less than significant.

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4.9.2.2 Rivers

The changes in flows based on the proposed action from the No Action alternative were averaged for both the April and May Reclamation model values. These differences in flow were then compared to the average flows of each river, and a percent change was calculated.

Under certain circumstances of hydrology and operational objectives (not modeled) there could occur an operation whereby flows from the reservoir operators that would otherwise have been released at their discretion during the summer may, as the result of the proposed action, no longer be released. The likelihood of these instances is considered rare, and its effect, if any, on Vernalis flow is complicated due to the potential reaction of New Melones Reservoir operations to flow and resultant water quality changes at Vernalis.

Stanislaus River

No Action. Summer releases on the Stanislaus River average 634 cfs and range from 255 cfs to 2,382 cfs.

Proposed Action. Based on averages of the April and May releases from the Reclamation's model (which simulates flows that are all at or above the established flows), the proposed action affects flow on the Stanislaus River (Table 4.9-4). With the project, the flow in the peak power producing months is changed, from -1.4 percent to 7.9 percent. Increasing the flow increases the potential for power production and thus is a beneficial impact. Consequently, decreasing the flow decreases the potential for power production and is an adverse impact on the potential to produce power. Since most of the flows are higher under the proposed action, the overall effect is beneficial but less than significant.

Table 4.9-4: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR FOR THE STANISLAUS RIVER*

Year Type	No Action Average Flow (cfs)	With Project Changes in Average Flows During Summer Months					
		June		July		August	
		Average (cfs)	%	Average (cfs)	%	Average (cfs)	%
All	634.3	27.4	4.3	11.0	1.7	4.1	0.6
Critical	417.4	22.1	5.3	27.8	6.7	0.0	0.0
Dry	710.6	-0.1	0.0	15.6	2.2	8.8	1.2
Below Normal	632.8	-9.0	-1.4	0.2	0.0	22.9	3.6
Above Normal	634.8	40.9	6.4	2.7	0.4	-3.3	-0.5
Wet	762.1	60.4	7.9	8.1	1.1	-1.8	-0.2

*April and May releases averaged.

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way in the absence of directly comparable data. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the No Action comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 0.3 percent of the power production in the Stanislaus River Basin. The impact is less than significant.

Tuolumne River

No Action. Summer releases on the Tuolumne River average 401 cfs and range from 50 cfs to 5,577 cfs. The FERC required minimum flow is 50 cfs in critical water years in summer months, and increases to 300 cfs in wet years.

Proposed Action. Using Tuolumne River averages of April and May releases (based on Reclamation's model, which simulates flows that are at or above the established flows), the proposed action affects flow (Table 4.9-5). With the project, the flow in the peak power producing months is changed, from -2.3 percent to 10.6 percent. Increasing the flow increases the potential for power production, and thus is a beneficial impact. Consequently, the overall impact is less than significant except in below normal years when the impact is significantly beneficial.

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Table 4.9-5: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR FOR THE TUOLUMNE RIVER*

Year Type	No Action Average Flow (cfs)	With Project Changes in Average Flows During Summer Months					
		June		July		August	
		Average (cfs)	%	Average (cfs)	%	Average (cfs)	%
All	401.1	2.7	0.7	-1.0	-0.2	-0.8	-0.2
Critical	50.0	0.0	0.0	-1.0	-2.0	-1.0	-2.0
Dry	66.1	5.1	7.7	3.5	5.3	3.5	5.3
Below Normal	75.3	8.0	10.6	6.0	8.0	6.0	8.0
Above Normal	258.2	1.9	0.7	-6.0	-2.3	-6.0	-2.3
Wet	1,183.2	0.7	0.1	-4.4	-0.4	-3.5	-0.3

*April and May releases averaged;

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 0.2 percent of the power production in the Tuolumne River Basin. The impact is less than significant.

Merced River

No Action. Summer releases on the Merced River average 634 cfs and range from 255 cfs to 2,382 cfs.

Proposed Action. Using an average of the April and May Merced River releases (based on Reclamation's model, which simulates flows that are at or above the established flows), the proposed action affects flows (Table 4.9-6). With the project, the flow in the peak power producing months is changed, from -46.4 percent to 2.2 percent. Increasing the flow increases the potential for power production, and thus is a beneficial impact. Consequently, decreasing the flow decreases the potential for power production and is an adverse impact. The large percentage decrease occurs only in above normal water years in June but is only a decrease of 117 cfs. This impact is potentially significant.

Table 4.9-6: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR FOR THE MERCED RIVER*

		With Project Changes in Average Flows During Summer Months					
		June		July		August	
Year Type	No Action Average Flow (cfs)	Average (cfs)	%	Average (cfs)	%	Average (cfs)	%
All	355.1	-39.9	-11.2	2.2	0.6	1.1	0.3
Critical	133.6	2.6	1.9	1.2	0.9	0.1	0.1
Dry	146.5	2.5	1.7	1.4	1.0	0.3	0.2
Below Normal	180.4	2.1	1.2	3.9	2.2	0.5	0.3
Above Normal	252.2	-116.9	-46.4	4.0	1.6	1.5	0.6
Wet	836.8	-67.8	-8.1	1.0	0.1	2.5	0.3

*April and May releases averaged.

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation's No Action alternative in a qualitative way. The SWRCB's Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 1.4 percent of the power production in the Merced River Basin. The impact is less than significant.

San Joaquin River

No hydropower is generated on the San Joaquin River that would be affected by either the proposed action or alternative action. No mitigation is necessary.

4.9.3 Impact Summary and Mitigation of Impacts

4.9.3.1 Reservoirs

Proposed Action

- Increases in storage capacity at New Melones have a beneficial effect on potential hydropower production. No mitigation is necessary.

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- There are less-than-significant impacts to hydropower production at New Don Pedro Reservoir. No mitigation is necessary.

- Decreases greater than 10 percent occur in critical, dry, and below normal years for June, July, and August for Lake McClure. This adverse impact to potential hydropower production is potentially significant and unavoidable, because the effects of changing the reservoir levels cannot be mitigated while still accomplishing project objectives.

Alternative Action

- There are less-than-significant impacts to potential hydropower production on either New Melones Reservoir, New Don Pedro Reservoir, or Lake McClure. No mitigation is necessary.

4.9.3.2 Rivers

Proposed Action

- Proposed releases on the Stanislaus River would have a less-than-significant effect on potential hydropower production. No mitigation is required.

- There are significant beneficial impacts to hydropower production at Tuolumne River powerplants during below normal years in June. No mitigation is necessary.

- Decreases greater than 10 percent occur in above normal years in June for the Merced River. This adverse impact to potential hydropower generation is potentially significant and unavoidable because the effects of changing the average flow cannot be mitigated while still accomplishing project objectives.

Alternative Action

- There are less-than-significant impacts to potential hydropower production on the Stanislaus, Tuolumne, or Merced rivers. No mitigation is required.

4.10 INDIAN TRUST ASSETS

The affected environment section for Indian Trust Assets was divided into the San Joaquin River Region and Sacramento-San Joaquin Delta in order to facilitate description of the assets of the project area and vicinity. This impact section focuses specifically on these two areas in order to determine whether or not there are any existing Indian Trust Assets (ITAs) that could potentially be impacted by the proposed action.

It is Reclamation's policy to protect ITAs from adverse impacts of its programs and activities whenever possible. Types of actions which could affect ITAs include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts to fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely impacts uses of the reserved land. (USBR 1997d)

4.10.1 San Joaquin River Region

Approximately 11 reservations or rancherias are located in the counties that make up this region. In addition, there are also an unknown number of public domain allotments within the region.

Actions evaluated in this EIS/EIR include the management of water resources. It is unknown if there are any ITAs that would be directly affected by the proposed action or alternative action, but it is expected that there would not be any adverse impacts to ITAs in the San Joaquin River Region. Increased or decreased flows would be within the normal floodplain of the affected rivers and would not negatively affect any ITAs that may be located adjacent to rivers.

4.10.2 Sacramento-San Joaquin Delta

There are no reservations or rancherias located in the Sacramento-San Joaquin Delta. There would be no impacts to ITAs in this region as a result of the proposed action or alternative action.

4.10.3 Impact Summary and Mitigation

4.10.3.1 Reservoirs

Proposed Action

- There are no adverse impacts to Indian Trust Assets at any of the reservoirs. No mitigation is necessary.

Alternative Action

- There are no adverse impacts to Indian Trust Assets at any of the reservoirs. No mitigation is necessary.

4.10.3.2 Rivers

Proposed Action

- There are no adverse impacts to Indian Trust Assets at any of the rivers. No mitigation is necessary.

Alternative Action

- There are no adverse impacts to Indian Trust Assets at any of the rivers. No mitigation is necessary.

4.11 ENVIRONMENTAL JUSTICE

This section addresses the concern of whether any group of people, including racial, ethnic, or socioeconomic group, would bear a disproportionate share of adverse environmental effects from implementation of the alternatives. Consideration of environmental justice is a federal requirement based on a Presidential Executive Order 12898; there is no corresponding requirement in CEQA.

4.11.1 Key Impact Issues and Evaluation Criteria

To address environmental justice concerns, the following issues are evaluated:

- Are affected resources are used by a minority or low-income community?
- Are there minority or low-income communities disproportionately subject to environmental or human health impacts?
- Do the resources used for the project support subsistence living?

4.11.2 Environmental Consequences

The San Joaquin River Area contains high percentages of Hispanics and persons/families living below the poverty level. Unemployment is significantly higher in the project area and vicinity than in other regions of the State. Consequently, there is the potential for low-income and minority groups to be disproportionately affected. Since there are no human health impacts from any of the project alternatives (including the No Action alternative), any issues related to environmental justice are focused on environmental impacts on natural resources and potential socioeconomic impacts. There would be no discernable impact to employment from either the proposed or alternative actions, so there is no socioeconomic impact on minority or low-income groups. The principal resources used by low-income and Hispanic groups in the project area are aquatic and recreation resources.

4.11.2.1 Aquatic Resources

No Action

Existing minority and low income groups use project area rivers and reservoirs for recreational fishing. The use is not at a subsistence level where fishers rely on fish and other animals caught in the wild as a major food source. Subsistence use of the renewable natural resources is common among Native Americans. Fishing to supplement normal food sources is expected to continue.

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Proposed Action

Since implementation of the project alternatives would provide water to enhance aquatic resources (fish), this enhancement to fisheries would provide benefit to minority and low income groups who fish for recreational purposes to supplement their food sources. This beneficial impact however would not disproportionately affect low-income and minority population groups, since the benefit would be available to all fishers.

Alternative Action

Additional flows for the San Joaquin River system, regardless of the source of supplemental water, would provide positive impacts to benefit fisheries. This beneficial impact is not expected to disproportionately affect low-income and minority population groups, since the benefit would be available to all fishers.

4.11.2.2 Recreation Resources

No Action

Existing minority and low income groups in the project area use the area rivers and reservoirs for recreation. This use is expected to continue over the 1999-2010 period. It is not known whether these groups use these resources disproportionately to the overall population.

Proposed Action

The proposed action would result in water releases for stream flow enhancement for fish. These releases would concurrently provide enhanced recreation opportunities. Consequently, there would be a positive effect on low-income and minority populations' use of the project area rivers. Concerning recreation use at the reservoirs, the low-income and minority populations would benefit from increased reservoir levels at New Melones. Since the proposed action would have no impact at New Don Pedro Reservoir and Lake McClure, there would be no change to recreationists including these two groups.

Alternative Action

The Water Right Priority System alternative has an adverse impact to beach use and boating at New Don Pedro Reservoir during critical water years. Low-income and minority groups would be adversely affected but not disproportionately to other user groups. Concerning river flows, there are no significant adverse impacts to recreationists on the Stanislaus, Tuolumne, and Merced rivers from use of the alternative action. Potentially significant adverse impacts occur on the San Joaquin River

during all years except for critical years where the impact is less than significant. These impacts would not occur disproportionately to low-income and Hispanic groups.

4.11.3 Impact Summary and Mitigation of Impacts

4.11.3.1 Aquatic Resources

Proposed Action

- Beneficial impacts to fisheries would not affect environmental justice. No mitigation is required.

Alternative Action

- Beneficial impacts to fisheries would not affect environmental justice. No mitigation is required.

4.11.3.2 Recreation Resources

Proposed Action

- Beneficial impacts to recreation in rivers and reservoirs would not affect environmental justice. No mitigation is required.

Alternative Action

- Adverse impacts to recreation at New Don Pedro Reservoir during critical water years would not affect environmental justice. No mitigation is required.

- No impacts to recreation would occur on the Stanislaus, Tuolumne, and Merced rivers; and there is no impact to environmental justice. No mitigation is required.

- Potentially significant impacts in all water years and less-than-significant impacts to recreationists on the San Joaquin River during critical years would not result in environmental justice impacts. No mitigation is required.

4.12 CUMULATIVE EFFECTS

Cumulative effects are defined as the combined impact upon the environment which results from the summation of all the incremental effects of the proposed project plus other past, present, and reasonably foreseeable future actions undertaken by the same or other agencies or persons (USBR 1997d). Cumulative impacts can result from individually minor but collectively significant actions taking place over the life of the project. This section identifies a list of related projects (including plans and programs), summarizes the environmental effects of these related projects, qualitatively analyzes the cumulative impacts of the proposed project (in the context of the related projects), and recommends mitigation measures for any significant cumulative impacts.

4.12.1 Actions Included in the Cumulative Impacts Analysis

Actions that may contribute to cumulative effects include the following programs which are described in the following sections.

- State Water Resources Control Board Bay/Delta Process
- Central Valley Project Improvement Act (especially Section 3406(b)(2))
- Interim South Delta Program
- CALFED Bay-Delta Program
- New Melones Long-Term Plan of Operation
- SSJID South County Water Supply Project
- OID/SSJID Water Transfer Project to SEWD

4.12.1.1 State Water Resources Control Board Bay/Delta Process

In 1995, the State Water Resources Control Board (SWRCB) adopted a water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Rivers Delta Estuary (1995 WQCP). The plan identifies municipal and industrial, agriculture, and fish and wildlife beneficial uses and specifies objectives to protect these uses. The objectives consist of numeric objectives for flow, numeric objectives for water quality constituents (salinity and dissolved oxygen), numeric operational constraints, and two narrative objectives for the protection of salmon and brackish tidal marshes in Suisun Marsh. The objectives in the 1995 WQCP are currently implemented through Biological Opinions issued by the U.S. Fish and Wildlife Service (Service) and the National Marine Fisheries

Service (NMFS) for protection of Delta smelt and winter-run chinook salmon, respectively, and through SWRCB water right decision 1485 (D-1485). Under the Biological Opinions, D-1485, and the interim order, responsibility for meeting most of the objectives is assigned to the State Water Project (SWP), operated by the California Department of Water Resources (DWR), and to the federal Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (Reclamation). The SWRCB program is an adjudicatory action designed to implement the 1995 WQCP by determining and allocating responsibility for achieving the 1995 WQCP objectives to water right holders (SWRCB 1998).

4.12.1.2 Central Valley Project Improvement Act (Bureau of Reclamation)

On October 30, 1992, the President signed into law the Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law 102-575) that included Title XXXIV, the Central Valley Project Improvement Act (CVPIA). This act amended previous authorizations of the California Central Valley Project (CVP) to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic uses, and fish and wildlife enhancement as a project purpose equal to power generation. The CVPIA identifies a number of specific measures to meet these new purposes and directs the Secretary of the Interior (Secretary) to operate the CVP consistent with these purposes, to meet the Federal trust responsibilities to protect the fishery resources of affected federally recognized Indian tribes, and to meet all requirements of Federal and California law and to achieve a reasonable balance among competing demands for use of CVP water (USBR 1997d).

The CVP is the system of reservoirs, powerplants, pumping plants, and canals managed by the federal Bureau of Reclamation in California. The combined storage capacity is about 12 million acre-feet, which accounts for approximately 25 percent of California's developed surface water supply. Interior is developing policies and programs to modify the operations, management, and physical facilities of the CVP and to renew existing CVP water services and repayment contracts to comply with the purposes and goals of the CVPIA (CALFED 1998).

The CVPIA mandates changes in the management of the CVP, particularly operation of the CVP to dedicate and manage 800,000 acre-feet of CVP yield for the protection, restoration, and enhancement of fish and wildlife (Section 3406(b)(2)). On November 20, 1997, Interior published its "Final Administrative Proposal on the Management of Section 3406(b)(2) Water" (USBR 1997n). This paper presents how Interior intends to comply with the statutory mandate to dedicate and manage the water dedicated pursuant to Section 3406(b)(2) of the CVPIA. It designates a set of fish, wildlife, and habitat restoration measures that will be implemented over a 5-year (or greater) period. These measures could result in water delivery impacts of 800,000 acre-feet of CVP yield. Actions included in the "(b)(2) water" management program include VAMP and ramping of San Joaquin River flows (after the 31-day pulse flow period). Interior determined that NEPA was not required

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for the implementation of Section 3406(b)(2) actions, and this EIS/EIR is addressing only the program to acquire water that would be needed to meet the San Joaquin River flow objectives of VAMP and other needs of the San Joaquin River system. Subsequent litigation on the NEPA exemption for "(b)(2) water" confirmed Interior's position. The CVPIA program also includes water acquisitions actions designed to meet instream target flows (Section 3406 (b)(3)) for the benefit of fish and wildlife.

Physical measures to restore fish and habitat include: establishment of fish screening programs; development and implementation of measures on the Sacramento River to minimize fish passage problems; expansion of the U.S. Fish and Wildlife Service's existing hatchery facility; development and implementation of a continuing program to restore and replenish lost spawning gravel; development and implementation of a program that provides for modified operations or new and improved control structures at the Delta Cross Channel and Georgiana Slough; and design and construction of new fish protection structures at selected agricultural pumping facilities (CALFED 1998).

4.12.1.3 Interim South Delta Program (California Department of Water Resources/ Bureau of Reclamation)

The objectives of the Interim South Delta Program (ISDP) are to improve water levels and circulation in South Delta channels for local agricultural diversions, improve South Delta hydraulic conditions to increase diversions into Clifton Court Forebay to optimize the frequency of full pumping capacity at the Harvey O. Banks Pumping Plant, and improve fishery conditions for salmon migrating along the San Joaquin River (CALFED 1998).

The preferred alternative for the ISDP is comprised of selected channel dredging of a 4.9-mile reach of Old River from the northwest corner of the Clifton Court Forebay to North Victoria Canal; construction and operation of a new intake gate at Clifton Court Forebay; and construction and operation of three radial gate flow control structures and one radial gate fish control structure in the south Delta, to increase water supply availability for local diverters and improve local fishery conditions. In addition, DWR is seeking a permit from the U.S. Army Corps of Engineers to divert up to 20,430 acre-feet of water per day on a monthly averaged basis from the Delta into Clifton Court Forebay. Collectively, these actions are intended to enhance the management of south Delta water resources to benefit local diverters, Delta fisheries and State Water Project water supply (CALFED 1998).

A Draft EIS/EIR and 404(b)(1) Analysis for ISDP was released for public review and comment in July 1996. The draft documents identified both beneficial and adverse impacts associated with the implementation of ISDP.

Potential adverse impacts upon aquatic resources include loss of habitat due to dredging of Old River; loss of habitat due to the construction of the proposed facilities; negative flows in channels leading to the South Delta due to the operation of the barriers; and increased straying, predation, and entrainment losses due to high SWP export pumping during the fall, winter, and early spring. Concurrently the project could benefit San Joaquin River fall-run chinook because the spring and fall fish control structure at the Head of Old River would reduce entrainment/predation loss of San Joaquin River salmon smolts at the Tracy and Harvey O. Banks Pumping Plants and improve dissolved oxygen levels in the San Joaquin River (CALFED 1998).

Water quality could be substantially improved in two ways and potentially degraded in one way. First, increased pumping would allow reductions in exports during critical seasons. This change in operation could lead to fewer conflicts among beneficial use of Delta waters. Secondly, the installation of barriers could improve water levels and circulation in the South Delta, and thereby enhance agricultural and municipal uses of the water. However, the operation of the barriers also could degrade water quality by rerouting relatively saline waters of the San Joaquin River away from the South Delta pumping plants, and towards the central Delta (CALFED 1998).

4.12.1.4 CALFED Bay-Delta Program

The CALFED Program began in June of 1995 to address the complex issues that surround the management of the Delta. The CALFED Program is a cooperative, interagency effort involving 15 state and federal agencies with management and regulatory responsibilities in the Bay-Delta. The purpose of the CALFED Program is 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 (CALFED 1998).

To achieve the programs purpose, CALFED concurrently addresses problems of the Bay-Delta system within four critical resource categories: ecosystem quality, water quality, water supply reliability, and levee system integrity. Important physical, ecological, and socioeconomic linkages exist between the problems and possible solutions in each of these categories. In addition to these four, core-element, categories, the CALFED program is evaluating water storage and conveyance alternatives (CALFED 1998).

New storage is being considered to provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural, and environmental beneficial users. Options under consideration include enlarging existing storage facilities, developing new off-stream and on-stream storage reservoirs, and groundwater storage. Conveyance options, intended to convey water from north of the Delta to south of the Delta, are also part of the program alternatives. The various conveyance components range from modifications to existing facilities in the south Delta,

to improvements of existing Delta channels, to the construction of an isolated transfer facility (CALFED 1998).

The Draft Programmatic EIS/EIR for the Bay-Delta Program was released for public comment in March 1998. A final document is expected to be completed in mid 1999.

4.12.1.5 New Melones Long-Term Plan of Operation

Reclamation is committed to completing the New Melones Long-Term Operation Plan with the participation of a wide range of stakeholders in the Stanislaus River Basin. The long term operations of the Stanislaus River will be affected by several pending actions including the SJRA. The stakeholders input combined with resolution of pending actions and planning studies will result in a revision of the 1997 Interim Plan of Operation to produce the long-term plan.

The Interim Operation Plan for New Melones Dam and Reservoir (USBR 1997) will expire October 1, 1998. Based on the general consensus of stakeholders in June 1998, Reclamation will continue to operate under the interim plan through October 1, 1999. Beginning in April 1999, Reclamation will sponsor discussions to consider the Interim Operation Plan for the years 2000 and 2001. (Ploss 1998, e-mail communication)

4.12.1.6 SSJID South County Surface Water Supply Project

The SSJID South County Surface Water Supply project as currently proposed consists of the construction of a water treatment plant to treat water currently held by SSJID under its pre-1914 water rights for use in the Southern San Joaquin County communities of Manteca, Escalon, Lathrop, and Tracy. The project would proceed in two stages. First, SSJID would construct a water treatment plant and associated conveyance facilities with a capacity of up to 30,000 acre-feet annually. The second stage would consist of expanding both the treatment plant and conveyance facilities as needed to a capacity of up to 50,000 acre-feet annually.

An initial study for the SSJID South County Surface Water Supply Project was released in February, 1998. The initial study concluded that an EIR would need to be prepared. SSJID is currently in the process of developing an EIR, and anticipates releasing a draft EIR in early 1999.

4.12.1.7 OID/SSJID Water Transfer Project to SEWD

The OID/SSJID Water Transfer Project to SEWD as currently proposed would transfer up to 30,000 acre-feet of surface water annually over a ten-year period from OID and SSJID through existing conveyance facilities to the SEWD, the City of Stockton, and the Lincoln Village and Colonial Heights Maintenance District. The transferred water would be used by SEWD primarily for direct

municipal and industrial use by the City of Stockton, California Water Service company, and the Lincoln Village and Colonial Heights Maintenance District in order to reduce groundwater pumping and enhance recovery of the Eastern San Joaquin Groundwater Basin.

A Draft Initial Study and Proposed Negative Declaration for the project was released in December, 1997. After reviewing the comments received on that document, OID and SSJID determined that a focused EIR was necessary to address some of the potential environmental impacts of the project. OID and SSJID anticipate that a DEIR for the project will be released in early 1999.

4.12.2 Cumulative Impact Analysis

The following is an analysis of projects discussed in Section 4.12.1 and their potential cumulative impacts. The analysis is qualitative in nature. Impacts were based on identified resources potentially affected by each project extracted from the CALFED Bay-Delta Draft Programmatic EIS/EIR (1998). The CALFED analysis based their determination upon available environmental documents/studies or knowledge of the generally expected kinds of effects of similar projects (CALFED 1998). Because of the preliminary phase of most of the projects (environmental reviews have not been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was not available. Table 4.12-1 summarizes the effects of all actions including the SJRA proposed action.

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Table 4.12-1: SUMMARY OF CUMULATIVE IMPACTS

Region	Actions Involved	Potential Cumulative Impacts from All Actions
Delta Region	• SWRCB Bay/Delta Process • Interim South Delta Program • Central Valley Project Improvement Act • CALFED Bay-Delta Program	• Beneficial and detrimental impacts to fisheries and Delta species listed as threatened or endangered • Beneficial and detrimental impact to water quality and supply availability
Sacramento River Region	• SWRCB Bay/Delta Process • Central Valley Project Improvement Act • CALFED Bay-Delta Program	• Beneficial impacts to fisheries and water quality • Adverse impact to water supply availability • Beneficial and/or adverse impacts to recreation
San Joaquin River Region	• SWRCB Bay/Delta Process • Central Valley Project Improvement Act • CALFED Bay-Delta Program • Interim South Delta Program • New Melones long-term plan of operation • SSJID South County Water Supply Project • OID/SSJID Water Transfer to SEWD	• Beneficial impacts to water supply reliability and the protection of water rights • Beneficial and detrimental impact to water quality • Beneficial impact to riparian vegetation, special-status and other wildlife species • Long-term beneficial impacts to fisheries • Adverse impacts to agricultural production • Adverse impacts to groundwater
SWP and CVP Service Areas	• All Projects Analyzed	• Adverse impacts to water supply availability and quality

Notes: * All actions include the specific programs mentioned and the SJRA proposed action. Actions have both negative and positive effects as indicated. The summary does not attempt to arrive at a net effect. See subsections of Section 4.12.2 for discussion of individual impacts.

The analysis above represents an approach that combines large projects/plans/programs and two specific recent projects in the OID/SSJID service areas in Stanislaus County. The SJRA proposed action is one component in the larger plans underway by the CALFED Bay-Delta Program and in the implementation of long-term water contracts under the CVPIA. The NEPA/CEQA documents prepared for these regional projects provide detailed analysis of collectively significant projects occurring over the 12-year time frame of the proposed action. Further detailed information on cumulative impacts is provided in the Draft PEIS on the CVPIA (USBR 1997d-n), and this information is herein incorporated by reference.

4.12.2.1 Delta Region

The SWRCB Bay/Delta Process would result in beneficial cumulative water quality and fishery impacts within the Delta. The proposed (SJRA) project and alternative (SWRCB Water Right Priority System) actions contribute beneficially to the attainment of most SWRCB Bay/Delta Process objectives for protection of beneficial uses.

Interior's CVPIA Administrative Proposal for management of (b)(2) water (USBR 1997n) includes Appendix B, Summary of Simulated CVP and SWP Delivery Impacts by Year Type. The impact varies based on hydrologic conditions with the greatest impacts occurring in dry years. Up to 800,000 acre-feet of CVP yield will be dedicated to actions that would benefit fish and wildlife and their habitats which include the Delta ecosystem.

One of the purposes of the (b)(2) water is to assist the State in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Delta actions in the Administrative Proposal include the following: VAMP, Head of Old River barrier/fish control structure, additional X2 protection, maintain Sacramento River flow, ramping of San Joaquin River flows, closure of Delta cross-channel gates based on spring-run chinook salmon protection plan, July flows and exports, and evaluate effects of exports on smolt survival in December-January. Measures to accomplish the actions to benefit Delta and upstream fish and wildlife are: increased Delta export, upstream purchases, joint point of diversion, export deliveries, land retirement, and water reserve account.

VAMP includes flow and export rate manipulation and installation of a barrier at the head of Old River. See Table 2.1-3 for target flows and export rates.

The Interim South Delta Program (ISDP) would have both beneficial and adverse cumulative impacts. Potential adverse impacts include the loss of aquatic resource habitat due to dredging and construction of intake and control structures; increases in reverse flow in some channels under low flow conditions due to the operations of barriers; and increased straying, predation, and entrainment losses due to high export pumping during the fall, winter, and early spring (CALFED 1998).

The ISDP includes the installation and monitoring of temporary flow and fish control structures for potential effects on threatened and endangered species, including a fish control structure at the Head of Old River near Mossdale during the April through June period to protect San Joaquin River salmon migrating through the Delta. A fall flow control stucture would also be installed at the Head of Old River to improve dissolved oxygen levels in the San Joaquin River between the Head of Old River and Medford Island to aid salmon migration in the San Joaquin River. Other temporary flow control structures are proposed to reduce dissolved oxygen problems, to avoid salt buildup in south Delta channels, and to lower the salt load in the Delta-Mendota Canal (USFWS 1996b). In

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particular, the operation of the fish and flow control structures in coordination with the export facilities determines the magnitude of impact to endangered species such as the delta smelt. The beneficial fishery impacts of high spring flows from the San Joaquin (due to project implemented pulse flows) could be offset by adverse impacts to delta smelt from the other projects. Mortalities of delta smelt, entrained into the SWP/CVP export facilities, could be high if the fish control structure at the Head of Old River (which protects emigrating chinook salmon) results in large reverse flows in the southern and central Delta. This hydrologic condition could result in more delta smelt being exposed to entrainment losses as the export facilities zone of influence extends northward. Currently, this condition of protecting delta smelt verses chinook salmon is managed by making the fish control structure at the Head of Old River "operable"; i.e., capable of allowing some flow through the structure to offset reverse flows created in the southern Delta by SWP/CVP exports. The relationship between export levels, operation of the Old River fish control structure, coordination with spring pulse flows in the San Joaquin River, and protection of delta smelt and chinook salmon is currently undergoing intensive study by DWR. At this time, however, adverse impacts to delta smelt could occur in the south Delta depending upon the operational conditions existing at the time of major project actions (e.g., release of spring pulse flows). These cumulative impacts can range from less than significant to significant based on the abundance and distribution of delta smelt, the ratio of flow in the San Joaquin River to SWP/CVP export, and the operation of the Old River fish control structure.

The fish control structure included in VAMP is the ISDP fish control structure described above. The Service issued a Formal Endangered Species Consultation and Conference on the Proposed South Delta Temporary Barrier Project for 1996 through 2000 (USFWS 1996b). They concluded that "the proposed continuation of the Temporary Barriers Project will likely adversely affect delta smelt and Sacramento splittail, and adversely modify or destroy delta smelt critical habitat, both directly and indirectly." However, the Service also concluded that the temporary installation of the rock barriers are not likely to jeopardize the continued existence of the delta smelt and the proposed Sacramento splittail, or result in the destruction or adverse modification of critical habitat for delta smelt because the impacts are temporary in nature, there are several protective measures in place to reduce the effects of the project, and there will be overall integration of this project with CVP/SWP operations and the Operations Group (USFWS 1996b). Although the temporary fish control structure would not be in place for the full period of VAMP implementation, its continuation or replacement for VAMP would occur under the ISDP.

Beneficial cumulative water quality impacts of the Interim South Delta Program are also expected. Increased pumping would allow reductions in exports during critical seasons when pulse flows from the San Joaquin River were being released. This change in operation could lead to fewer conflicts among beneficial uses of Delta waters. In addition, the installation of fish and flow control structures could improve water levels and circulation in the south Delta, and thereby enhance agricultural and municipal uses of the water. However, the operation of either the Grant Line or Head of Old River

barriers could degrade water quality by rerouting relatively saline waters of the San Joaquin River away from the south Delta pumping plant, and toward the central Delta. This degradation of water quality could be exacerbated during the summer as flows from the San Joaquin River drop.

The CVP/SWP project operations may adversely affect fish production and survival in Delta waterways when combined with potential impacts associated with the CALFED or other options to increase storage within the Delta (e.g., Delta Wetlands Project). Potential effects would depend largely on the volume of water released, and the operation of the downstream releases. However, proposed new storage sites and modifications to existing sites associated with the projects within the Sacramento River Region could potentially benefit fisheries resources in the Delta by dampening the water-level fluctuations and improving water quality by increasing the concentration of dissolved oxygen. In-Delta storage projects (CALFED or Delta Wetlands Project) could potentially add adverse effects to Delta water quality and circulation by the discharge of lower quality or potentially contaminated water to receiving waters. All four of the Delta Region actions (Table 4.12-1) could benefit water availability and Delta exports.

4.12.2.2 Sacramento River Region

The conditions for water quality and fisheries in the Sacramento River Region would generally improve with implementation of any of the actions involved (SWRCB, CVPIA, CALFED). This results from increased flows and non-flow actions (CVPIA, CALFED) such as fish screens and fish passage improvements, habitat restoration, improved water quality, and predator control.

Upon implementation of the San Joaquin River Agreement, the Sacramento River flows would likely (1) decrease or remain constant during the pulse flow and (2) increase or remain constant depending on the hydrologic conditions and applicable outflow objectives as SJRA project area reservoirs refill. Outflow can be increased through a reduction of export rates as well as through increased river flows. Depending on the operation of storage reservoirs, which would provide this additional water for flows, recreation could be adversely affected by water levels and discharge/recharge cycles. Non project water users in the Sacramento Valley would not be affected. New storage capacity (under CALFED or CVPIA) would benefit recreation in the long term and have a cumulative beneficial impact on direct recreation activities and indirect activities by increasing water recreation opportunities within the region.

4.12.2.3 San Joaquin River Region

Implementation of the preferred alternative (SJRA) would positively impact the SWRCB Bay/Delta Process. A negotiated settlement would avoid potentially contentious and protracted proceedings to protect Delta beneficial uses. The SJRA action would benefit water supply reliability to meet the objectives of the SWRCB Bay/Delta Process. This would also have beneficial impacts to the

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protection of water rights in the region since willing sellers, rather than water right modifications, would be used to meet SWRCB Vernalis flow objectives.

Special-status and other wildlife species in the San Joaquin River Region would benefit from the CVPIA project due to land fallowing and retirement, riparian restoration, increased spring flows, and refuge water supply increases for wetland habitat. The CVPIA land retirement program in the San Joaquin River Region, however, would impact agricultural land use by reducing the amount of available farmland. Reductions in delivery, related to water storage short-falls, could add incrementally to the loss of agricultural production in the Region. Use of groundwater to offset these surface water delivery shortages would have potentially adverse impacts to groundwater resources in an area already characterized by overdraft problems.

As explained in Section 4.12.2.1, the Administrative Proposal for management of (b)(2) water includes much of the proposed action: VAMP 31-day spring pulse flow (up to 110,000 acre-feet) and ramping flows around the pulse flow. The October flow would be in addition to the (b)(2) action and represents an additional benefit.

Fisheries resources would obtain long-term benefits from the CVPIA and CALFED actions by improved conditions along the lower San Joaquin River with respect to temperatures, improved habitat, reduced losses to diversion, and improved fish movement. These benefits would be incrementally increased by the actions proposed in the current project (SJRA), since they involve increased flows to enhance movement of salmon in the basin.

The Interim South Delta Project would have a beneficial cumulative impact on the San Joaquin River fall-run chinook salmon because the spring and fall barriers at the Head of Old River would reduce entrainment/predation loss of San Joaquin River salmon smolts at the Tracy and Harvey O. Banks pumping plant and improve dissolved oxygen levels in the San Joaquin River.

The SSJID South County Water Supply Project and the OID/SSJID Water Transfer Project to SEWD would shift water use away from irrigation use to municipal and industrial uses in San Joaquin County. Such a transfer has the potential for adverse environmental impacts on the Stanislaus River through reduced flows, but because it is anticipated that the water for both projects would be made available largely through conservation and improved conjunctive use of water, these impacts would likely be insignificant. The projects may result in additional groundwater use within OID and SSJID, with possible adverse environmental impacts; but they would likely result in lower groundwater use in the areas receiving the water, thereby reducing groundwater depletion, subsidence, and saltwater intrusion into the aquifers of San Joaquin County, which would be a beneficial environmental impact.

4.12.2.4 SWP and CVP Service Areas

A cumulative impact of all the projects analyzed which change operations or add substantially to upstream storage, is the potential to contribute to adverse cumulative water supply availability and water quality impacts within the SWP and CVP Service Areas. When combined with higher instream flow requirements and increased consumptive water use demands placed on water within the SWP and CVP service areas, the cumulative impacts on water supply availability may be significant. Mitigation of these impacts would include the (1) use of water transfers to redistribute water efficiently and as needed, and (2) development of additional water storage facilities. These facilities would primarily be conjunctive use projects that would store surface water in underground aquifers for later withdrawal and use. Potential water quality cumulative impacts would be adverse but not significant (CALFED 1998).

4.13 RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

This section provides a summary of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity of the affected resources for the proposed action (SJRA) and the alternative action (Water Right Priority System), 1999-2010. There are no short-term construction impacts associated with the releases of water for stream flow enhancement. In summary, the long-term benefits of increased productivity of the San Joaquin River ecosystem and reliability in water supplies outweigh short-term adverse effects on individual resources listed below.

4.13.1 Proposed Action

Surface Water

Most impacts to water deliveries, water storage, and water quality are associated with specific hydrologic conditions, and these conditions vary throughout the period. Potentially significant impacts are short-term impacts (1 to 5 years) related to dry hydrologic events. Over the long-term, the twelve-year period 1999-2010, the probability is low that an extended adverse impact would occur, i.e., a long-term drought. Water supply reliability would be enhanced with the proposed action over the long term. Rather than relying on short-term individual water acquisitions, Reclamation and the Authority would plan their water operations with greater performance reliability.

Groundwater

Groundwater impacts to the Merced Groundwater Basin and to the OID and Exchange Contractors service areas are short term because they are related to dry hydrologic events when the full amount of water would most likely not be required. Over the long term, conjunctive use programs and natural groundwater recharge during wet years would minimize the long-term impact on groundwater overdrafting, water level, water quality, and subsidence problems.

Terrestrial Resources

The pulse flows are to occur in most years, so the impacts to vegetation and wildlife are annual events that would benefit the long-term productivity of the riparian ecosystems as long as the releases are timed to include ramping flows.

Aquatic Resources

The pulse flows would occur in most years, so the impacts to aquatic resources are long-term rather than short-term, and most impacts are beneficial. Ramping flows would ensure that juvenile salmon and salmon redds are not adversely affected.

Land Use

Short-term impacts are associated with dry hydrologic events that could result in the use of groundwater to offset reductions in irrigation deliveries or reductions in crop production. Over the long term, agricultural production would not be affected. Short-term reductions in employment and income would not significantly affect the regional economy over the long term.

Cultural Resources

Exposure of resources to recreational users would occur in the short term due to specific hydrologic events. This impact could affect maintenance of the integrity of the resources over the long term if several dry years occurred over the life of the proposed project, 1999-2010.

Recreation

There are no short-term or long-term impacts to recreation on the rivers or at the reservoirs.

Energy Resources

Impacts to hydropower generation during peak power production months would occur in the short term at Lake McClure/Merced River, depending on dry hydrologic events. Over the long term, productivity would not be significantly affected. Also, there would be some energy use associated with short-term pumping of groundwater, primarily during dry hydrologic events.

Indian Trust Assets

There are no identified Indian Trust Assets in the project area, so there are no short-term impacts to the detriment of long-term protection of these assets for Native Americans.

Environmental Justice

There are no environmental justice impacts associated with use of the reservoirs or the rivers in either the short- or long-terms.

4.13.2 Alternative Action

Impacts in the short-term are similar to the proposed action and described above (Section 4.13.1). Since the specific water right holders and their geographic locations and service areas are not identified, it is possible that the following resources would be affected differently in either the short- or long-terms.

Surface Water

Implementation of the alternative action is accomplished by "taking" (via SWRCB administrative action) the water associated with the rights of junior appropriators as required to achieve the 1995 WQCP objectives. The amount of water required, and therefore the number of junior water right holders affected, varies each year depending upon the water year type (wet, above normal, etc.). Junior appropriators, high on the list (i.e., first to lose their water), could experience long-term significant losses of water deliveries and productivity as their water supply is continually called upon to meet fish attraction and pulse flow needs (except under wet conditions when supply exceeds all the demands). In addition, since it would be impossible to predict (with any degree of certainty) the type of water year in advance, long-term water supply reliability would be sacrificed to meet short-term (annual) needs. This could have significant consequences to productivity, as decision making under this uncertainty would preclude conventional planning and reliability of resources.

Groundwater

Other water right holders may rely more heavily on groundwater supplies to provide sufficient releases into the San Joaquin River system. Short-term use of substantial amounts of groundwater could affect the long-term productivity of the affected groundwater basins and the resultant problems of overdrafting, water levels, water quality, and subsidence.

Land Use

If any of the water right holders rely on water planned for municipal use, then deliveries to municipal water users would be affected in the short-term, based on hydrologic conditions. Short-term reductions in water deliveries would adversely affect the long-term reliability of water supples for municipal users which could affect population growth and the regional economy.

Recreation

Long-term impacts to boating occur on the San Joaquin River. In the short term, critically dry years, impacts occur to recreationists at New Don Pedro Reservoir.

4.14 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF NATURAL RESOURCES

Irreversible impacts are those which cause either directly or indirectly the use of natural resources so that they cannot be restored or returned to their original condition. For both the proposed action and the alternative action, these potential irreversible impacts are associated with consumption of resources: surface water, groundwater, land, and energy. Use of surface and groundwater may be mitigated, depending on the extent to which mitigation can be implemented. Changes in agricultural production could involve the potential loss of agricultural land under the alternative action. Both the proposed and alternative actions result in the loss or consumption of energy resources, either through reduced energy production (hydropower) and/or through additional energy consumption to pump groundwater (directly or indirectly).

4.15 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are those that cannot be mitigated. A summary of unavoidable adverse impacts for both the proposed and alternative action are as follows:

Proposed Action

- **Surface Water, Storage (Merced River)** - The carryover storage for Lake McClure would be reduced during below normal or dry hydrologic conditions.

- **Energy Resources** - Storage in Lake McClure would be decreased more than 10 percent during critical, dry, and below normal years during peak hydropower generation months.

Alternative Action

- **Surface Water, Storage (Tuolumne River)** - The carryover storage for New Don Pedro Reservoir would be reduced.

- **Surface Water, Storage (Merced River)** - The carryover storage for Lake McClure would be reduced during below normal or dry hydrologic conditions.

- **Recreation (San Joaquin River)** - Steam flows above the critical flow threshold for boating occur in all years.

4.16 GROWTH-INDUCING EFFECTS

Section 21100(b)(5) of CEQA requires that an EIR discuss the growth-inducing impacts of a proposed project. This requirement is further explained in the CEQA Guidelines Section 15126(g) which states that an EIR must address "the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly in the surrounding environment." In NEPA, growth-inducing impacts fall under the category of potential indirect effects. Indirect effects include those that occur later in time or farther away in distance, but are still reasonably foreseeable. Growth-inducing projects are those that remove obstacles to population growth or enourage and facilitate other activities that could stimulate growth later in time.

Section 4.6 discusses the effects of the proposed and alternative actions on population, population density, the regional economy and employment, and agricultural land use. Neither alternative would make additional water available to serve municipal and industrial development. Neither alternative would stimulate the economy to a significant level.

5. CONSULTATION AND COORDINATION

This chapter reviews agency consultation and coordination that occurred prior to and during preparation of this EIS/EIR. It also includes the list of agencies and individuals who received the Draft document. The consultation process began in December 1998 with a Notice of Preparation of an EIS/EIR (CEQA) and the comparable Notice of Intent under NEPA. Three public meetings were held in January 1998 to obtain input on issues and concerns to be evaluated in the EIS/EIR. A report on the public scoping process is included as Appendix E.

5.1 FISH AND WILDLIFE COORDINATION

5.1.1 Fish and Wildlife Coordination Act

The action proposed in this document is a joint activity of the U.S. Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service). In addition, Reclamation has coordinated closely with the Service and with the National Marine Fisheries Service (NMFS) on the preparation of this EIS/EIR. These activities have met any consultation/coordination requirements that may exist pursuant to the Fish and Wildlife Coordination Act.

5.1.2 Endangered Species Act

Reclamation and the Service are continuing close coordination for Endangered Species Act (ESA) compliance of all aspects of the Central Valley Project Improvement Act (CVPIA).

The Service and NMFS have been consulted regarding the effects of the proposed action on species listed pursuant to the ESA. For this proposed action, endangered species protections include compliance with existing ESA requirements, including the Service's 1995 and 1996 Biological Opinions for the Delta Smelt and the 1995 Biological Opinion for the Winter-run Chinook Salmon.

In April 1998, Reclamation requested assistance from the Service in identifying threatened, endangered, proposed, and candidate plant and animal species that may be located in the San Joaquin River project area. The Service responded in June 1998 with lists of species that may be present in or may be affected by projects in the subject project area. Using this information, Reclamation prepared this EIS/EIR for the proposed action; this document was used to initiate informal consultation. Appendix D presents a comprehensive list of sensitive species that may be present in the project area and whether they could be affected by the proposed and alternative actions. The results of this consultation have been incorporated into this EIS/EIR.

NMFS identified the fall/late fall-run chinook salmon as proposed-as-threatened and the steelhead as threatened species to be addressed. Critical habitat for chinook salmon has been proposed in the San Joaquin River Agreement (SJRA) project area of the San Joaquin River and its tributaries.

The provision of water for instream flow will improve conditions for fishery resources, including the proposed-as-threatened fall-run chinook salmon. Indirectly, this action will also improve conditions for other native species including the splittail. As a result of compliance with the existing Biological Opinions and further consultation with the NMFS, there are no anticipated adverse significant impacts to listed species including the threatened steelhead due to water supply activities. Reclamation believes that all possible adverse impacts to listed aquatic species from the 1999-2010 period of implementation of the proposed action have been addressed in existing biological opinions (or will be addressed in biological opinions that will be completed prior to taking a federal action). Consultation is continuing with the Service and NMFS to complete ESA compliance activities. Reclamation will complete Section 7 consultation pursuant to the Endangered Species Act for threatened Central Valley steelhead and all other required federal Endangered Species Act compliance activities before any final federal action is taken.

5.1.3 State Agency Coordination

CEQA requires that the Lead Agency must formally consult with responsible and trustee agencies in determining whether to prepare an EIR. The primary tool for this coordination is the preparation of a Draft EIS/EIR for review by state agencies. Section 5.4 is a list of all agencies receiving this document directly from Reclamation and the San Joaquin River Group Authority (SJRGA); however, additional State agencies may receive a copy directly from the State Clearinghouse.

Prior to release of the Draft EIS/EIR, an Administrative Draft EIS/EIR was sent to the Department of Fish and Game (DFG), the Regional Water Quality Control Board, and the Department of Water Resources (DWR). DFG biologists were consulted pursuant to the Fish and Wildlife Coordination Act and the California Endangered Species Act. In May 1998, the SJRGA requested assistance in developing species lists for the EIS/EIR. DFG started their participation on the steering committee in July 1998. This and other consultations will occur both prior to and during the public review of the Draft EIS/EIR and include agencies who comment on the Draft EIS/EIR.

5.2 COOPERATING AGENCY INVOLVEMENT

Federal, State, and local agencies involved with Reclamation and the SJRGA in the development of this EIS/EIR participated on a steering committee for development and review of NEPA/CEQA documentation for projects involving water supplies for flows on the San Joaquin River and its tributaries. These agency representatives are:

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Richard Jewell, Central Valley Fish and Wildlife Restoration Program

National Marine Fisheries Service

Laura Hamilton, Protected Resources Division
Dennis E. Smith, Protected Resources Division

California Department of Fish and Game

Jeff Single, Environmental Services Division

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Marc Van Camp, Merced Irrigation District
Richard Martin, South San Joaquin Irrigation District
Richard Moss, Friant Water Users Authority
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Allen Short, Modesto Irrigation District
William Johnston, Modesto Irrigation District
Walter Ward, Modesto Irrigation District
Art Godwin, Turlock Irrigation District
Steve Chedester, San Joaquin River Exchange Contractors Water Authority

All members of the SJRA steering committee have reviewed one or more drafts of this EIS/EIR.

The City and County of San Francisco, Public Utilities Commission, is cooperating with the SJRGA in developing solutions to Bay/Delta issues. Westlands Water District and the Metropolitan Water District have also participated on the committee and in review of preliminary CEQA/NEPA documentation.

5.3 LIST OF ENVIRONMENTAL COMMITMENTS

U. S. Bureau of Reclamation

As a member of the San Joaquin River Technical Committee, Reclamation will develop a flow regime for releases of purchased water in coordination with the SJRGA and DWR. By February 15 of each year, the operations plan will be developed and describe how the Vernalis Adaptive Management Plan (VAMP) and the other flows in the Agreement will be implemented in that year.

State Water Resources Control Board

The Parties' obligations under the San Joaquin River Agreement are conditioned upon the entry and enforcement by the California State Water Resource Control Board (SWRCB) of an order pursuant to Water Code Section 1707 or similar protection that prohibits (1) unauthorized diversions of any portion of the flows provided by the SJRGA's members pursuant to this Agreement until they pass Vernalis; and, (2) unauthorized diversions of any existing flow between SJRGA members' last point of control and Vernalis. Section 1707 petitions were filed on December 10, 1998.

There is no construction proposed nor would alterations of stream channels occur under the proposed action. No permit is required from the U.S. Army Corps of Engineers. There are no local or State permits required for the water purchases for release to the rivers.

5.4 DISTRIBUTION LIST

Recirculation of the Draft EIS/EIR is not necessary, because all of the comments received resulted in minor modifications to the Draft EIS/EIR. This Final EIS/EIR is being circulated to the commenters and interested parties for review and final comment during a 30-day no action period from February 5, 1999 through March 8, 1999 under NEPA (and a 10-day review from January 29, 1999 to February 9, 1999 under CEQA). The distribution list is provided on the following pages.

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6. COMPLIANCE REQUIREMENTS

This EIS/EIR was prepared in compliance with the appropriate federal, state, and local requirements. A brief description of applicable compliance requirements is discussed in the sections of this chapter.

6.1 FEDERAL

6.1.1 Central Valley Project Improvement Act (CVPIA)

As mentioned in Chapter 1, the CVPIA (Title XXXIV of Public Law 102-575) mandated changes in Central Valley Project management to protect, restore, and enhance fish and wildlife. The statutory obligations include increasing instream flows in Central Valley streams to provide for improved flow stability, and migration and attraction flow conditions for anadromous fish, in accordance with the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA.

The CVPIA directs the Secretary of the Interior to develop and implement a program in coordination with the Anadromous Fish Restoration Program (AFRP) to acquire water to supplement the up to 800,000 acre-ft of CVP yield dedicated for fish and wildlife purposes by Section 3406(b)(2); to assist the State of California in its efforts to protect the waters of the Bay-Delta estuary; and to help meet such obligations as may be legally imposed upon the CVP under state or Federal law subsequent to enactment of the CVPIA. The prescription for the dedicated water, commonly called "(b)(2) water," will vary depending on hydrologic conditions, and will be determined annually by the U.S. Fish and Wildlife Service (Service) through consultation with the U.S. Bureau of Reclamation (Reclamation). To the extent that (b)(2) water is either not available or insufficient to meet the fish and wildlife provisions of the CVPIA, supplemental water will be acquired under the authority of Section (b)(3) of the Act from willing sellers within the geographic area of need.

The proposed action is consistent with this provision of the CVPIA in that it seeks to implement the Act in the San Joaquin Valley under the authority of Section 3406 (b)(3).

6.1.2 Delta Smelt Biological Opinion

The Service's March 6, 1995 Biological Opinion for Delta Smelt, Delta Smelt Critical Habitat, and Proposed Threatened Sacramento Splittail limits CVP exports during the April and May 31-day spring pulse flow period to flows in the San Joaquin River at Vernalis. The Opinion also states that Reclamation will pursue acquisition of additional water. The proposed action will increase the ability of Reclamation to meet this objective in 1999-2010, and it would be implemented under this Biological Opinion.

6.1.3 National Environmental Policy Act

This EIS/EIR was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4321 *et seq.*). NEPA ensures that federal agencies will consider the environmental effects of their actions. It also requires that an EIS be included in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. This EIS/EIR provides detailed information regarding the No Action, Proposed Action, and the Alternative Action, the environmental impacts of each alternative, potential mitigation measures, and adverse environmental impacts that cannot be avoided (USBR 1997d).

6.1.4 Endangered Species Act

The Endangered Species Act (ESA) most recently amended in 1988 (16 USC 1536), establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the preservation of the ecosystems upon which they depend. Section 7(a) of the ESA requires federal agencies to consult with the Service and/or National Marine Fisheries Service (NMFS) on any activities that may affect any species listed as threatened or endangered (USBR 1997d). Sections 4.4 and 4.5 provide detailed discussions on any potential impacts and mitigation for terrestrial and aquatic resources which may result from the proposed or alternative actions. Consultations with these agencies is addressed in Section 5.1.2.

6.1.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) requires consultation with Service and consideration of these views and recommendations when any water body is impounded, diverted, controlled, or modified for any purpose. The Service and state agencies charged with administering wildlife resources are to conduct surveys and investigations to determine the potential damage to wildlife and the mitigation measures that should be taken. The Service may incorporate the concerns and findings of the state agencies and other federal agencies, including the NMFS, into a report that addresses fish and wildlife concerns and provides recommendations for mitigating or enhancing impacts to fish and wildlife affected by a federal project. Compliance can also be addressed by fully considering the Service's recommendations and integrating the Service into the development of the selection of the preferred alternative and mitigation actions (USBR 1997d). Compliance with the Coordination Act will be coordinated with consultation for ESA, as described above. Sections 4.4 and 4.5 provide detailed discussions on any potential impacts and mitigation for terrestrial and aquatic resources which may result from the proposed or alternative actions. Section 5.1.1 addresses coordination with the Service and NMFS.

6.1.6 Environmental Justice

Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission, by identifying and addressing disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority populations and low-income populations of the United States. (USBR 1997d)

This EIS/EIR evaluates the environmental, social, and economic impacts on minority and low-income populations in Section 4.11.

6.1.7 Indian Trust Assets

The United States Government's trust responsibility for Native American Natural resources requires that federal agencies take measures to protect and maintain trust resources. These responsibilities include taking reasonable actions to preserve and restore tribal resources. Indian Trust Assets (ITAs) are legal interests in property and rights held in trust by the United States for Native American tribes or individuals. Indian reservations, rancherias, and allotments are common ITAs. Section 4.10 provides a discussion on any potential impacts and mitigation for ITAs which may result from the proposed or alternative actions.

6.1.8 Indian Sacred Sites

Executive Order 13007 provides that in managing Federal lands, each federal agency with statutory or administrative responsibility for management of Federal lands shall, to the extent practicable and as permitted by law, accommodate access to and ceremonial use of Native American sacred sites by Native American religious practioners, and avoid adversely affecting the physical integrity of such sacred sites.

No sacred sites were identified during the scoping or planning process of the Draft PEIS (USBR 1997d) or the public scoping for this EIS/EIR. If sites are identified in future scoping efforts, efforts will be made to identify and protect the sacred sites.

6.1.9 National Historic Preservation Act

This project requires compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended and its implementing regulations, 36 CFR Part 800. Section 106 requires that federal agencies take into account the effects of their actions on properties that may be eligible for or listed in the National Register of Historic Places (NRHP). To determine whether an undertaking could affect NRHP-eligible properties, cultural resources (including prehistoric and historic

archeological sites and structures, buildings, and ethnographic resources) must be inventoried and evaluated for the NRHP. The second step is to identify the possible effects of proposed actions on any NRHP-eligible properties or cultural resources. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot be avoided, measures must be taken to minimize or mitigate potential adverse effects. In addition to compliance with Section 106, implementation of the project must also take into consideration the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act.

Due to the fact that two of the affected reservoirs, New Don Pedro and Lake McClure, were constructed before guidelines required cultural resources surveys, there may be cultural resources that are impacted by the proposed action or alternative action. If any resources are discovered, compliance under Section 106 would require that a survey be conducted (USBR 1997d). Section 4.7 provides a discussion on any potential impacts and mitigation for cultural resources which may result from the proposed or alternative action.

6.1.10 Flood Plain Management

Executive Order 11988 requires federal agencies to evaluate the potential effects of any actions they might take in a flood plain and to ensure that planning, programs, and budget requests reflect consideration of flood hazards and flood plain management. If a federal agency program will affect a flood plain, the agency must consider alternatives to avoid adverse effects in the floodplain or to minimize potential harm (USBR 1997d). Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative actions.

6.1.11 Wetlands Protection

Executive Order 11990 authorizes federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal's effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses (USBR 1997d). Section 4.4 provides a detailed discussion on any potential impacts and mitigation for terrestrial resources which may result from the proposed or alternative actions.

6.1.12 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act designates qualifying free-flowing river segments as wild, scenic, or recreational. The Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System, as well as rivers designated on the national Rivers Inventory. Under the Act, a federal agency may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a wild or scenic river. If the project would affect the free-flowing characteristics of a designated river or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area, such activities should be undertaken in a manner that would minimize adverse impacts and should be developed in consultation with the National Park Service. None of the proposed actions would affect flows in any designated wild and scenic rivers. (USBR 1997d)

6.1.13 Clean Water Act of 1977

The Clean Water Act (PL 95-217), through implementation by the U.S. Environmental Protection Agency (U.S. EPA), seeks to restore and maintain the chemical, physical, and biological integrity on the Nation's waters. The significant features of the Act include:

- the National Pollutant Discharge Elimination System (NPDES);
- technology based effluent limits;
- a program for imposing more stringent water quality based limits in permits to achieve state water quality standards;
- additional provisions applicable to certain toxic and other pollutant discharges of particular concern or special character; and
- a program of financial assistance to help fund publicly owned treatment works.

In addition to the elements described above, the Act prescribes special guidelines for protecting aquatic habitats, including wetlands and estuaries. It also provides several enforcement options to the U.S. EPA (Water Environment Federation 1997). Section 303(d) of the Clean Water Act requires that each state develop a list, known as a 303(d) list, of waterbodies that are impaired with respect to water quality. In 1996, California identified approximately 90 impaired waterbodies in its 303(d) list (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion of potential impacts and mitigation which may result from the proposed or alternative actions.

6.1.14 Memorandum on Farmland Preservation and the Farmland Protection Policy Act

The Farmland Protection Policy Act of 1981 (FPPA) and Memoranda on Farmland Preservation require federal agencies preparing EISs to include assessments of the effects of proposed projects on prime and unique farmlands. Before taking any action that would result in the conversion of designated prime or unique farmland for nonagricultural purposes, the federal agencies must examine the potential impacts of the proposed action and, if there are adverse effects on farmland preservation, consider alternatives to lessen those effects. Federal agencies must also ensure that their programs, to the extent possible, are compatible with state, local, and private programs for the protection of farmland (CALFED 1998). Section 4.6 mentions potential impacts for prime and unique farmlands which may result from the proposed or alternative actions.

6.1.15 Federal Agriculture Improvement and Reform Act of 1996 and 1985 Food Security Act

The Federal Agriculture Improvement and Reform Act of 1996, also known as the 1996 Farm Bill, includes conservation provisions designed to provide landowners with a variety of incentives programs and technical assistance for incorporating sound conservation practices into farming, grazing, and livestock operations. The 1996 Farm Bill replaces and incorporates portions of previous farm bills, including the Food Security Act of 1985 and the 1990 Farm Bill.

Under Title III, the Wetlands Reserve Program and the Conservation Reserve Program of the Food Security Act of 1985 are extended through 2002. Changes in the programs provide landowners with more options for protecting wetlands and highly erodible lands. Also addressed under Title III is a new Wildlife Habitat Incentives Program to help landowners improve wildlife habitat on private land. A Flood Risk Reduction Program was established to provide incentives to move farming operations from frequently flooded lands (CALFED 1998). Section 4.6 provides a discussion of potential impacts and mitigation for conservation of farmlands which may result from the proposed or alternative actions.

6.2 STATE

6.2.1 California Environmental Quality Act

The California Environmental Quality Act (CEQA) was enacted in 1970 and has six main objectives (California State CEQA Guidelines, California Administrative Code, Section 15000, et seq). These objectives are:

- disclose to decision makers and the public significant environmental effects of proposed activities;
- identify ways to avoid or reduce the environmental damage;
- prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures;
- disclose to the public reasons for agency approval of projects with significant environmental effects;
- foster interagency coordination in the review of projects; and
- enhance public participation in the planning process.

CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. This EIS/EIR provides detailed information regarding the No Action, Proposed Action, and the Alternative Action, the environmental impacts of each alternative, potential mitigation measures, and adverse environmental impacts that cannot be avoided. (USBR 1997d)

6.2.2 California Endangered Species Act

The California Endangered Species Act (CESA) provides for the protection and conservation of threatened and endangered species and their habitats. It is very similar to the Federal ESA. In general, CESA

- authorizes determination and listing of species as endangered or threatened;
- prohibits the take, possession, purchase, or sale of endangered, threatened or candidate species;
- provides authority for state agencies to purchase habitat for endangered and threatened species; and
- directs the California Department of Fish and Game (CDFG) to work closely with the Service and NMFS, to participate to the greatest extent practicable in Federal consultations, and to adopt the Federal biological opinion whenever possible.

The Natural Community Conservation Planning Act (California Fish and Game Code Section 2800, et seq.) provides for the preparation and implementation of large-scale natural resource conservation plans. A natural community conservation plan (NCCP) must identify and provide for "the regional or area wide protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth." NCCPs are intended to provide comprehensive management and conservation of multiple wildlife species including, but not limited to, species listed pursuant to the CESA, Section 2050, et seq. (CALFED 1998, California and Federal Endangered Species Act Compliance Technical Appendix)

6.2.3 State Historic Preservation Officer

Under any alternative involving a federal undertaking, Reclamation will consult with the California State Historic Preservation Officer (SHPO) about meeting the requirements of 36 CFR 800. Consultation with Reclamation and SHPO will address cultural resources identification, evaluation, effects, and possible mitigation needs (SWRCB 1998).

Due to the fact that two of the affected reservoirs, New Don Pedro and Lake McClure, were constructed before guidelines required cultural resources surveys, there may be cultural resources which are impacted by the proposed action or alternative action. Section 4.7 provides a detailed discussion on any potential impacts and mitigation for cultural resources which may result from the proposed or alternative action.

6.2.4 Delta Protection Commission

The Delta Protection Commission (DPC) is a state regional planning agency with authority over a 450,000 acre portion of the Legal Delta. The authorizing legislation (PRC Section 29700 et seq.) was passed in 1992. The DPC was charged with preparing a regional land use and resources management plan for the Primary Zone of the Delta to protect and enhance the three existing land uses: agriculture, wildlife habitat, and recreation. The plan was adopted in 1995. Local governments are required to ensure that their general plans are in conformance with the regional plan; local general plan amendments were completed in 1997 (CALFED 1998). Section 4.6 provides a detailed discussion on any potential impacts and mitigation for local plans which may result from the proposed or alternative action.

6.2.5 The Delta Protection Act of 1959

The Delta Protection Act of 1959 requires adequate water supplies for multiple uses (for example, agriculture, industry, urban, and recreation) within the Delta and for export. Various water quality and flow objectives have been established by the State Water Resources Control Board (SWRCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) since the passing of this Act. (CALFED 1998) Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative action.

6.2.6 Porter-Cologne Act

In 1967, the Porter-Cologne Act established the SWRCB and nine regional boards as the state agencies with primary authority over the regulation of water quality and allocation of appropriative surface water rights in California. The Porter-Cologne Act is the primary state water quality legislation administered by SWRCB and provides the authority to establish water quality control

plans that are reviewed and revised, as well as statewide plans. Water quality control plans, also known as basin plans, designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses. In acting on water rights applications, the SWRCB may establish terms and conditions in a permit to carry out water quality control plans (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion on any potential impacts and mitigation for surface water and groundwater resources which may result from the proposed or alternative action.

6.2.7 D-1485 and the 1978 Water Quality Control Plan

In 1978, SWRCB adopted the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh (1978 Delta Plan). At the same time, SWRCB adopted Water Right Decision D-1485, which required compliance with water quality objectives in the 1978 Delta Plan, that were designed to protect natural resources by maintaining Delta conditions as they would exist in the absence of the CVP and State Water Project (SWP). D-1485 also required monitoring and study of the Delta aquatic resources. In 1978, legal challenges were brought against D-1485 and the 1978 Delta Plan. In 1986, the State was required to revise its water quality standards. Pursuant to that decision, SWRCB implemented a hearing process, known as the Bay-Delta hearings, to review and amend the 1978 Delta Plan. Following this hearing process, SWRCB issued revised water quality objectives in the 1991 Delta Water Quality Control Plan for Salinity, Temperature and Dissolved Oxygen (1991 Delta Plan). The SWRCB conducted a water right hearing to receive evidence and recommendations on measures to protect fish and wildlife. After the hearing, the SWRCB released a draft water right decision, draft D-1630, that included interim water right terms and conditions. Actions taken by the NMFS and the Service to protect winter-run chinook salmon and Delta smelt resulted in the withdrawal of D-1630. Several of the concepts from D-1630 have been partially adopted in other actions taken by SWRCB, Department of Water Resources (DWR), Reclamation, fishery protection agencies, and other regulatory agencies (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion on any potential impacts and mitigation for surface water and groundwater resources which may result from the proposed or alternative action.

6.2.8 1995 Water Quality Control Plan (WQCP)

In 1994, SWRCB initiated development of new water quality objectives and released a draft version, the same day the Bay-Delta Accord was signed. SWRCB subsequently released an environmental report that documented the effects of implementing the plan. The WQCP was adopted in May 1995 (1995 WQCP) and incorporated several elements of EPA, NMFS, and Service regulatory objectives for salinity and endangered species protection. The 1995 WQCP objectives are expected to be implemented with a new water-rights decision in 1998. The major changes associated with the WQCP in relation to the 1978 and 1991 WQCPs and associated D-1485 requirements are as follows:

- Water-year classifications are based on the 40-30-30 Sacramento Valley Four-River Index and the 60-20-20 San Joaquin Valley Four-River Index. The outflow requirements from February through June depend on the previous month's Eight-River Index runoff volume.

- Delta outflow requirements are the combination of fixed monthly requirements and estuarine habitat requirements (expressed in terms of "X2", the position of the 2-parts-per-thousand [ppt] salinity gradient). Because the X2 requirements in the 1995 WQCP depend on the previous month's Eight-River Index runoff, the required outflow must be calculated for each month.

- Combined SWP and CVP Delta exports are limited to a percentage of the Delta river inflow (which does not include rainfall). These percentages are in the range of 35 to 45 percent depending on the Delta inflow from February through June and 65 percent for the remainder of the year. Export pumping during the pulse-flow period was limited to an amount equivalent to the pulse flow during half of April and half of May. (CALFED 1998)

Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative actions.

6.2.9 Water Rights

Water use in California is characterized by two basic types of water rights: riparian water rights and appropriative water rights. Riparian water rights are based on ownership of land adjacent to a waterbody, while appropriative water rights are based on the principle of "first in time, first in right" and are not related to riparian land ownership.

Riparian water rights are not lost if not used and are not quantified unless they are adjudicated. Landowners with these rights can divert portions of the natural waterflow for reasonable and beneficial use on their land, provided the land is located within the same watershed as the waterbody and on the smallest parcel adjacent to the waterbody. During times of water shortage, all riparian water rights holders must share the available supply according to each landowner's reasonable requirements and uses (California's SWRCB, 1989).

Appropriative water rights are quantified and may be lost if not used. Appropriative water rights obtained after 1914 require permits and licenses issued by the SWRCB. All existing rights before 1914 have seniority based on the date when they were initiated. The SWRCB issues appropriative rights with conditions to protect other water rights holders, including Delta and upstream riparian water users, and to protect the public interest, including fish and wildlife resources. The quantity and quality of water used by existing riparian and senior appropriative users can only be limited by

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subsequent appropriations in limited circumstances where the senior rights are not legally injured. (CALFED 1998)

6.2.10 National Primary Drinking Water Standards

The National Primary Drinking Water Standards or maximum contaminant levels (MCLs) are the maximum permissible levels of contaminants in water that enters the distribution system of a public water system. The federal and state MCLs are enforceable and must be met by appropriate public drinking water systems. National maximum contaminant level goals (MCLGs) are the maximum levels of contaminants in drinking water at which no known or anticipated adverse effect on the health of persons would occur and which allow an adequate margin of safety. MCLGs are non-enforceable health goals and are strictly health based. Action levels (ALs) are health-based numbers that take into account analytical detection levels. They are interim guidance levels that may trigger mitigation action on the part of a water purveyor. An AL is dropped once an MCL is promulgated and final. (CALFED 1998)

6.2.11 National Secondary Drinking Water Standards

National Secondary Drinking Water Standards, or secondary MCLs, were established by the EPA in 1979 and 1991. The secondary MCLs are maintained to protect public welfare and to assure a supply of pure, wholesome, and potable water. They are applied at the point of delivery to the consumer and generally involve protection of the taste, odor, or appearance of drinking water. Federal secondary MCLs are nonenforceable; however, state secondary MCLs are enforceable for all new systems and new sources developed by existing systems. (CALFED 1998)

6.2.12 California Nonpoint Source Program

Two primary federal statues, Clean Water Act (CWA) §319 and Coastal Zone Act Reauthorization Amendments (CZARA) §6217, along with the Porter-Cologne Act, establish a framework for addressing nonpoint source (NPS) pollution in California. As enacted by Congress in 1987, CWA §319 required California to develop an assessment report detailing the extent of nonpoint pollution and a management program specifying nonpoint source controls. In 1990, Congress passed §6217 that requires the state to "develop and implement management measures for nonpoint source pollution to restore and protect coastal waters..." which is to serve as an update and expansion of the existing NPS program.

In 1994 the State initiated a comprehensive process to consider the requirements of CZARA and update the existing statewide Nonpoint Source Program rather than create a separate program dealing specifically with coastal waters. The State's updated program calls for managing nonpoint sources

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on a watershed basis and focuses on Nonpoint source problems associated with pesticides, grazing, urban runoff, hydromodification, and abandoned mines. (CALFED 1998)

6.2.13 Bay-Delta Framework Agreement and the Bay-Delta Accord

In June 1994, a Bay-Delta Framework Agreement was signed by the Federal Ecosystem Directorate and the Governor's Water Policy Council of the State of California. The framework established a comprehensive program in the Bay-Delta estuary for coordination and cooperation of environmental protection and water supply. It addressed three major areas of agreement including formulation of a new WQCP acceptable to both EPA and SWRCB, coordination of SWP and CVP operations in order to rapidly respond to environmental conditions in the Delta with an adaptive management approach, and implementation of a long-term management approach integrating objectives for water supply and environmental protection. The Principles for Agreement, or Bay-Delta Accord, was signed on 15 December 1994.

In addition, the Bay-Delta Accord calls for early implementation of certain ecosystem restoration projects before the comprehensive solution is finalized. Funding for these projects has come from Proposition 204, passed by California voters in 1996, from the California Bay Delta Environmental Enhancement Act, passed by Congress in 1996, and from voluntary contributions from urban water agencies. (CALFED 1998)

6.3 LOCAL

The proposed action will take place on the San Joaquin River system which is located in the following counties: San Joaquin, Stanislaus, Merced, Fresno, Madera, Mariposa, and Tuolumne. Each county and city is required by Section 65300 of the California Government Code to have a comprehensive, long-term general plan for the physical development of the county and city. Mandatory elements of the general plan that have bearing on the proposed action are land use, open space, and conservation. Additional optional plan elements may include agriculture.

This section of the EIS/EIR summarizes key goals and policies in these counties, where most of the proposed action of additional stream flows and deliveries to wetland habitats occur and could potentially impact local communities and businesses. Since the proposed action does not involve urban development, key issues are whether the water purchases are consistent with county policies for resource conservation and support of agriculture. In conclusion, the proposed action is consistent with county goals, objectives, and policies as presented in the following sections.
The goals and objectives of each county which are relevant to the proposed action are summarized below (Table 6.3-1). The full text of each county's objectives and policies relevant to the proposed action is contained in Appendix F.

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Table 6.3-1: COUNTY GENERAL PLAN POLICY SUMMARY

County	Goals and Objectives
San Joaquin	Protect and improve the county's vegetation, fish, and wildlife resources. Provide undeveloped open space for nature study, protection of endangered species, and preservation of wildlife habitat.
Stanislaus	Conserve water resources and protect water quality in the county. Provide for the long-term conservation and use of agricultural lands. Protect fish and wildlife species in the county. Protect the natural resources that sustain agriculture in Stanislaus County.
Merced	Protect rare and endangered species from urban development and recognize them in rural areas. Protect surface and groundwater resources from contamination, evaporation an inefficient use. Support measures to protect and improve water quality.
Fresno	Preserve and enhance the value of the river environment as a multiple use, open space resource. Maintain the environmental and aesthetic qualities of the area. Protect the quality and quantity of the surface water and ground water resources. Conserve and enhance the natural wildlife habitat. Preserve and enhance areas of significant natural resources, the retention of which is necessary to maintain the environmental quality and economic potential of the area. Manage vegetation and wildlife resources in a responsible and productive manner. Protect the habitats of plants and wildlife from unnecessary activities of man.
Madera	Promote the wise, efficient, and environmentally-sensitive use of county land to meet the present and future needs of county residents and businesses. Protect and enhance the natural quality of county's streams, creeks and groundwater. Protect wetland communities and related riparian areas throughout Madera County as valuable resources.

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Table 6.3-1: COUNTY GENERAL PLAN POLICY SUMMARY (CONT.)

County	Goals and Objectives
Madera	Protect, restore, and enhance habitats that support fish and wildlife species so as to maintain populations at viable levels. Preserve and enhance open space lands to maintain the natural resources of the county.
Mariposa	Provide for the identification, delineation, description, and maintenance of vegetative types and related wildlife habitats in order to maintain the inherent diversity of both vegetation and wildlife species in Mariposa County for the recreational, commercial, and aesthetic enjoyment of both present and future residents and visitors to the county. Enhance the natural open space resources of Mariposa County to include preservation of natural resources, managed production of resources, outdoor recreational resources and open space for public health and safety, for the benefit of present and future residents of the county and visitors to the area.
Tuolumne	Conserve the quality and quantity of the county's water resources, while protecting the rights of the land owner. Conserve public water resource areas with high recreational value for future public use.

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7. PREPARERS OF EIS/EIR

The following personnel were directly involved in the preparation of the EIS/EIR.

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Technical and support personnel from EA Engineering, Science, and Technology and other firms who were involved in document preparation are listed in Table 7-1.

Table 7-1: LIST OF TECHNICAL AND SUPPORT PERSONNEL

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
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Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
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APPENDIX A

HYDROLOGIC ANALYSIS
SAN JOAQUIN RIVER AGREEMENT

Hydrologic Analysis

San Joaquin River Agreement

Prepared for the
United States Bureau of Reclamation and
San Joaquin River Group Authority

By
Daniel B. Steiner, Consulting Engineer
September, 1998

HYDROLOGIC ANALYSIS - SAN JOAQUIN RIVER AGREEMENT

I. INTRODUCTION

Several interests, including the Department of Interior (Interior) , the San Joaquin River Group Authority and its members, the Department of Water Resources and the Department of Fish and Game, and Central Valley Project/State Water Project Export Interests have developed the San Joaquin River Agreement (SGRA) which provides for a San Joaquin River flow and SWP/CVP export study during the April-May pulse flow period to gather better scientific fisheries information on the lower San Joaquin River while at the same time provide environmental benefits in the lower San Joaquin River and Delta.

The proposed project/action is the acquisition of water by Interior from the San Joaquin River Group Authority and its members to provide a pulse flow at Vernalis during April and May, and the acquisition of other water identified by the SJRA. The water is needed to support the Vernalis Adaptive Management Plan (VAMP) during the pulse flow period and to assist Interior in meeting the Anadromous Fish Restoration Plan, Bay-Delta flow objectives and the U.S. Fish and Wildlife Service 1995 Biological Opinion for Delta Smelt.

As part of the VAMP, Central Valley Project (CVP) and State Water Project (SWP) exports during the VAMP test period (April/May) will be managed to specified levels. These levels in relation to Vernalis flows are less than allowed under current regulatory requirements. The San Joaquin River Agreement provides for the development of an operations plan acceptable to all parties including address of export reductions caused by VAMP.

This technical report presents the results of an analysis that models potential hydrologic effects of an action under which Interior purchases water identified by the SJRA.

II. DESCRIPTION OF THE PROPOSED PROJECT/ACTION

The proposed project/action is acquisition of water by Interior from certain San Joaquin River Group Authority (SJRGA) members for use as a pulse flow at Vernalis during April and May, and the acquisition of other water for use during other times of the year. The SJRGA members that will be providing water are Modesto Irrigation District (MID), Turlock Irrigation District (TID), Merced Irrigation District (Merced), South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors). This water is intended to supplement flows of the San Joaquin River during the next twelve years, 1999 through year 2010.

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The water provided by the SJRGA will be provided by several potential means, including the increase of flows from tributary reservoirs, the bypass of diversions, indirect substitution of groundwater, reduction of applied surface water, and increased system efficiency.

Water Made Available Through the SJRA

Four components of water will be provided by the SJRGA members:

- Up to 110,000 acre-feet per year towards meeting the VAMP flow target. Water provided under this component will be divided among the SJRGA members. This water is to only be used during the VAMP 31-day test flow period;

- Additional water from willing SJRGA members to achieve full flow targets;

- Additional water from Merced (12,500 acre-feet) during October of all years. This flow will be provided above the "existing flow" in the Merced River during October.

- Additional water from OID (15,000 acre-feet) every year to be available to Reclamation. In addition to this water, any of the (up-to) 11,000 acre-feet of OID VAMP water not provided towards meeting the VAMP flow target is also available to Reclamation.

Determination of VAMP Water

The SJRA defines the determination of water to be provided for VAMP by the SJRGA's members. The SJRGA members will provide, during the pulse flow period, the amount of water needed to achieve the VAMP flow target or 110,000 acre-feet, whichever is less. The water provided by the SJRGA members will be determined as the sum of flows released in excess of flows which would otherwise have been released during the pulse flow period.

The VAMP flow target is determined by a series of procedures and conditions based on the flow at Vernalis which would occur in the absence of the SJRA ("existing flow"), and the San Joaquin Valley Water Year Hydrologic Classification. The SJRA provides a VAMP flow target that will be incrementally larger than the existing flow at Vernalis consistent with the following table:

San Joaquin Valley
Water Year Hydrologic Classification

The San Joaquin Valley Water Year Hydrologic Classification was developed as an index of wetness and water supply availability within the San Joaquin River basin. The index is mathematically derived as the summation of 0.6 times the current year's April through July San Joaquin Valley unimpaired runoff plus 0.2 times the current year's October through March unimpaired runoff plus 0.2 times the previous year's index (with the previous year's index capped at 4.5 million acre-feet). The index is commonly referred to as the 60-20-20 Classification. The streams used in the index are the Stanislaus, Tuolumne and Merced rivers and the San Joaquin River at Friant. The index defines five different year types: wet, above normal, below normal, dry and critical.

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Existing Flow At Vernalis (cfs)	VAMP Test Flow Target (cfs)
0 to 1,999	* 2,000
2,000 to 3,199	3,200
3,200 to 4,449	4,450
4,450 to 5,699	5,700
5,700 to 7,000	7,000

* For the purpose of determining water to be provided by the SJRGA's members. The VAMP Test Flow Target is 3,200 cfs.

The SJRA assigns a numeric adjunct (60-20-20 Indicator) to the San Joaquin Valley Water Year Hydrologic Classification: a wet year is assigned the numeric value of 5, an above normal year is assigned the numeric value of 4, a below normal year is assigned the numeric value of 3, a dry year is assigned the numeric value of 2, and a critical year is assigned the numeric value of 1. In any year when the sum of the current year's 60-20-20 Indicator and previous year's 60-20-20 Indicator is seven (7) or greater, the 31-day flow target will be the flow target one level higher than that established by the table described above (e.g., if the existing flow is 3,500 cfs then the flow target will be 5,700 cfs). This condition is referred to as a "double-step".

As described above, the SJRGA members will provide up to 110,000 acre-feet of water to achieve the VAMP flow target. The SJRA also provides for relaxation of this obligation during sequential dry-year periods (if such a period were to occur during the term of the SJRA). During years when the sum of the current year's 60-20-20 Indicator and the previous two years' 60-20-20 Indicator is four (4) or less (a sequence of dry and critical years), the SJRGA members will not be required to provide water above the existing flow.

Assumed Division of Flow

The SJRGA members have executed an agreement (the "Division Agreement") that identifies the division of the water to be provided for the proposed project/action. The hierarchy for the provision of flow by the SJRGA members is consistent with the following table:

Division of VAMP Pulse Flow Water (AF)					
Entity (in order of providing flow)	First 50,000 AF	Next 23,000 AF	Next 17,000 AF	Next 20,000 AF	Totals
Merced	25,000	11,500	8,500	10,000	55,000
OID/SSJID	10,000	4,600	3,400	4,000	22,000
Exchange Contractors	5,000	2,300	1,700	2,000	11,000
MID/TID	10,000	4,600	3,400	4,000	22,000

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This component of contribution will draw from each member up to the following maximum amounts of water: Merced, 55 TAF; OID, 11 TAF; SSJID, 11 TAF; Exchange Contractors, 11 TAF; MID, 11 TAF; and TID, 11 TAF. For the other components of water, an individual entity is responsible. Although the above described hierarchy for providing VAMP flows is established by the Division Agreement, the agreement also allows for other arrangements between the members to provide water, so long as the VAMP pulse flow is met.

III. MODELING

This analysis was conducted to evaluate a range of potential hydrologic effects attributable to the proposed project/action. The SJRA has a term of 12 years (unless extended); however, the hydrologic character of the next 12 years can not be predicted. To evaluate a range of conditions and hydrologic impacts that may occur, the SJRA was evaluated using a long-term hydrologic sequence, the hydrology of the period 1922 through 1992. Within that period of record various sequences of hydrologic events occurred ranging from flood to extended periods of drought.

Two primary operational settings were developed, the No-action setting and the Proposed Project/Action setting. The No-action setting depicts an environment representative of existing hydrology and operations within the Bay-Delta watershed absent the SJRA. This setting includes the CVP and SWP meeting the 1995 Water Quality Control Plan and biological opinions for winter run Chinook salmon and Delta Smelt. Operations for the San Joaquin River include Reclamation operating New Melones to the Interim Plan of Operations, and due to limited availability of water from New Melones the water quality and flow objectives of the 1995 Water Quality Control Plan for the San Joaquin River are not always met.

The Proposed Project/Action setting depicts the performance of the SJRA if it were in place for the entire 71 years of sequential hydrology. The elements of the SJRA that are directly evaluated are the 110,000 acre-feet component of VAMP water, and the Merced October flows, and the OID reallocation water.

Operation Simulation Models

This analysis relied on the interface of three hydrologic models to simulate the potential hydrologic effects of the proposed project/action.

San Joaquin Area Simulation Model (SANJASM)

The Bureau of Reclamation's (Reclamation) SANJASM provided the simulation of the San Joaquin River upstream of the confluence of the Stanislaus River, including the hydrology of west side San Joaquin Valley CVP deliveries.

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Stanislaus Operations Model (STNMODAM version)

Reclamation's STNMODAM spreadsheet model provided the simulation of Stanislaus River operations under assumptions of Reclamation's Interim Plan of Operation for New Melones.

Projects Simulation Model (PROSIM)

Reclamation's PROSIM provided the simulation of the CVP and SWP, and the Bay-Delta.

Results of PROSIM are dependent on the flow at Vernalis resulting from SANJASM and STANMODAM. However, the flow and water quality at Vernalis are determined by SANJASM and STANMODAM for which those results are partially dependent on the results of PROSIM. This interaction between the models requires an iterative series of simulations to reach a point of closure between the models. Figure 1 illustrates the interaction between the models. The iteration begins with developing a simulation of non-Stanislaus River hydrology, e.g., the operation of the Merced and Tuolumne Rivers. From that result, non-Stanislaus River flow and water quality information are provided to Reclamation's STNMODAM for integration with a Stanislaus River operation that is consistent with Reclamation's Interim Plan of Operation for New Melones. The results of that step then provide the simulation of flow and water quality conditions at Vernalis, which is then provided to PROSIM for simulation of the CVP and SWP and west side San Joaquin Valley deliveries. The results of that PROSIM study are then re-entered into San Joaquin River operations for a redetermination of Vernalis flows and quality. A PROSIM study is then rerun to provide closure between the revised Vernalis flow and quality conditions and CVP and SWP Delta operations.

Although there is only the No-action and Proposed Project/Action settings, four simulations were performed. Due to a combination of modeling constraints (average monthly hydrologic data and a monthly modeling time-step) and the potential for the VAMP test flow period being established anytime during the April through May period, the No-action and Proposed Project/Action were each modeled to occur entirely during the month of April <u>or</u> May.

Modeling Assumptions - No-action Setting

New Melones Reservoir is assumed to operate consistent with the Interim Plan of Operation as modeled within STNMODAM, with the out-migration pulse flow focused during either the month of April or May. As hydrologic and operational conditions of the San Joaquin River upstream of the mouth of the Stanislaus River change with each analysis, the operation of the Stanislaus River will sometimes change as the result of water quality operations.

The allocation of annual water supplies to the uses of fishery, Vernalis water quality, Bay-Delta, and CVP contractors was assumed as follows, dependent on the water supply of New Melones:

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New Melones Allocation of Supplies (1,000 acre-feet)									
New Melones Storage Plus Inflow		Fishery		Vernalis Water Quality		Bay-Delta		CVP Contractors	
From	To	From	To	From	To	From	To	From	To
0	1,400	0	98	0	70	0	0	0	0
1,400	2,000	98	125	70	80	0	0	0	0
2,000	2,500	125	345	80	175	0	0	0	59
2,500	3,000	345	467	175	250	75	75	90	90
3,000	6,000	467	467	250	250	75	75	90	90

Allocations to OID and SSJID were assumed consistent with their 1988 agreement with Reclamation.

The Merced and Tuolumne River reservoir systems are modeled to operate to meet diversion demands and minimum instream flow requirements. The FERC required spring pulse flows for the Tuolumne River are assumed to be scheduled coincident with the period of desired supplemental flow in the San Joaquin River (April or May). Releases in excess of minimum flow requirements on the tributaries occasionally occur in accordance with flood control storage reservation requirements.

Primary assumptions for the hydrology and operation of the SWP and CVP include the following:

- Implementation of the State Water Resources Control Board's 1995 Water Quality Control Plan through the operations of the SWP and CVP. At times, full compliance to San Joaquin River flow and quality objectives does not occur. Combined SWP/CVP exports are allowed to pump up to 100 percent of the flow occurring at Vernalis during the spring pulse flow period;

- Delta Smelt and winter run chinook salmon Biological Opinions for the SWP and CVP;

- November 1997 AFRP actions for instream flows in Clear Creek and below Keswick and Nimbus reservoirs, and a Trinity River maximum required release of 340 TAF. No additional AFRP Delta actions other than the 1995 WQCP;

- Current level of hydrology and operations in the San Joaquin Valley, including delivery of Level 4 refuge supplies.

The No-action setting modeling results in Vernalis flow conditions that define the "existing flow" for the SJRA. The results also define the SWP/CVP export levels which are associated with a pre-

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SJRA setting. The Vernalis flow simulated from this setting is used to calculate the VAMP flow to be provided by the SJRGA members.

Modeling Assumptions - Proposed Project/Action Setting

Subsequent to the determination of the water to be provided by the SJRGA members for the VAMP, and its division among the members, a series of procedures to simulate the Proposed Project/Action setting were employed. These procedures are described as follows.

Water originating from Merced is assumed to occur as increased stream releases from New Exchequer Dam. This release is modeled as an increase in flow above the release which would otherwise be made in the absence of the proposed project/action. Merced's VAMP contribution is added to the Merced River flow that occurred within the No-action simulation. Merced's additional provision of water during October is depicted by increasing Merced's minimum flow requirement during October by 12,500 acre-feet. In certain sequential critical year sequences, surface water diversions by Merced are reduced to accommodate the additional stream releases.

Water originating from MID and TID is also modeled as additional stream releases, in this case from New Don Pedro Dam. As with the Merced release, this release is modeled as an increase in flow above the release which would otherwise be made in the absence of the proposed project/action.

VAMP water originating from OID and SSJID is assumed to occur two different ways: 1) if lower Stanislaus River flow from Goodwin is less than 1,500 cfs, OID and SSJID flows are modeled to occur as an increase in releases below Goodwin, but will not in combination with the existing flow at Goodwin exceed the 1,500 cfs objective, or 2) when Goodwin releases are 1,500 cfs, it is assumed that OID and SSJID will provide their respective flow through diversion bypass via a "hydraulic means" that will not frustrate the 1,500 cfs flow objective on the Stanislaus River. This "hydraulic means" is currently assumed to be a conveyance of water from OID and SSJID to MID occurring over several months and MID releasing the OID/SSJID component of VAMP pulse flow to the Tuolumne River.

Water originating from the Exchange Contractors is assumed to occur as an incremental additional accretion to San Joaquin River near the mouth of the Merced River.

Under the Proposed Project/Action setting, New Melones is assumed to operate consistent with the allocations of the Interim Plan of Operation as described above for the No-action setting with the exception that subsequent to the determination of water available to OID and SSJID, 15,000 acre-feet plus any unrequired VAMP flow from OID (up to 11,000 acre-feet) will be reduced from OID's allocation and diversion. The reduction in diversion will result as additional storage in New Melones and be subsequently reallocated to other uses in subsequent years consistent with the allocations of the Interim Plan of Operation.

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OID/SSJID VAMP water that is released at Goodwin to the Stanislaus River (within the 1,500 cfs flow objective) and OID water that is reduced from OID's allocation of New Melones supplies are assumed as reductions to OID's diversions during the months of March, April, September and October.

Hydrology and operation assumptions of the CVP and SWP are the same between the No-action setting and the Proposed Project/Action setting.

Adjustment of New Melones Operations due to Reallocation of OID Water

As a result of OID decreasing its diversion of its entitlement from Reclamation, the allocation of water to the fishery (and other uses) increases. In instances when the No-action release to the Stanislaus River was less than 1,500 cfs, this additional allocation of fishery water would result in releases from Goodwin to the Stanislaus River higher than would occur without the OID reallocated water. If left unadjusted, this revised Goodwin release in combination with the VAMP flows provided by the SJRGA members would overshoot the Vernalis flow target. This occasional occurrence was remedied by shifting any excess in Vernalis flow caused by the OID reallocation water from the assumed month of VAMP to the other potential pulse flow month.

IV. SIMULATIONS AND RESULTS

Results of this analysis are available from Reclamation upon request (hard copy) and are accessible from the Internet at *www.mp.usbr.gov.mp140.vampdir.html*. The following listed files contain the results of the SANJASM and STANMODAM simulations of the No-action and Proposed Project/Action settings.

<u>No-Action Setting - April</u>

VAB_IT3.BIN	(SANJASM binary output file)
VAB_IT3.WK4	(STANMODAM spreadsheet)

<u>No-Action Setting - May</u>

VMB_IT3.BIN
VMB_IT3.WK4

<u>Proposed Project/Action Setting - April</u>

VAP_IT1.BIN
SJRA_A_1.WK4

<u>Proposed Project/Action Setting - May</u>

VMP_IT1.BIN
SJRA_M_1.WK4

Numerous hydrologic parameters can be extracted from these data files. Table 1 lists the parameters that were extracted for consideration. Figure 2 provides a geographical representation of the area analyzed by the studies, and the general location of the parameters depicted in the modeling.

Additional information not directly included in the previously described data files is provided in Tables 2 through 5. Table 2 provides a listing of the San Joaquin Valley Water Year Hydrologic Classification for the years 1922 through 1992. Table 3 and Table 4 illustrate the determination of VAMP pulse flow water for the months of April and May, respectively, and Table 5 illustrates the modeled division of VAMP pulse flows between the SJRGA's members.

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Figure 1
Representation of Interaction Between Modeling Tools

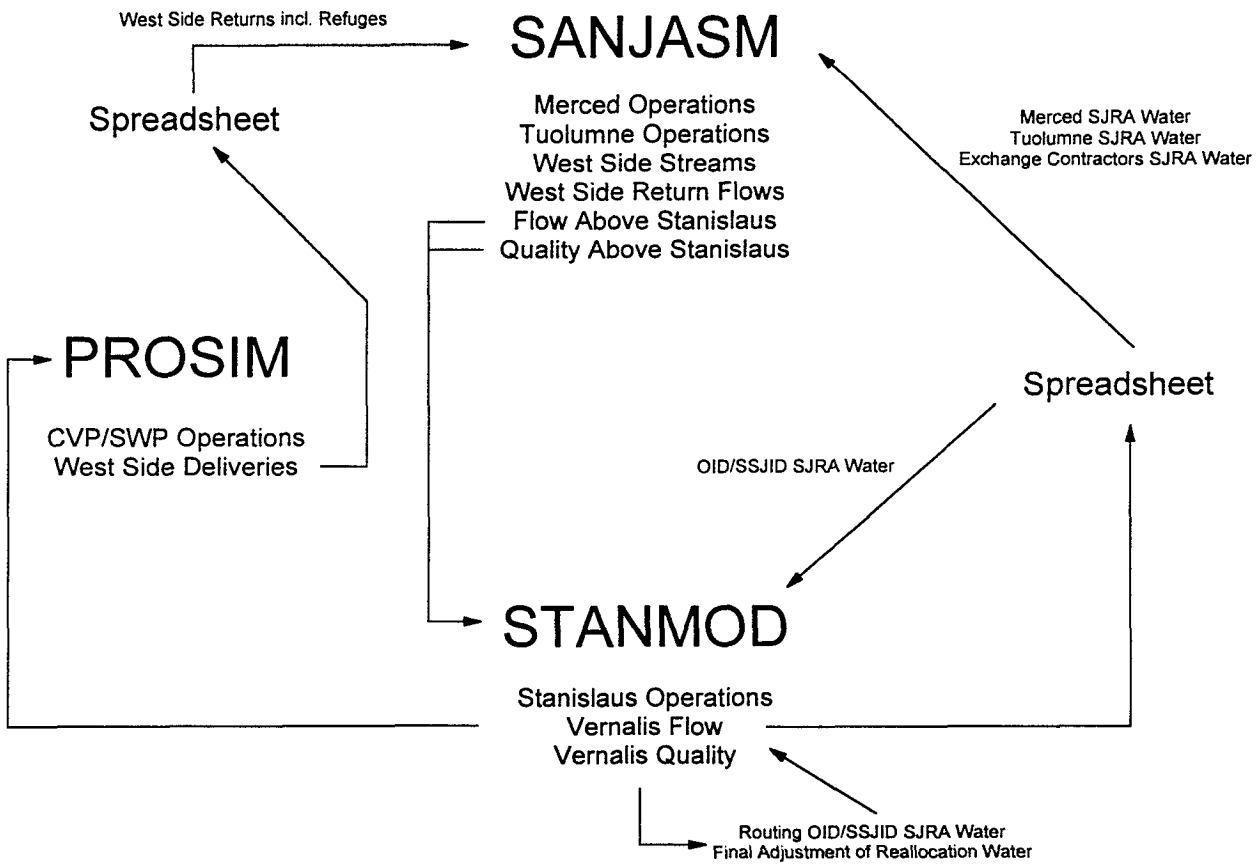


Table 1
Hydrologic Analysis Parameters
(Page 1/2)

Stanislaus River

New Melones Storage (TAF)
- 1 April No-action
- 2 April Proposed Action
- 3 April - difference
- 4 May No-action
- 5 May Proposed Action
- 6 May - difference

Goodwin Release to River (cfs)
- 7 April No-action
- 8 April Proposed Action
- 9 April - difference
- 10 May No-action
- 11 May Proposed Action
- 12 May - difference

New Melones Fish Release (TAF)
- 13 April No-action
- 14 April Proposed Action
- 15 April - difference
- 16 May No-action
- 17 May Proposed Action
- 18 May - difference

New Melones WQ Release (TAF)
- 19 April No-action
- 20 April Proposed Action
- 21 April - difference
- 22 May No-action
- 23 May Proposed Action
- 24 May - difference

New Melones Bay-Delta Release (TAF)
- 25 April No-action
- 26 April Proposed Action
- 27 April - difference
- 28 May No-action
- 29 May Proposed Action
- 30 May - difference

New Melones DO Release (TAF)
- 31 April No-action
- 32 April Proposed Action
- 33 April - difference
- 34 May No-action
- 35 May Proposed Action
- 36 May - difference

New Melones CVP Delivery (TAF)
- 37 April No-action
- 38 April Proposed Action
- 39 April - difference
- 40 May No-action
- 41 May Proposed Action
- 42 May - difference

New Melones Optional Delivery (TAF)
- 43 April No-action
- 44 April Proposed Action
- 45 April - difference
- 46 May No-action
- 47 May Proposed Action
- 48 May - difference

Tuolumne River

New Don Pedro Storage (TAF)
- 49 April No-action
- 50 April Proposed Action
- 51 April - difference
- 52 May No-action
- 53 May Proposed Action
- 54 May - difference

La Grange Release to River (cfs)
- 55 April No-action
- 56 April Proposed Action - Including Routed Water from OID/SSJID
- 57 April - difference
- 58 May No-action
- 59 May Proposed Action - Including Routed Water from OID/SSJID
- 60 May - difference
- 61 April Proposed Action - Routed Water from OID/SSJID
- 62 May Proposed Action - Routed Water from OID/SSJID

Merced River

New Exchequer Storage (TAF)
- 63 April No-action
- 64 April Proposed Action
- 65 April - difference
- 66 May No-action
- 67 May Proposed Action
- 68 May - difference

Merced River below Diversion (cfs)
- 69 April No-action
- 70 April Proposed Action
- 71 April - difference
- 72 May No-action
- 73 May Proposed Action
- 74 May - difference

Merced ID Diversion (TAF)
- 75 April No-action
- 76 April Proposed Action
- 77 April - difference
- 78 May No-action
- 79 May Proposed Action
- 80 May - difference

Table 1
Hydrologic Analysis Parameters
(Page 2/2)

San Joaquin River

Below Mouth of Merced River (cfs)

81 April No-action
82 April Proposed Action
83 April - difference
84 May No-action
85 May Proposed Action
86 May - difference

Below Mouth of Tuolumne River (cfs)

87 April No-action
88 April Proposed Action
89 April - difference
90 May No-action
91 May Proposed Action
92 May - difference

Vernalis flow (cfs)

93 April No-action
94 April Proposed Action
95 April - difference
96 May No-action
97 May Proposed Action
98 May - difference

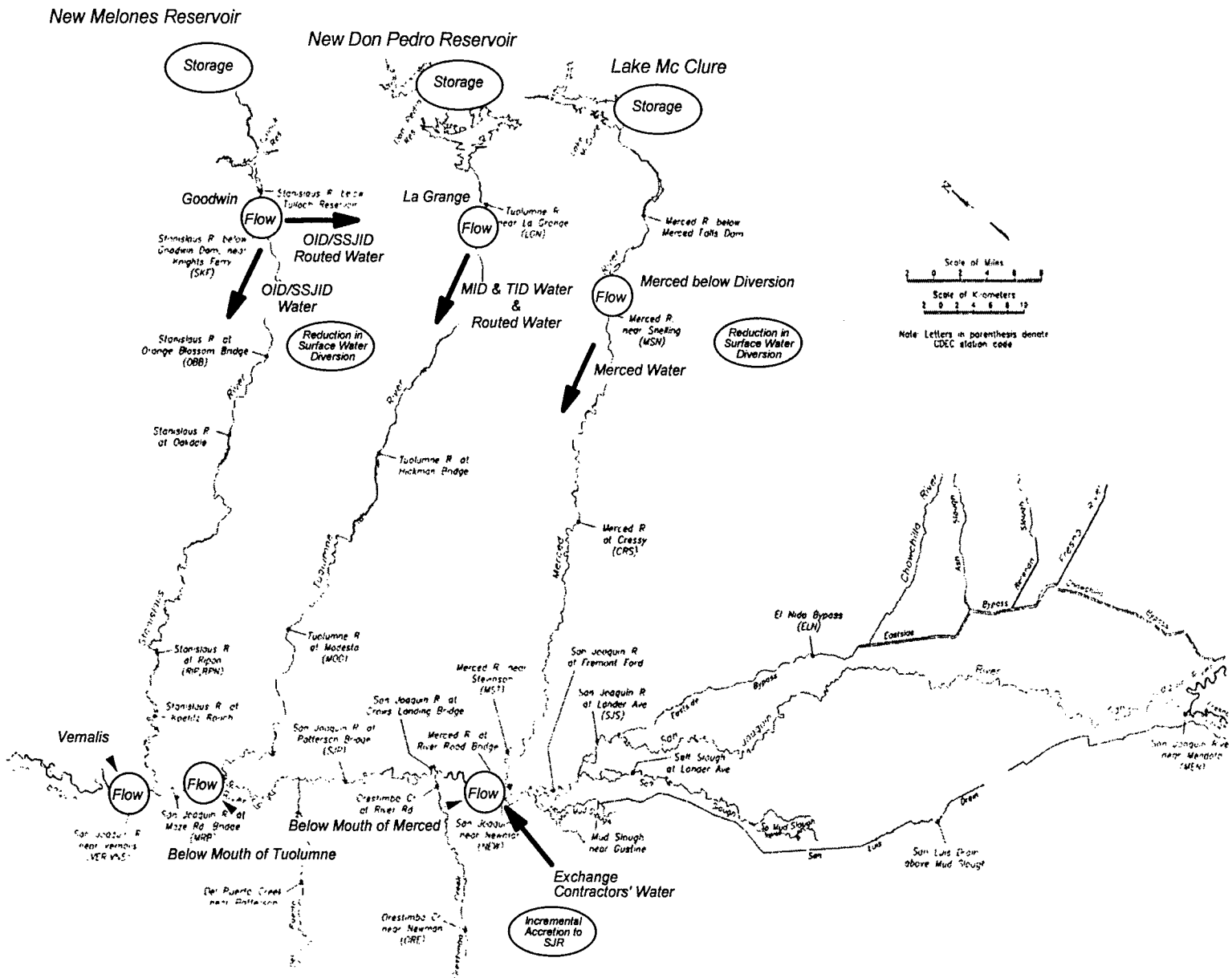
Vernalis Quality (TDS)

99 April No-action
100 April Proposed Action
101 April - difference
102 April - Non-compliance with No-action
103 April - Non-compliance with Proposed Project/Action
104 April - Difference with No-action Compliance
105 May No-action
106 May Proposed Action
107 May - difference
108 May - Non-compliance with No-action
109 May - Non-compliance with Proposed Project/Action
110 May - Difference with No-action Compliance

Other Information

111 Allocation of VAMP Pulse Flow Water
112 San Joaquin Index

Figure 2
Area Location Map



DWR Background Graphic

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Table 2
San Joaquin Valley Water Year Hydrologic Classification

Water Year	Index	Type
1922	4,544,266	Wet
1923	3,549,800	Above
1924	1,419,960	Critical
1925	2,929,392	Below
1926	2,300,478	Dry
1927	3,558,896	Above
1928	2,632,779	Below
1929	2,004,556	Critical
1930	2,015,911	Critical
1931	1,201,582	Critical
1932	3,410,716	Above
1933	2,440,943	Dry
1934	1,440,989	Critical
1935	3,556,198	Above
1936	3,739,440	Above
1937	3,897,088	Wet
1938	5,910,218	Wet
1939	2,198,200	Dry
1940	3,364,440	Above
1941	4,425,888	Wet
1942	4,440,778	Wet
1943	4,023,556	Wet
1944	2,761,511	Below
1945	3,589,102	Above
1946	3,304,020	Above
1947	2,183,004	Dry
1948	2,698,601	Below
1949	2,531,320	Below
1950	2,853,264	Below
1951	3,138,053	Above
1952	5,165,011	Wet
1953	3,025,800	Below
1954	2,720,960	Below
1955	2,300,392	Dry
1956	4,463,078	Wet
1957	3,008,616	Below
1958	4,772,923	Wet
1959	2,208,800	Dry
1960	1,854,560	Critical
1961	1,375,912	Critical
1962	3,073,382	Below
1963	3,572,476	Above
1964	2,186,695	Dry
1965	3,804,739	Wet
1966	2,511,948	Below
1967	5,251,790	Wet
1968	2,213,800	Dry
1969	6,094,560	Wet
1970	3,182,800	Above
1971	2,884,560	Below
1972	2,155,912	Dry
1973	3,498,382	Above
1974	3,903,676	Wet
1975	3,848,135	Wet
1976	1,571,027	Critical
1977	840,805	Critical
1978	4,583,561	Wet
1979	3,668,400	Above
1980	4,731,480	Wet
1981	2,441,000	Dry
1982	5,446,000	Wet
1983	7,219,800	Wet
1984	3,688,800	Above
1985	2,403,560	Dry
1986	4,305,112	Wet
1987	1,863,622	Critical
1988	1,476,924	Critical
1989	1,964,385	Critical
1990	1,514,877	Critical
1991	1,954,175	Critical
1992	1,558,035	Critical

Table 3
Determination of VAMP Pulse Flow Water
April Pulse Flow

(1) Index 602020	(2) Year Class	(3) Water Year	(4) Current Year 1 Crit 5 Wet	(5) Current Plus Previous Year	(6) Current Plus 2 Previous	(7) April Vernalis Existing Flow (CFS)	(8) Flow Target (CFS)	(9) Suppl. Flow Required (CFS)	(10) Suppl. Flow Required (TAF)	(11) Suppl. w/ 110 Cap Invoked (TAF)
4,544,266	Wet	1922	5	9	12	10,088	7,000	0	0	0
3,549,800	Above	1923	4	9	13	6,559	7,000	441	27	27
1,419,960	Critical	1924	1	5	10	1,778	2,000	222	14	14
2,929,392	Below	1925	3	4	8	4,713	5,700	987	61	61
2,300,478	Dry	1926	2	5	6	3,495	4,450	955	59	59
3,558,896	Above	1927	4	6	9	6,617	7,000	383	24	24
2,632,779	Below	1928	3	7	9	5,611	7,000	1,389	85	85
2,004,556	Critical	1929	1	4	8	2,314	3,200	886	54	54
2,015,911	Critical	1930	1	2	5	2,334	3,200	866	53	53
1,201,582	Critical	1931	1	2	3	1,470	2,000	0	0	0
3,410,716	Above	1932	4	5	6	5,484	5,700	216	13	13
2,440,943	Dry	1933	2	6	7	2,471	3,200	729	45	45
1,440,989	Critical	1934	1	3	7	1,617	2,000	383	24	24
3,556,198	Above	1935	4	5	7	7,889	7,000	0	0	0
3,739,440	Above	1936	4	8	9	7,812	7,000	0	0	0
3,897,088	Wet	1937	5	9	13	10,157	7,000	0	0	0
5,910,218	Wet	1938	5	10	14	22,643	7,000	0	0	0
2,198,200	Dry	1939	2	7	12	3,903	5,700	1,797	110	110
3,364,440	Above	1940	4	6	11	7,164	7,000	0	0	0
4,425,888	Wet	1941	5	9	11	11,349	7,000	0	0	0
4,440,778	Wet	1942	5	10	14	7,735	7,000	0	0	0
4,023,556	Wet	1943	5	10	15	8,576	7,000	0	0	0
2,761,511	Below	1944	3	8	13	5,080	7,000	1,920	118	110
3,589,102	Above	1945	4	7	12	7,971	7,000	0	0	0
3,304,020	Above	1946	4	8	11	5,803	7,000	1,197	74	74
2,183,004	Dry	1947	2	6	10	2,562	3,200	638	39	39
2,698,601	Below	1948	3	5	9	4,077	4,450	373	23	23
2,531,320	Below	1949	3	6	8	3,517	4,450	933	57	57
2,853,264	Below	1950	3	6	9	3,840	4,450	610	37	37
3,138,053	Above	1951	4	7	10	5,399	7,000	1,601	98	98
5,165,011	Wet	1952	5	9	12	12,156	7,000	0	0	0
3,025,800	Below	1953	3	8	12	4,307	5,700	1,393	86	86
2,720,960	Below	1954	3	6	11	4,895	5,700	805	50	50
2,300,392	Dry	1955	2	5	8	2,685	3,200	515	32	32
4,463,078	Wet	1956	5	7	10	6,576	7,000	424	26	26
3,008,616	Below	1957	3	8	10	4,340	5,700	1,360	84	84
4,772,923	Wet	1958	5	8	13	15,080	7,000	0	0	0
2,208,800	Dry	1959	2	7	10	3,450	5,700	2,250	138	110
1,854,560	Critical	1960	1	3	8	2,453	3,200	747	46	46
1,375,912	Critical	1961	1	2	4	1,783	2,000	0	0	0
3,073,382	Below	1962	3	4	5	4,857	5,700	843	52	52
3,572,476	Above	1963	4	7	8	6,626	7,000	374	23	23
2,186,695	Dry	1964	2	6	9	2,418	3,200	782	48	48
3,804,739	Wet	1965	5	7	11	7,214	7,000	0	0	0
2,511,948	Below	1966	3	8	10	3,522	5,700	2,178	134	110
5,251,790	Wet	1967	5	8	13	15,097	7,000	0	0	0
2,213,800	Dry	1968	2	7	10	3,517	5,700	2,183	134	110
6,094,560	Wet	1969	5	7	12	24,593	7,000	0	0	0
3,182,800	Above	1970	4	9	11	5,786	7,000	1,214	75	75
2,884,560	Below	1971	3	7	12	4,223	5,700	1,477	91	91
2,155,912	Dry	1972	2	5	9	2,595	3,200	605	37	37
3,498,382	Above	1973	4	6	9	7,988	7,000	0	0	0
3,903,676	Wet	1974	5	9	11	8,324	7,000	0	0	0
3,848,135	Wet	1975	5	10	14	8,458	7,000	0	0	0
1,571,027	Critical	1976	1	6	11	2,476	3,200	724	45	45
840,805	Critical	1977	1	2	7	1,626	2,000	374	23	23
4,583,561	Wet	1978	5	6	7	18,120	7,000	0	0	0
3,668,400	Above	1979	4	9	10	7,635	7,000	0	0	0
4,731,480	Wet	1980	5	9	14	8,609	7,000	0	0	0
2,441,000	Dry	1981	2	7	11	3,735	5,700	1,965	121	110
5,446,000	Wet	1982	5	7	12	25,315	7,000	0	0	0
7,219,800	Wet	1983	5	10	12	27,742	7,000	0	0	0
3,688,800	Above	1984	4	9	14	5,349	7,000	1,651	102	102
2,403,560	Dry	1985	2	6	11	3,492	4,450	958	59	59
4,305,112	Wet	1986	5	7	11	12,240	7,000	0	0	0
1,863,622	Critical	1987	1	6	8	2,542	3,200	658	40	40
1,476,924	Critical	1988	1	2	7	1,748	2,000	252	16	16
1,964,385	Critical	1989	1	2	3	2,039	2,039	0	0	0
1,514,877	Critical	1990	1	2	3	1,711	2,000	0	0	0
1,954,175	Critical	1991	1	2	3	2,312	2,312	0	0	0
1,558,035	Critical	1992	1	2	3	1,815	2,000	0	0	0

Table 4
Determination of VAMP Pulse Flow Water
May Pulse Flow

(1) Index 602020	(2) Year Class	(3) Water Year	(4) Current Year 1 Crit 5 Wet	(5) Current Plus Previous Year	(6) Current Plus 2 Previous	(7) May Vernalis Existing Flow (CFS)	(8) Flow Target (CFS)	(9) Suppl. Flow Required (CFS)	(10) Suppl. Flow Required (TAF)	(11) Suppl. w/ 110 Cap Invoked (TAF)
4,544,266	Wet	1922	5	9	12	8,053	7,000	0	0	0
3,549,800	Above	1923	4	9	13	5,549	7,000	1,452	89	89
1,419,960	Critical	1924	1	5	10	1,491	2,000	509	31	31
2,929,392	Below	1925	3	4	8	4,022	4,450	428	26	26
2,300,478	Dry	1926	2	5	6	2,681	3,200	519	32	32
3,558,896	Above	1927	4	6	9	5,181	5,700	519	32	32
2,632,779	Below	1928	3	7	9	3,797	5,700	1,903	117	110
2,004,556	Critical	1929	1	4	8	2,027	3,200	1,173	72	72
2,015,911	Critical	1930	1	2	5	1,949	2,000	51	3	3
1,201,582	Critical	1931	1	2	3	1,244	2,000	0	0	0
3,410,716	Above	1932	4	5	6	3,910	4,450	540	33	33
2,440,943	Dry	1933	2	6	7	2,182	3,200	1,018	63	63
1,440,989	Critical	1934	1	3	7	1,247	2,000	753	46	46
3,556,198	Above	1935	4	5	7	6,091	7,000	909	56	56
3,739,440	Above	1936	4	8	9	5,319	7,000	1,681	103	103
3,897,088	Wet	1937	5	9	13	9,274	7,000	0	0	0
5,910,218	Wet	1938	5	10	14	23,955	7,000	0	0	0
2,198,200	Dry	1939	2	7	12	3,321	5,700	2,379	146	110
3,364,440	Above	1940	4	6	11	5,906	7,000	1,094	67	67
4,425,888	Wet	1941	5	9	11	9,500	7,000	0	0	0
4,440,778	Wet	1942	5	10	14	6,703	7,000	297	18	18
4,023,556	Wet	1943	5	10	15	8,589	7,000	0	0	0
2,761,511	Below	1944	3	8	13	4,475	7,000	2,525	155	110
3,589,102	Above	1945	4	7	12	5,841	7,000	1,159	71	71
3,304,020	Above	1946	4	8	11	5,549	7,000	1,452	89	89
2,183,004	Dry	1947	2	6	10	2,218	3,200	982	60	60
2,698,601	Below	1948	3	5	9	3,520	4,450	930	57	57
2,531,320	Below	1949	3	6	8	2,995	3,200	205	13	13
2,853,264	Below	1950	3	6	9	3,243	4,450	1,207	74	74
3,138,053	Above	1951	4	7	10	4,963	7,000	2,037	125	110
5,165,011	Wet	1952	5	9	12	15,451	7,000	0	0	0
3,025,800	Below	1953	3	8	12	4,101	5,700	1,599	98	98
2,720,960	Below	1954	3	6	11	4,394	4,450	56	3	3
2,300,392	Dry	1955	2	5	8	2,614	3,200	586	36	36
4,463,078	Wet	1956	5	7	10	6,866	7,000	134	8	8
3,008,616	Below	1957	3	8	10	4,345	5,700	1,355	83	83
4,772,923	Wet	1958	5	8	13	13,370	7,000	0	0	0
2,208,800	Dry	1959	2	7	10	3,061	4,450	1,389	85	85
1,854,560	Critical	1960	1	3	8	2,047	3,200	1,153	71	71
1,375,912	Critical	1961	1	2	4	1,593	2,000	0	0	0
3,073,382	Below	1962	3	4	5	3,330	4,450	1,120	69	69
3,572,476	Above	1963	4	7	8	5,483	7,000	1,517	93	93
2,186,695	Dry	1964	2	6	9	2,191	3,200	1,009	62	62
3,804,739	Wet	1965	5	7	11	5,874	7,000	1,126	69	69
2,511,948	Below	1966	3	8	10	3,190	4,450	1,260	77	77
5,251,790	Wet	1967	5	8	13	18,378	7,000	0	0	0
2,213,800	Dry	1968	2	7	10	3,207	5,700	2,493	153	110
6,094,560	Wet	1969	5	7	12	22,281	7,000	0	0	0
3,182,800	Above	1970	4	9	11	5,158	7,000	1,842	113	110
2,884,560	Below	1971	3	7	12	4,069	5,700	1,631	100	100
2,155,912	Dry	1972	2	5	9	2,305	3,200	895	55	55
3,498,382	Above	1973	4	6	9	5,874	7,000	1,126	69	69
3,903,676	Wet	1974	5	9	11	6,524	7,000	476	29	29
3,848,135	Wet	1975	5	10	14	6,719	7,000	281	17	17
1,571,027	Critical	1976	1	6	11	2,207	3,200	993	61	61
840,805	Critical	1977	1	2	7	1,433	2,000	567	35	35
4,583,561	Wet	1978	5	6	7	13,804	7,000	0	0	0
3,668,400	Above	1979	4	9	10	6,313	7,000	687	42	42
4,731,480	Wet	1980	5	9	14	9,077	7,000	0	0	0
2,441,000	Dry	1981	2	7	11	3,272	5,700	2,428	149	110
5,446,000	Wet	1982	5	7	12	17,305	7,000	0	0	0
7,219,800	Wet	1983	5	10	12	25,762	7,000	0	0	0
3,688,800	Above	1984	4	9	14	4,849	7,000	2,151	132	110
2,403,560	Dry	1985	2	6	11	3,033	3,200	167	10	10
4,305,112	Wet	1986	5	7	11	9,711	7,000	0	0	0
1,863,622	Critical	1987	1	6	8	2,204	3,200	996	61	61
1,476,924	Critical	1988	1	2	7	1,521	2,000	479	29	29
1,964,385	Critical	1989	1	2	3	1,695	2,000	0	0	0
1,514,877	Critical	1990	1	2	3	1,558	2,000	0	0	0
1,954,175	Critical	1991	1	2	3	1,728	2,000	0	0	0
1,558,035	Critical	1992	1	2	3	1,180	2,000	0	0	0

Table 5
Modeled Division of VAMP Pulse Flow Water
(Values in 1,000 acre-feet)

April Pulse Flow					
Water Year	Merced	OID SSJID	Exchange Contractors	MID TID	Total
1922	0	0	0	0	0
1923	25	2	0	0	27
1924	14	0	0	0	14
1925	36	10	5	10	61
1926	34	10	5	10	59
1927	24	0	0	0	24
1928	45	18	8	15	85
1929	29	10	5	10	54
1930	28	10	5	10	53
1931	0	0	0	0	0
1932	13	0	0	0	13
1933	25	10	5	5	45
1934	24	0	0	0	24
1935	0	0	0	0	0
1936	0	0	0	0	0
1937	0	0	0	0	0
1938	0	0	0	0	0
1939	55	22	11	22	110
1940	0	0	0	0	0
1941	0	0	0	0	0
1942	0	0	0	0	0
1943	0	0	0	0	0
1944	55	22	11	22	110
1945	0	0	0	0	0
1946	37	15	7	15	74
1947	25	10	4	0	39
1948	23	0	0	0	23
1949	32	10	5	10	57
1950	25	10	2	0	37
1951	53	18	9	18	98
1952	0	0	0	0	0
1953	45	18	8	15	86
1954	25	10	5	10	50
1955	25	7	0	0	32
1956	25	1	0	0	26
1957	45	17	7	15	84
1958	0	0	0	0	0
1959	55	22	11	22	110
1960	25	10	5	6	46
1961	0	0	0	0	0
1962	27	10	5	10	52
1963	23	0	0	0	23
1964	25	10	5	8	48
1965	0	0	0	0	0
1966	55	22	11	22	110
1967	0	0	0	0	0
1968	55	22	11	22	110
1969	0	0	0	0	0
1970	38	15	7	15	75
1971	46	18	9	18	91
1972	25	10	2	0	37
1973	0	0	0	0	0
1974	0	0	0	0	0
1975	0	0	0	0	0
1976	25	10	5	5	45
1977	23	0	0	0	23
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	0	0	0	0
1981	55	22	11	22	110
1982	0	0	0	0	0
1983	0	0	0	0	0
1984	55	20	9	18	102
1985	34	10	5	10	59
1986	0	0	0	0	0
1987	25	10	5	0	40
1988	16	0	0	0	16
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0

May Pulse Flow					
Water Year	Merced	OID SSJID	Exchange Contractors	MID TID	Total
1922	0	0	0	0	0
1923	45	18	9	17	89
1924	25	6	0	0	31
1925	25	1	0	0	26
1926	25	7	0	0	32
1927	25	7	0	0	32
1928	55	22	11	22	110
1929	37	15	7	14	72
1930	3	0	0	0	3
1931	0	0	0	0	0
1932	25	8	0	0	33
1933	37	11	5	10	63
1934	25	10	5	6	46
1935	31	10	5	10	56
1936	55	21	9	18	103
1937	0	0	0	0	0
1938	0	0	0	0	0
1939	55	22	11	22	110
1940	37	15	6	10	67
1941	0	0	0	0	0
1942	18	0	0	0	18
1943	0	0	0	0	0
1944	55	22	11	22	110
1945	37	15	7	13	71
1946	45	18	9	17	89
1947	35	10	5	10	60
1948	32	10	5	10	57
1949	13	0	0	0	13
1950	38	15	7	15	74
1951	55	22	11	22	110
1952	0	0	0	0	0
1953	53	18	9	18	98
1954	3	0	0	0	3
1955	25	10	1	0	36
1956	8	0	0	0	8
1957	45	16	7	15	83
1958	0	0	0	0	0
1959	45	18	8	15	85
1960	37	15	7	13	71
1961	0	0	0	0	0
1962	37	15	7	10	69
1963	48	18	9	18	93
1964	37	11	5	10	62
1965	37	15	7	11	69
1966	41	15	7	15	77
1967	0	0	0	0	0
1968	55	22	11	22	110
1969	0	0	0	0	0
1970	55	22	11	22	110
1971	55	18	9	18	100
1972	30	10	5	10	55
1973	37	15	7	11	69
1974	25	4	0	0	29
1975	17	0	0	0	17
1976	36	10	5	10	61
1977	25	10	0	0	35
1978	0	0	0	0	0
1979	25	10	5	2	42
1980	0	0	0	0	0
1981	55	22	11	22	110
1982	0	0	0	0	0
1983	0	0	0	0	0
1984	55	22	11	22	110
1985	10	0	0	0	10
1986	0	0	0	0	0
1987	36	10	5	10	61
1988	25	4	0	0	29
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0

APPENDIX B

GROUNDWATER CONDITIONS

APPENDIX B

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APPENDIX B
GROUNDWATER CONDITIONS

Appendix B describes in detail the groundwater conditions in each of the basins in the San Joaquin River Region. Included are the Turlock Groundwater Basin, Modesto Basin, Merced Groundwater Basin, Eastern San Joaquin County Groundwater Basin, and the San Joaquin River Exchange Contractors Service Area.

B.1 GROUNDWATER RESOURCES OF THE TURLOCK GROUNDWATER BASIN

B.1.1 Physical Description of the Basin

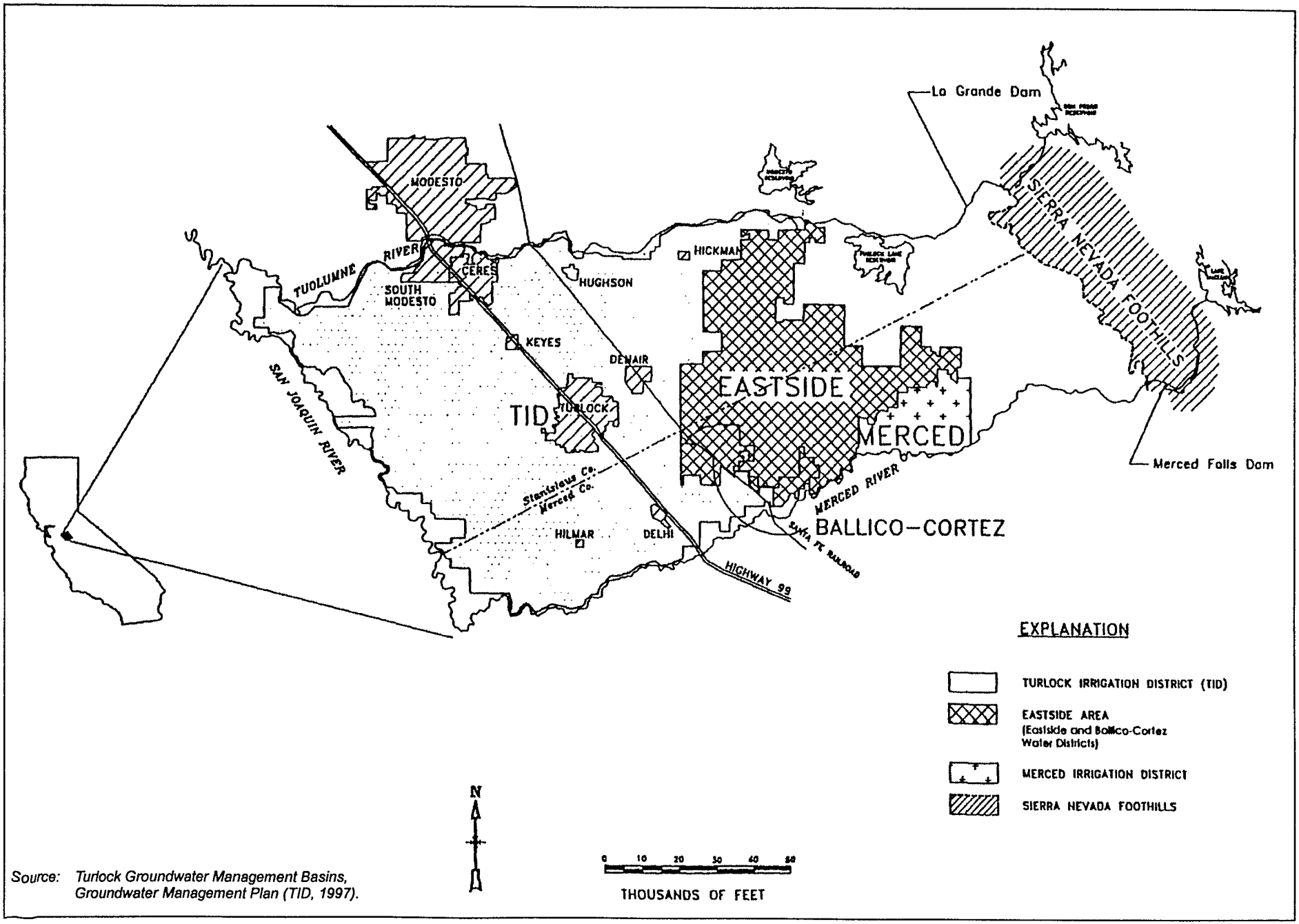
The Turlock Groundwater Basin lies on the eastern side of the San Joaquin Valley, and encompasses portions of both Stanislaus and Merced counties. The groundwater system is bounded by the Tuolumne River on the north, the Merced River on the south, and the San Joaquin River on the west, as shown in Figure B.1-1. The eastern boundary of the system is the western extent of the outcrop of low-permeability sediments on the western flanks of the Sierra-Nevada.

Groundwater within the Basin occurs under unconfined and confined conditions. The alluvial and continental deposits constitute two principal aquifers, which are separated by the Corcoran Clay in portions of the Turlock Basin. Although these deposits are characteristically heterogeneous in composition, the interbedded clays, with the exception of the Corcoran Clay, are generally discontinuous.

Groundwater is considered to be unconfined in both the shallow alluvial aquifer system overlying the Corcoran Clay and the aquifer system to the east. Long-term water level fluctuations in the shallow aquifer system about the Corcoran Clay and the unconfined aquifer system east of the Corcoran Clay demonstrate similar seasonal groundwater level fluctuations. The general direction of regional groundwater flow is westward and southward towards the valley trough. Groundwater within the Turlock basin also moves eastward towards a large cone of depression east of TID. The direction of groundwater flow is controlled by the elevations of the Tuolumne, Merced and San Joaquin Rivers which bound the basin (TID 1997).

B.1.2 Water Balance in the Turlock Groundwater Basin

Historically, municipal consumers within the Basin have relied solely on groundwater as the source of supply. The municipal suppliers (major utilities) within the Basin are: the cities of Turlock, Modesto, Ceres and Hughson; the Hilmar and Delhi county water districts; and the Denair and Keyes community services districts. The total water produced by these major water utilities in 1995 was 36,200 acre-feet, supplied entirely through groundwater pumping. An additional estimated 10,900 acre-feet per year is produced by small private residential water systems, commercial businesses, and industrial plants not served by the major utilities. Figure B.1-2 shows the historical groundwater production for the various municipal agencies.



Source: Turlock Groundwater Management Basins, Groundwater Management Plan (TID, 1997).

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Figure B.1-1. Turlock Groundwater Basin.

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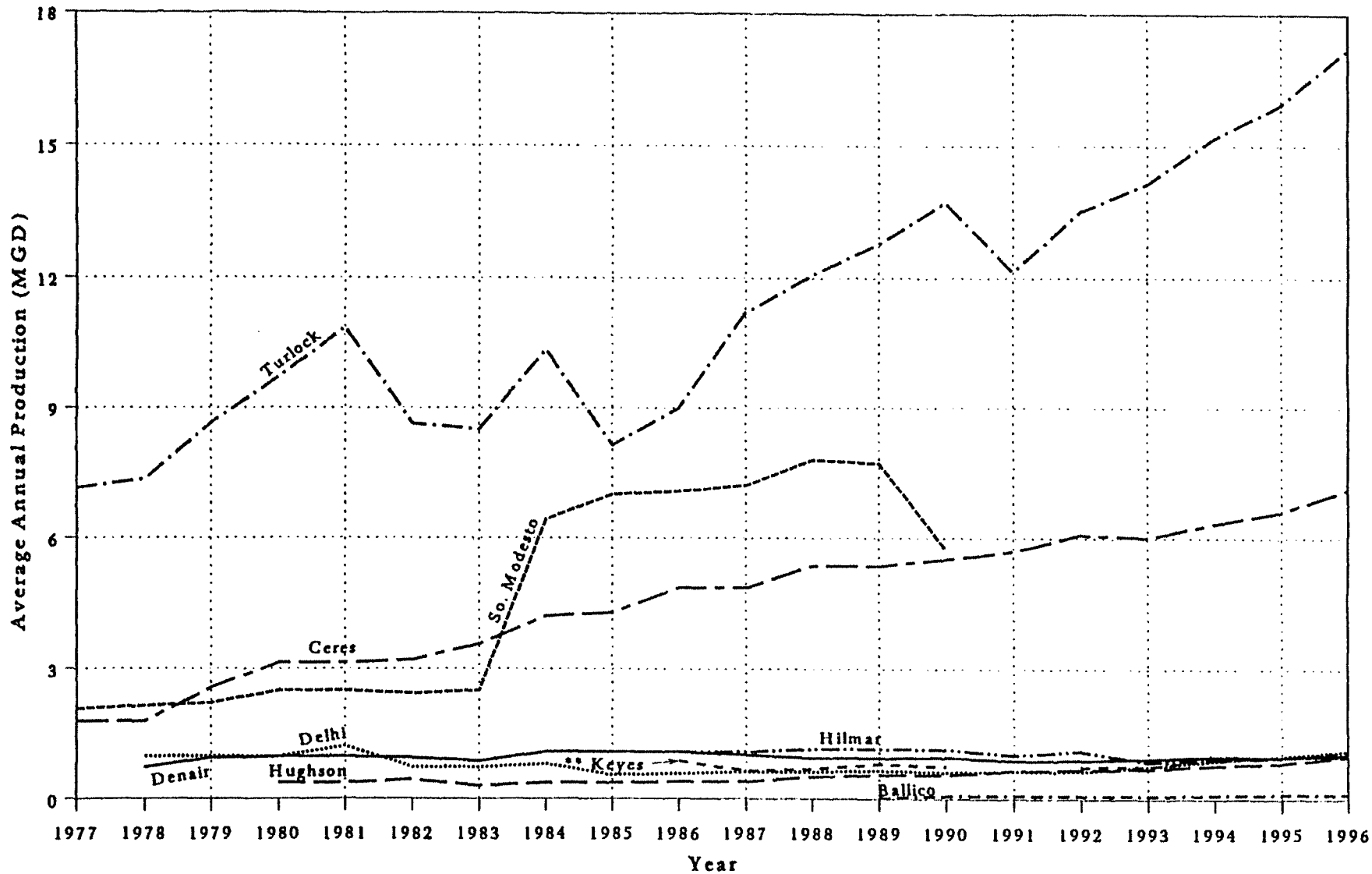

Notes: * So. Modesto includes both So. Modesto pumping from 1984 - 1990 and Del Este pumping from 1977 - 1996.

** Keyes Community Services District data from 1991 is unavailable at this time.

Source: Turlock Groundwater Basin Management Plan (TID, 1997).

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Figure B.1-2. Historic municipal groundwater production.

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Agricultural land within the respective irrigation districts within the basin uses an average of 881,000 acre-feet per year (TID 1997). On the average the total crop-water requirements is comprised of approximately forty seven percent, or 411,000 acre-feet of groundwater (Table B.1-1). However, the deep percolation of extracted groundwater for irrigation returns a portion of the extracted groundwater to the aquifer.

Table B.1-1: AVERAGE ANNUAL AGRICULTURE USAGE IN THE TURLOCK GROUNDWATER BASIN

	Surface Water		Groundwater		Total
Agency	(AF/Yr)	Percentage	(AF/Yr)	Percentage	(AF/Yr)
Turlock Irrigation District (TID) *	435,000	80	106,000	20	541,000
Individual growers within TID **	0	0	123,000	100	123,000
Merced Irrigation District ******	22,000	100	0	0	22,000
Eastside Water District *****	0	0	155,000	100	155,000
Ballico-Cortez Water District *****	0	0	27,000	100	27,000
Individual Irrigators					
Municipal Waste Water Effluent ***	13,000	100	0	0	13,000
Total	470,000	53	411,000	47	881,000

Notes:

* TID usage is based on a 1984-1996 average. Total usage equals the avg. SW & GW into the system minus the avg. spills to the river. Evaporation is minimal. The percentage of total usage to total system water was subtracted from the total GW & SW to calculate the GW & SW usage. (Note: Spills to the river from the TID canals vary from year to year and over the course of a season, depending on the type of year, irrigation and drainage requirements, etc.)

** Individual grower pumping is an estimate based on electrical usage.

*** Waste water effluent from the municipalities is utilized for agricultural purposes.

**** The individual irrigators refer to:

1. The irrigation water used for those areas outside of other agency boundaries. There a fairly large area located on the eastern boundary of the Basin which could potentially be developed into agricultural farm land. The extent of the current development and water usage is unknown at this time.
2. The individual growers within both the Merced Irrigation District which use groundwater to supply their crop-water requirement.

***** With the exception of minor amounts of surface water made available from Turlock and Merced irrigation districts in wet years, irrigators within the Eastside and Ballico-Cortez water districts rely on groundwater to supply irrigation water.

****** Groundwater is used to supply approximately 4% of Merced ID's total deliveries, however, the wells used to supply that water are not located within the Turlock Groundwater Basin. Therefore, since the groundwater is not pumped from this Basin, Merced ID's deliveries within the Turlock Groundwater Basin are assumed to be 100% surface water.

Source: ***Turlock Groundwater Basin Groundwater Management Plan,*** **October 1997.**

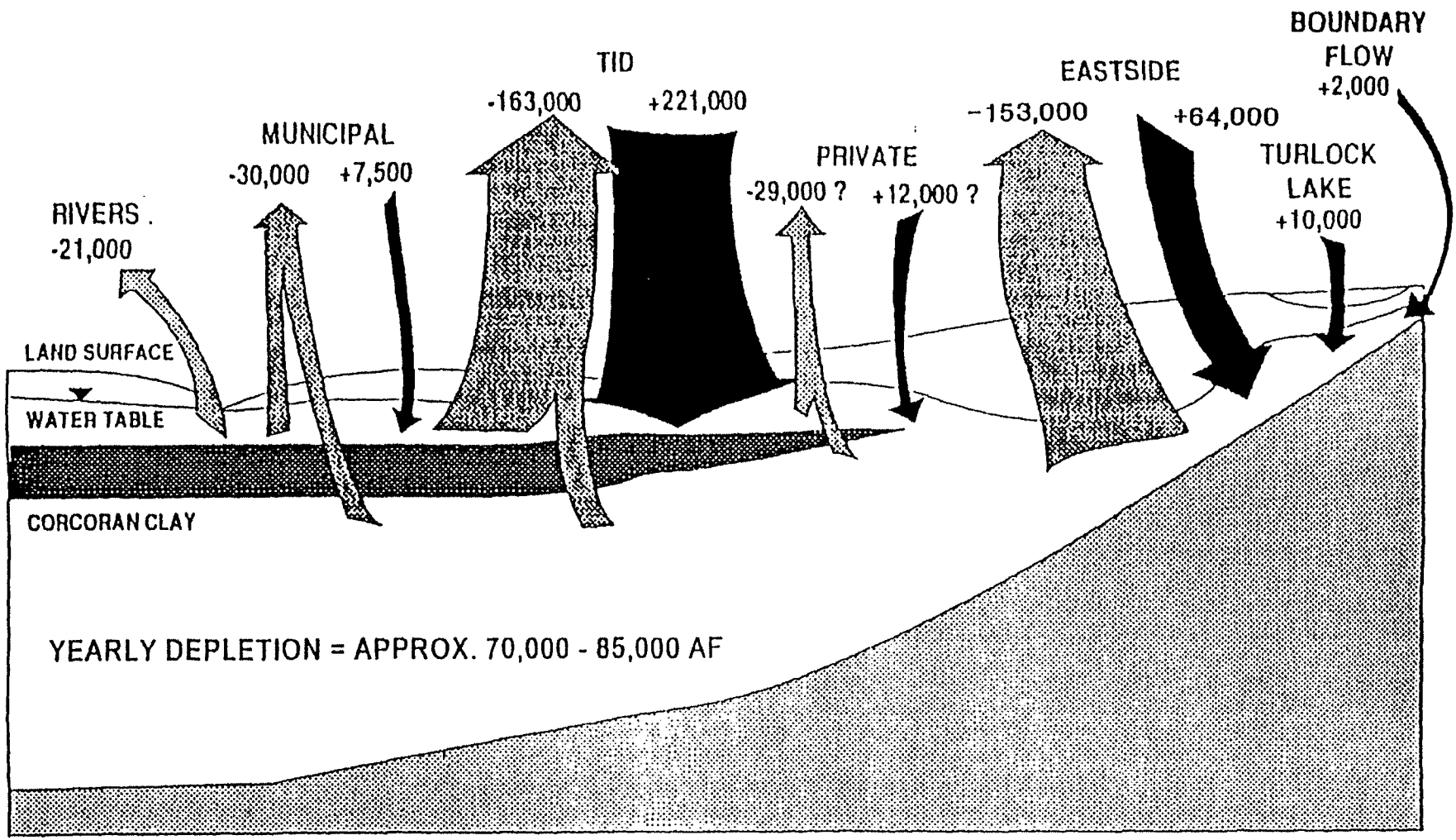
TID's Groundwater Basin Management Plan (TID 1997), included an estimate of various components of the groundwater balance for the Turlock Basin. Table B.1-2 and Figure B.1-3 display the components. Based on a summary of the average annual values for the various components of inflow and outflow into the Basin, (Table B.1-1) the average annual water budget for 1988-89 indicated an average overdraft of 70,000 to 85,000 acre-feet per year. All inflow and most outflow component values were estimated. The data used to generate Table B.1-2 and Figure B.1-3 are based on old data that are not accurate, although they show generally the net inflows and outflows in the Turlock groundwater basin.

Table B.1-2: INFLOW AND OUTFLOW IN THE TURLOCK GROUNDWATER BASIN

Source	Acre Feet per Year
Inflow	
Boundary Flow	2,000
Groundwater Inflow and Agricultural subsurface drainage	297,000
Turlock Lake Seepage	10,000
Municipal Inflow	7,500
Total	**316,500**
Outflow	
Irrigation and Drainage Well Pumping	345,000
Municipal Pumping	30,000
Discharge to Streams	21,000
Total	**396,000**
Difference	
Change in Storage	**-79,500**

Source: ***Turlock Groundwater Basin Groundwater Management Plan, Figure 10,*** **October 1997.**

The overdraft is not a basin-wide occurrence due to varying withdrawal rates throughout the Basin and heterogeneities in the underlying aquifers. Overdraft is occurring in the Turlock Groundwater Basin where the absence of surface supplies on the east side of the valley has resulted in concentrated pumping to support irrigated agriculture. Overdraft on the east side is the result. Simultaneously, surplus supplies exist in the western portion of the basin, and pumping occurs for the maintenance of groundwater levels rather than for water supply purposes.



NOTES: 1. Water quantities, representing amounts of water flowing into and out of the Basin, are in Acre-Feet per Year.
2. Information sources include: TID (Current Water Supply Conditions), 1989 and Eastside Water District (Irrigation Water Master Plan), 1990

Source: Turlock Groundwater Basin Groundwater Management Plan (TID 1997).

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Figure B.1-3. Inflows and outflows to the Turlock Groundwater Basin.

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B.1.3 Groundwater Elevations

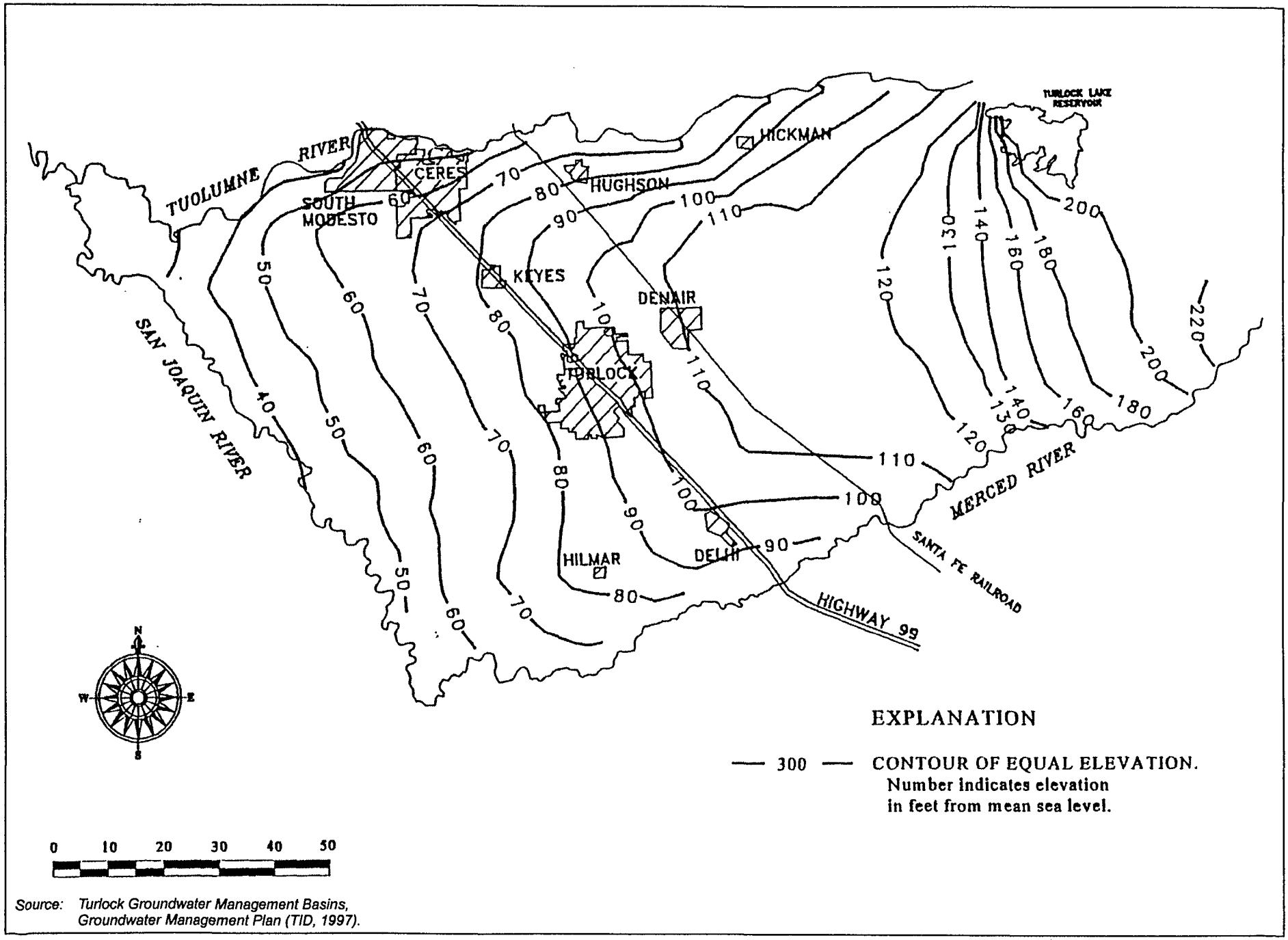
TID monitors static and high groundwater levels monthly from a total of 248 wells within its irrigation boundaries. Forty of those wells provide information on groundwater level trends within the District. The District monitors the other 208 shallow monitoring wells, located at section corners, to determine areas of high groundwater. In addition, the municipalities within the Basin monitor groundwater levels on a regular basis.

The depth to groundwater in most of the Turlock Basin ranges from less than 6 feet to over 100 feet below the ground surface (bgs). Fluctuations of water levels are of two main types, seasonal and long term. These fluctuations are controlled by irrigation practices, drainage techniques, and local pumpage. Seasonally, in areas of intense pumpage such as the vicinity of east of Turlock, the water table declines during the summer and rises during the winter.

Long term groundwater levels within the Basin for the period from 1971 through 1991 show that water levels declined throughout the period (DWR 1998). Figure B.1-4 represents conditions which existed in fall 1971. The fall 1991 map (Figure B.1-5), shows the decline in water levels over the 20 year period. The largest water level drop has developed approximately 6.5 miles east of Turlock within a large depression where the water table has declined as much as 90 feet. Water levels have declined approximately five feet throughout the western part of the Basin. The observed decline in water levels on the east side of the Basin is largely due to groundwater pumping. Within this area, surface water supplies are not available, and pumping has produced irrigation water in a large part by depleting stored groundwater (TID 1997).

B.1.4 Projected Turlock Basin Water Demand

For the foreseeable future, it is anticipated that cropping patterns and related irrigation requirements, on a per acre basis, will remain essentially the same (Table B.1-3). Furthermore, if no appreciable amount of additional lands are brought into agricultural production, it is estimated that agricultural water demand will decrease as municipal/industrial development gradually encroaches upon agricultural lands (TID 1997).



Source: *Turlock Groundwater Management Basins, Groundwater Management Plan (TID, 1997).*

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Figure B.1-4. Groundwater elevations, Turlock Groundwater Basin - Fall 1971.

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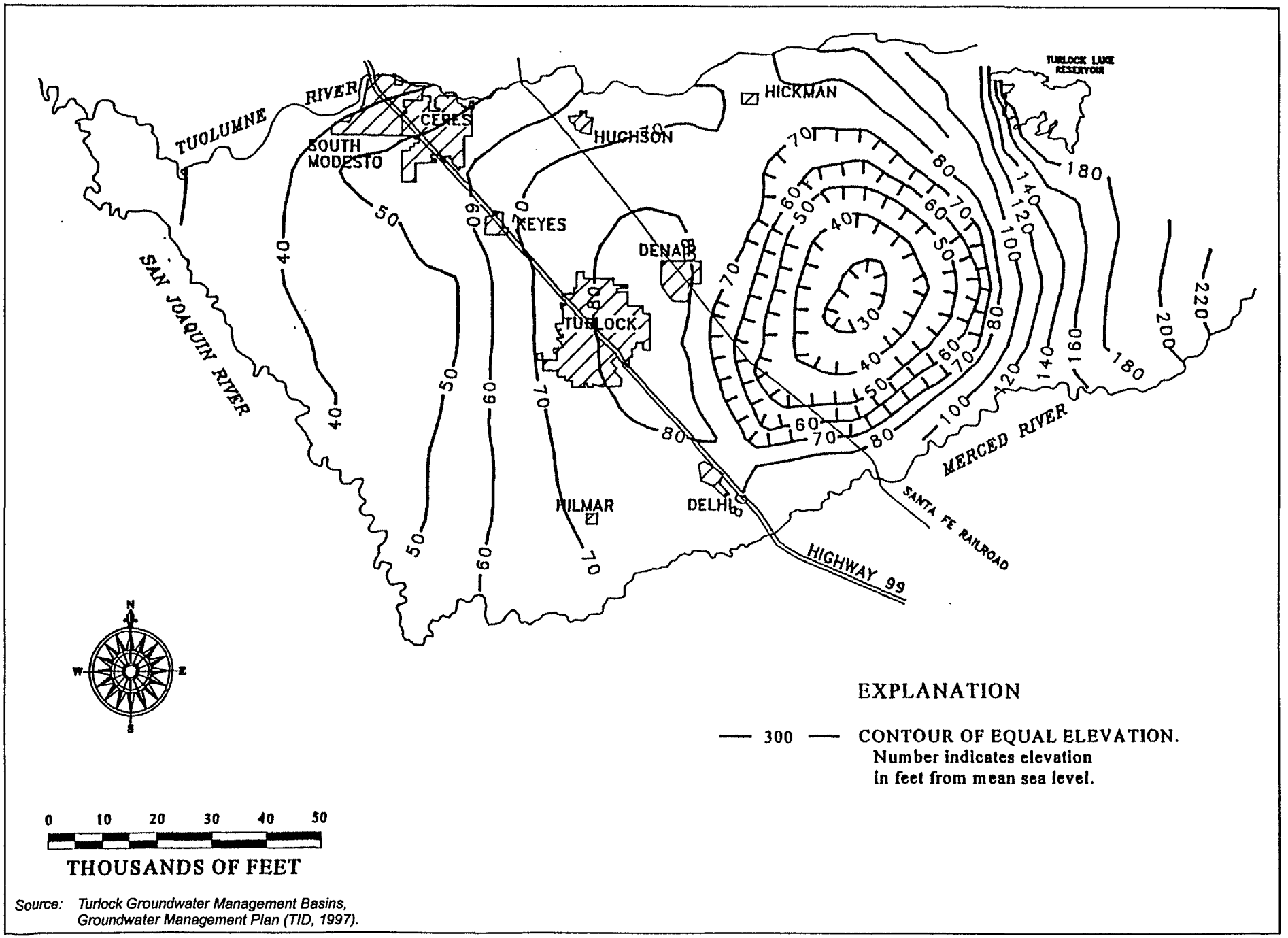

Source: *Turlock Groundwater Management Basins, Groundwater Management Plan (TID, 1997).*

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Figure B.1-5. Groundwater elevations, Turlock Groundwater Basin - Fall 1991.

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Table B.1-3. PROJECTIONS OF AGRICULTURAL AND MUNICIPAL GROUNDWATER DEMANDS IN THE TURLOCK GROUNDWATER BASIN

Year	Agricultural Demands AF/Yr	Municipal Demands AF/Yr	Total Groundwater Demand[1] AF/Yr
1995	411,000	36,405	447,405
2005	411,000[1]	48,390	459,390
2030	411,000[1]	109,100	520,100

Source: ***Turlock Groundwater Basin Groundwater Management Plan*, October 1997.**
[1]TID projects demand to remain at least static for the foreseeable future and perhaps decrease.

The population and developed municipal acreage are projected to triple by 2030 (TID 1997). Using current population trends within the Basin's communities (projected to be a 3.6 percent increase per year), the population within the municipalities is expected to increase from 119,000 in 1995 to over 400,000 by 2030 with developed acreage increasing proportionally. As a result, the average daily water usage in these communities is expected to increase from 36,200 acre-feet per day in 1995 to over 109,000 acre-feet per day in the 2030 (Table B.1-3). The majority of the municipal/industrial demand is projected to be concentrated along the Highway 99 corridor. If groundwater remains the sole source of municipal supply, it is estimated that 205 additional wells will be required (TID 1997).

B.1.5 Groundwater Quality in the Turlock Groundwater Basin

The groundwater within the Basin is a mixture of groundwater recharge from irrigation water, streamflow, and precipitation. The major contributors to groundwater used for irrigation are the Tuolumne and Merced rivers and, to a lesser extent, precipitation. Its chemical character is formed by reactions of the mixtures with the physical, chemical, and biological environment in which it is found and the types of materials it has passed through. Hardness in the form of calcium bicarbonate is moderate to very hard (Page and Balding 1973). Exceptions to the general chemical composition of groundwater cited by Hall (1960) include: sodium bicarbonate water located in the western part of the area; and the mixing of saline water that has moved up into the fresh water bodies of the Basin.

B.1.5.1 Total Dissolved Solids

Total Dissolved Solids (TDS) concentrations in groundwater in the western two-thirds of the Basin are generally less than 500 ppm. TDS in groundwater increases westward towards the San Joaquin River and southward towards the Merced River (TID 1997). In these areas, high TDS water is found in wells deeper than 350 feet. Better quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.

Groundwater with high concentrations of total dissolved solids is present beneath the entire Basin at depths from about 400 feet in the west to over 800 feet in the west. The shallowest groundwater with high TDS occurs in zones five to six miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Hilmar, where high TDS water is believed to be upwelling (TID 1997).

B.1.5.2 Nitrates

The principal source of nitrate in groundwater is from plants that fix atmospheric nitrogen and then transfer it to the soil where it is used by plants, or is removed by downward percolation of water. Other sources of nitrate are decomposing plant debris, animal wastes, and nitrogen fertilizers. Natural nitrate concentrations in groundwater range from 0.1 to 10 mg/l (Driscoll 1986).

The maximum contaminant level (MCL) for nitrate in domestic water is set at 45 mg/l by the USEPA. Water containing as much as 90 mg/l of nitrate is harmful to infants. Communities within the Basin, including Ceres, Turlock, Keyes, Delhi, Hilmar, Deanir and South Modesto have had wells test high in nitrate concentrations close to or exceeding the current MCL (TID 1997).

Nitrate is an essential element for agricultural crops. However, permanent crops, including grape vineyards, may be adversely affected by excess nitrate concentrations. Nitrates may enter the groundwater from sewage discharges on land or from sewage lagoons. Additionally, many industrial waste chemicals contain high concentrations of nitrogen, which is reduced to nitrate. High nitrate concentrations are typically found in shallow groundwater zones and are attributed to the various sources described above.

B.1.5.3 Arsenic

Arsenic is a trace element that occurs naturally. Arsenic has also been an important component of pesticides, and thus enters streams or groundwater. Arsenic concentrations in water from public water supply wells in the Basin are below the current MCL of 0.05 mg/l. However, the Environmental Protection Agency (EPA) is considering lowering the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which may have a considerable impact to use of groundwater supplies for drinking water.

B.1.5.4 Iron and Manganese

Groundwater in several areas within the Basin has elevated iron and manganese levels. Some wells in the cities of Ceres and Turlock, as well as within what was the Del Este system, have encountered problems due to manganese (TID 1997).

B.1.5.5 Radionuclides

The MCL for gross alpha is 15 picocuries per liter, and the MCL for uranium has recently been increased from 5 to 20 picocuries per liter. Natural sources are responsible for radionudides which affect drinking water supplies (TID 1997). Sampling in the Basin for radiological constituents has generally been limited to public water systems. Groundwater with high uranium activity has been detected in the past 10 years in the Hilmar and Hughson areas (TID 1997).

B.1.5.6 Pesticides

Dibromochloropropane (DBCP) has contaminated the groundwater in portion of the basin. DBCP has been found in public water supply wells in the South Modesto, Keyes and Ceres areas at levels close to or exceeding the MCL. In cases where the DBCP levels are exceeding the MCL, wellhead treatment is being utilized (TID 1997).

Another trace organic compounds (used as a nematocide) that has been detected in the Basin's groundwater is ethylene dibromide (EDB). EDB has been detected in one public water supply well in the Turlock area (TID 1997).

B.1.5.7 Volatile Organic Compounds

Trace organic compounds have been detected in the Basin's groundwater including, but not limited to, carbon tetrachloride, perchloroethylene and hydrocarbon-based products.

Several unauthorized fuel releases from underground storage tanks (UST) have occurred in the Basin. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been effected (TID 1997). The extent of methyl tertiary butyl ether (MTBE) in groundwater within the basin has not been fully evaluated.

B.1.6 Land Subsidence in the Turlock Groundwater Basin

Ground subsidence is not currently a problem in the Turlock Groundwater Basin. However, if overdrafting of the Basin continues and if the area experiences a multi-year drought, localized ground subsidence and loss of groundwater storage as groundwater levels decline could result.

B.1.7 Agricultural Subsurface Drainage and Waterlogging in the Turlock Groundwater Basin

TID reports that several areas in the western portion of the Basin experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation

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season as a result of pumping, precipitation and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet from ground level would not be uncommon, resulting in agricultural seepage and potentially adverse impacts to local crop production (TID 1997).

To minimize these potentially adverse impacts on crops, the TID provides groundwater control or drainage pumping in areas where groundwater levels are within six feet of the ground surface. TID owns and operates approximately 170 drainage wells within their service area. In recent history subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage is typically discharged into the District's canal system where it is utilized, as much as possible, for irrigation (TID 1997).

B.2 GROUNDWATER RESOURCES OF THE MODESTO BASIN

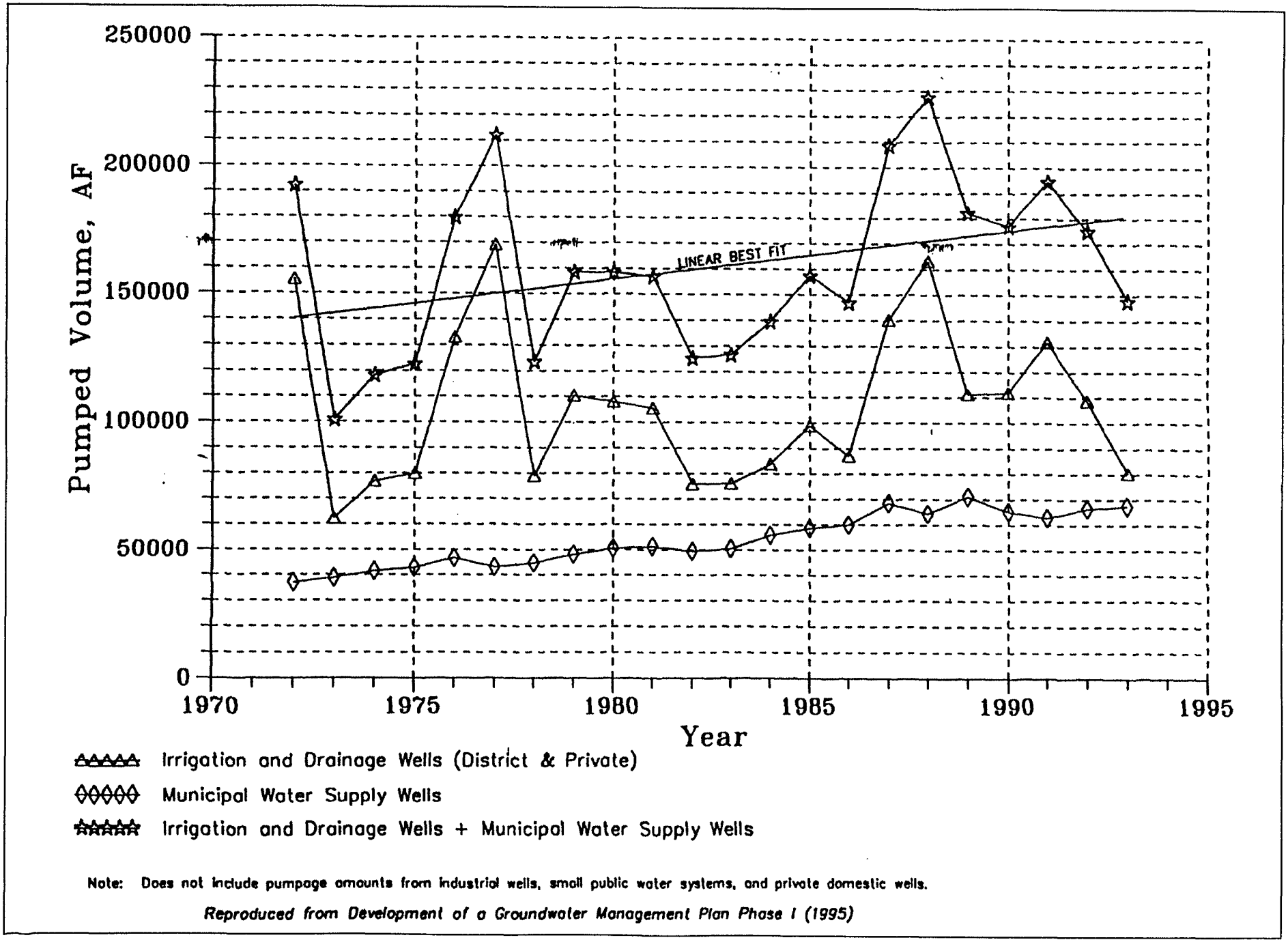
B.2.1 Physical Description of the Modesto Basin

The Modesto Groundwater Basin is located in eastern Stanislaus County, which is part of the northeastern San Joaquin Valley. Elevations range from over 200 feet on the east to less than 40 feet on the west. The location of the Modesto Groundwater Basin is shown on Figure 3.1-1 in Section 3.1. The major physical features in the Modesto Groundwater Basin include the Sierra-Nevada foothills, the broad alluvial plain, and the Stanislaus and Tuolumne rivers that bound the basin on the north and south.

The alluvial and continental deposits constitute two principal aquifers, which are separated by the Corcoran Clay in portions of the Modesto Basin. Although these deposits are characteristically heterogeneous in composition, the interbedded clays, with the exception of the Corcoran Clay, are generally discontinuous. Groundwater in both the shallow alluvial aquifer system overlying the Corcoran Clay and the aquifer system to the east is considered to be unconfined.

B.2.2 Groundwater Balance in the Modesto Basin

Estimates of pumpage during the period of 1972-1993 were compiled from data provided by Modesto Irrigation District (MID) and Oakdale Irrigation District (OID). The Oakdale Irrigation District is divided by the Stanislaus River into the north zone and south zone. The south zone information is described in the Modesto groundwater Basin and the north zone is described in the Eastern San Joaquin County Basin. Data are summarized in Figure B.2-1, which includes estimated pumpage amounts from agricultural irrigation and drainage wells, private and Modesto Irrigation District wells, and municipal water supply wells, including Modesto, Riverbank, and Oakdale public supply wells. Data on pumping from a number of significant sources were not available, including industrial wells, small public water system, rural residential, and rural domestic wells.



Note: Does not include pumpage amounts from industrial wells, small public water systems, and private domestic wells.

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Figure B.2-1. Estimated historic groundwater pumping in the Modesto Groundwater Basin.

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Pumpage amounts have varied widely from year to year, peaking in drought years. Pumpage in the project area averaged approximately 160,000 acre-feet per year in the basin from 1970 through 1990 (FGMP MID 1996). An overall upward increase in annual groundwater use is observed, which roughly corresponds to the increase in pumpage from urban areas. Of the 160,000 acre-feet average amount, approximately 44,000 acre-feet per year was in the Modesto area; 7,000 acre-feet per year from other smaller urban areas; and 109,000 acre-feet per year from MID, OID, and privately-owned irrigation and drainage wells. By 1994, pumpage in the Modesto urban area increased to around 60,000 acre-feet, and pumpage in the other smaller urban areas increased to approximately 8,000 acre-feet, for a total municipal pumping rate of approximately 68,000 acre-feet in the Basin. These rates do not include the city of Oakdale, OID's small public water system, or the numerous private domestic wells located throughout the Basin.

B.2.2.1 Groundwater Balance Calculations by DWR

The Department of Water Resources (DWR) Bulletin 160-93, *California Water Plan Update* published in October 1994, included an estimate of various components of the groundwater balance for the Modesto Basin. The components included:

Groundwater extraction	236,000 acre-feet per year
Overdraft	15,000 acre-feet per year
Perennial Yield	221,000 acre-feet per year

DWR defines overdraft as "the condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions." Perennial yield is the maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition. The perennial yield was estimated by DWR by plotting the change in groundwater level against the amount of groundwater extracted each year over a 13-year period ending in 1982. A best fit curve was drawn and the intersections of the best fit curve with the line showing zero groundwater level change determines the estimated perennial yield of the basin.

B.2.2.2 Groundwater Balance Calculations by HCI Inc.

Table B.2-1 summarizes the average annual values for the various components of inflow and outflow that were utilized in modeling the area that approximates the Modesto Groundwater Basin (Hydrologic Consultants Inc. 1993). The average annual water budget for 1952-91 indicated an average overdraft of 2,300 acre-feet per year. Many inflow and most outflow component values were not directly measured but were estimated. Water level records for the model indicated that the

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water levels in most wells in most of the area fell between 1971 and 1991. A slight overdraft was indicated by the water level decline, which averaged approximately 0.5 feet per year (HCI 1993).

Table B.2-1: INFLOW AND OUTFLOW IN THE MODESTO GROUNDWATER BASIN

Values Based on 40 Year Average	Acre-Feet per Year
Inflow	
Deep Percolation and Canal Seepage	226,000
Stream Bed Seepage	17,000
Modesto Reservoir Seepage	40,000
Groundwater Inflow	2,000
Total	**285,000**
Outflow	
Irrigation and Drainage Well Pumping	100,000
Municipal Pumping	
Discharge to Streams	37,000
Total	150,000
	287,000
Difference	
Change in Storage	**-2,000**

Source: Hydrologic Consultants, Inc., September 1993.

MID reports in their 1996 *Final Groundwater Management Plan* that estimated long term decline in storage, rural plus urban, in the Basin is about 3,000 acre-feet per year. This estimate represents the average reductions in groundwater storage during the base period, and can be considered as overdraft. It should be noted that changes in storage in recent years have greatly exceeded this long term average, due to the 1987-1992 drought (MID 1996).

B.2.3 Groundwater Elevations and Flow Direction

The depth to groundwater in most of the Modesto Basin ranges from less than 5 feet to over 100 feet bgs. The measurement used to collect the data for these maps was collected from approximately 243 wells within and in the vicinity of the Modesto Basin.

Fluctuations of water levels are of two main types, seasonal and long term. These fluctuations are controlled in the project area by irrigation practices, drainage techniques, and local pumpage. In areas of intense pumpage such as around the vicinity of Modesto, the water table declines during the summer and rises during the winter. Long term fluctuations, such as those reported by DWR (HCI 1992) indicated that the Modesto Groundwater Basin represented by DWR's Detailed Analysis Unit

206 has experienced groundwater level declines of 15.3 feet for the period 1970–90. This decline represents depletion of storage of 404,000 acre-feet.

Figure B.2-2 represents conditions which existed in spring 1985 after a period of relatively high rainfall and runoff. The spring 1994 map (Figure B.2-3), shows conditions after a prolonged period of relatively low rainfall and runoff. These two conditions represent relative extremes in the hydrologic record. In comparing the two water-level elevation maps, the water levels over most of the project areas dropped at least 10 feet from 1984 to 1994. Areas near pumping centers experienced even greater water level declines.

Changes in groundwater levels also affect streamflow in the rivers bordering the basin. Where groundwater elevations at the river are significantly lower than the water surface elevation in the river, streams lose flow through seepage into the groundwater and thus provide recharge. In 1985, the only river section which appeared to be significantly losing stream flow was an approximately five-mile long reach of the Tuolumne River near central Modesto. In 1994, this reach had extended approximately five additional miles to the east. Also in 1994, the entire portion of the Stanislaus River east of Highway 99 was apparently a losing stream (MID 1997).

In 1985, gaining reaches within the Basin included the Stanislaus River east of Riverbank, the Stanislaus River upstream of the confluence with the San Joaquin River, the San Joaquin River, and the Stanislaus River upstream of the San Joaquin confluence.

B.2.4 Projected Basin Water Demand in the Modesto Basin

Projected agricultural and municipal groundwater demands for the MID service area are listed in Table B.2-2. Projections are based on land use, irrigation applications, and population projections. The projections in Table B.2-2 were developed for the MID Irrigation Master Plan.

Table B.2-2: PROJECTIONS OF AGRICULTURAL AND MUNICIPAL GROUNDWATER DEMANDS IN THE MODESTO GROUNDWATER BASIN

Year	Agricultural Demands (AF/Yr)	Municipal Demands (AF/Yr)	Total Groundwater Demand (AF/Yr)
1995	69,000	39,000	108,000
2000	94,000	53,000	147,000
2010	117,000	45,000	162,000
2020	147,000	75,000	222,000

Source: Modesto ID 1996

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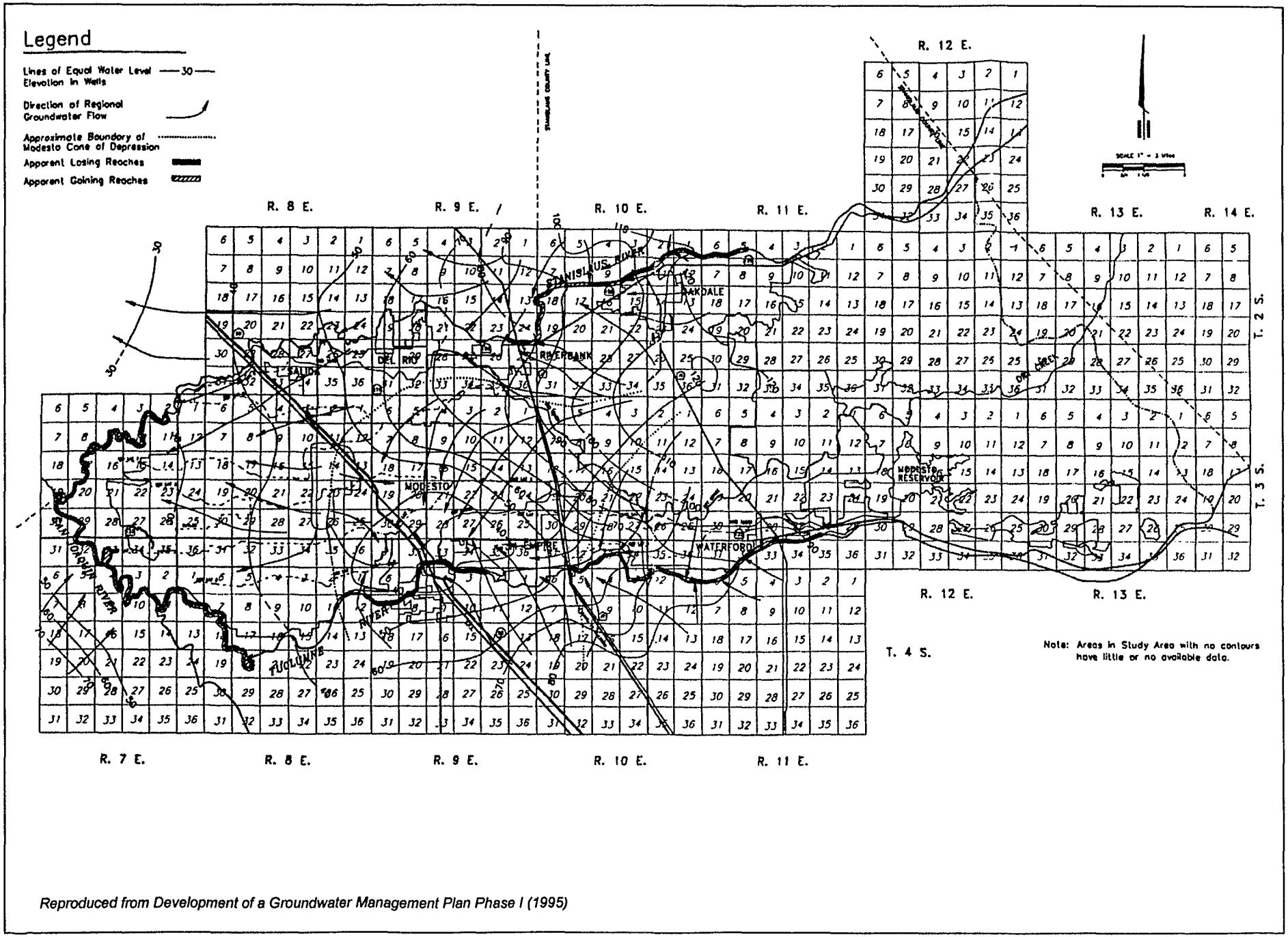

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Figure B.2-2. Regional water level elevation in wells and direction of groundwater flow - Spring 1985.

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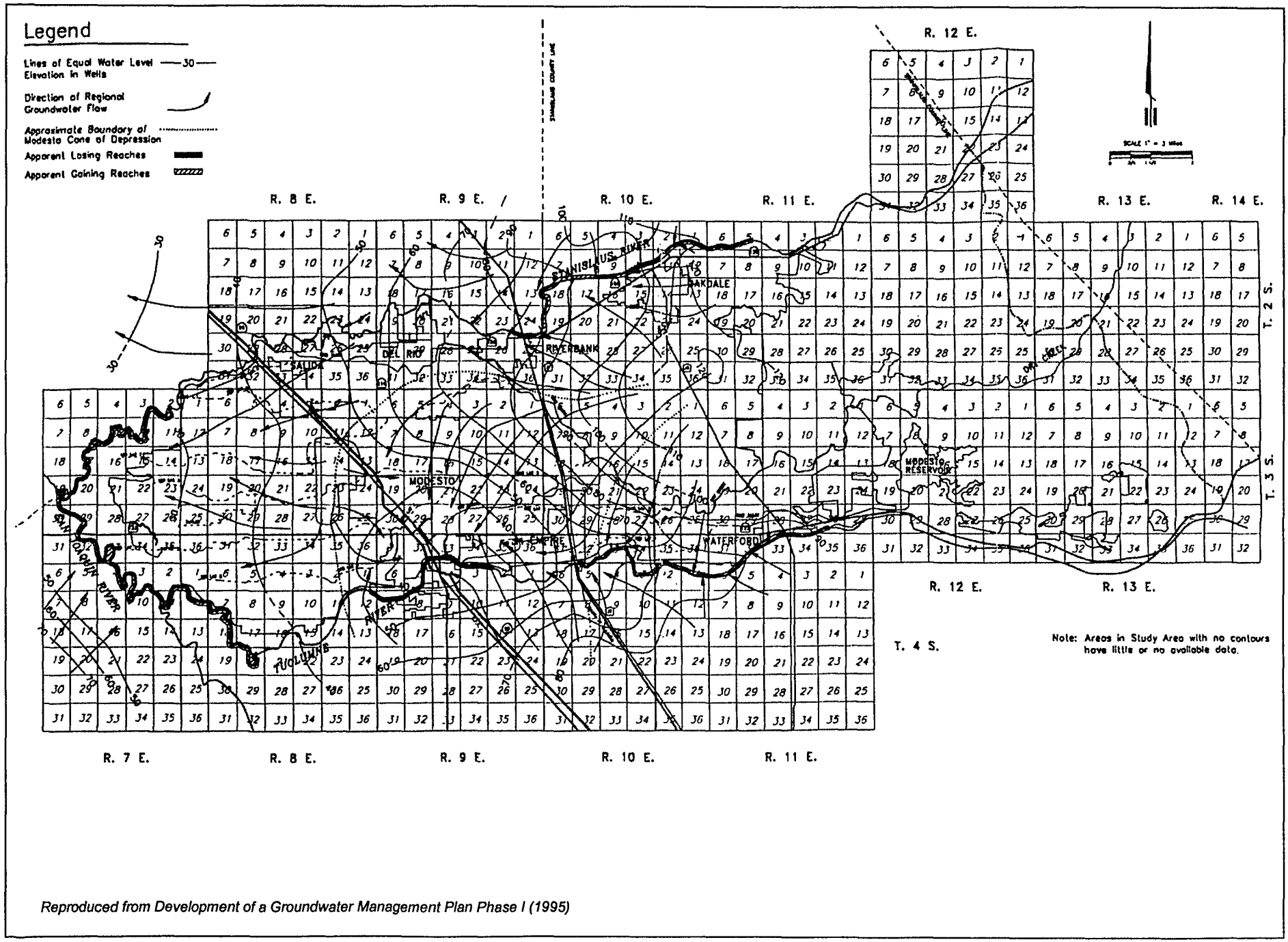

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Figure B.2-3. Regional water level elevation in wells and direction of groundwater flow - Spring 1994.

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Projections for MID, OID and private agricultural groundwater use could range from approximately 69,000 acre-feet per year in 1995 to between 95,000 and 148,000 acre-feet per year in 2020. The broad interval for projected agricultural groundwater use in 2020 represents uncertainty associated with regulations and cost on local water supplies and the adoption of changing irrigation technologies.

Urban growth is a significant trend in the Modesto area (MID 1996). Urban land use is steadily displacing agricultural land, and with this transition the need for potable water is also projected to increase in the future. Municipal and industrial groundwater uses in the Modesto urban area that include the cities of Modesto and Waterford and the communities of Salida and Empire are projected to increase from about 34,000 acre-feet per year in 1995 to approximately 62,000 acre-feet per year in 2020 (MID 1996). Similarly, urban groundwater production for the cities of Riverbank and Oakdale is expected to increase from about 5,000 acre-feet per year in 1995 to almost 10,000 acre-feet per year in 2020 (Table 3.3-5 in Section 3.3).

B.2.5 Groundwater Quality in the Modesto Basin

According to Hall (1960), the chemical quality of water in the Mehrten is usually good in the northern part of the area, including Riverbank and Oakdale, but may be poor, depending on depth along the Tuolumne River east of Empire. West of Empire and Riverbank, the chemical water quality of the Mehrten is generally very poor. Saline water present in the Mehrten is a mixture of saline brines migrating upwards from the underlying marine layer and the downward percolation of groundwater through the Mehrten.

Groundwater quality within the Modesto Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics have been found in the groundwater. In addition to the water constituents listed above, some localized areas within the Basin have been contaminated through spills or dumping of hazardous materials. The Basin includes two Superfund sites: the Norris plant located south and east of Riverbank, and Halford Cleaners located in the city of Modesto.

B.2.5.1 Total Dissolved Solids

TDS concentrations in water from most of the wells in much of the project area relatively low, presenting few problems for agricultural or potable uses. Water from wells in the Del Rio, Riverbank, Oakdale, Waterford, and northern Modesto areas have concentrations of TDS below 500 mg/l. TDS Concentrations in water from many of the wells west of Highway 99 are between 500 and 1,000 mg/l. Some of these would be high enough to affect yields of salt sensitive crops. Most crops in the area, however, would not be affected by these salinity concentrations. A number of

scattered wells in Central Modesto also have TDS levels between 500 and 1,000 mg/l. Some of these wells produce at least some of the pumped water from below the Corcoran Clay. These levels exceed recommended levels for drinking water, but are below the maximum allowed.

B.2.5.2 Nitrates

A large zone of nitrate concentrations ranging from 64 to 96 mg/l was found in seven wells beneath the western part of the basin in the early 1990s. The eastern boundary of this zone is approximately three miles west and parallel to Highway 99.

A second zone of nitrate concentrations exceeding the MCL was detected in groundwater samples collected from wells tapping groundwater beneath the city of Modesto in the area north of the Tuolumne River and West of Highway 99. Water from six wells in this area had nitrate concentrations between 47 to 86 mg/l in the early 1990s. Most of this high nitrate area coincides with the former City sewage effluent disposal area. The remaining areas of high nitrate concentrations appear to be relatively localized point sources located near the Tuolumne River.

B.2.5.3 Arsenic

Arsenic concentrations in water from public water supply wells in the Modesto Groundwater Basin are generally below the current MCL of 0.05 mg/l. However, the EPA is expected to lower the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which will have a considerable impact to groundwater supplies for drinking water. In fact, the lowest MCL considered by EPA is higher than natural levels of arsenic that are present in groundwater in the basin. Much of the deeper groundwater will then be unusable for public supply without arsenic removal.

B.2.5.4 Iron and Manganese

Groundwater in the western part of the Basin near the San Joaquin River frequently has high concentrations of naturally occurring iron. Deeper groundwater is also found to have elevated levels of iron and manganese. Shallow groundwater near streams often show high levels of manganese and sometimes high iron concentrations.

B.2.5.5 Radionuclides

Groundwater with high uranium activities has been found in part of Modesto and in Empire. The occurrences are indicated to be natural and are based on available data (MID 1997). The largest area appears to be in Modesto. Uranium activity in water from six wells ranged from 20 to 37 picocuries per liter in 1994. Most of the area with high uranium concentrations is east of Highway 99 and northwest of Dry Creek. Two north-northeast trending bands are present in this area, and are

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suggestive of buried stream channel deposits. The EPA has discussed establishing a standard for radon in drinking water.

B.2.5.6 Pesticides

DBCP has contaminated the groundwater in portion of the basin, exceeding the MCL in three areas. The largest area is in eastern Modesto and Empire. Most of this area is located between MID Lateral 3 and the Tuolumne River. The western edge of this area is several miles northeast of Highway 99. The area extends about five to six miles from east to west, and from two to three miles from north to south. Water from seven wells in this area exceeded the MCL.

Central Modesto has relatively large area of high DBCP concentrations, primarily northeast of Highway 99. High DBCP concentrations have also been detected south of Del Rio. DBCP concentrations ranged from about 0.3 to 0.5 ug/l in water from three wells in this area. DBCP has been detected in groundwater in several other areas of the basin, including Waterford and West Modesto, but at concentrations less than the MCL. The Riverbank and Oakdale areas have not had DBCP contamination problems, based on available data.

B.2.5.7 Other Trace Organics

Other trace organic compounds have been detected in the groundwater in and around the Modesto area. These include the nematacide, EDB, carbon tetrachloride, and petroleum products from such sources such as underground storage tank leaks. Volatile organic compounds (VOCs) derived primarily from solvents have locally contaminated the groundwater in a number of places in and around the city of Modesto. Some of these can be attributed to dry-cleaning establishments and other industries that used solvents. Perchloroethylene (PCE) has been detected at one time or another in nine of the city of Modesto's wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in some urban areas, such as Turlock and Merced. Several fuel leaks from USTs have also occurred in and around the Modesto area. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been affected. The extent of MTBE in groundwater within the basin has not been fully evaluated.

B.2.6 Land Subsidence in the Modesto Basin

Currently ground subsidence is not a problem within the MID service area.

B.2.7 Agricultural Subsurface Drainage and Waterlogging in the Modesto Basin

Drainage wells have been employed by MID to control shallow groundwater levels in the western part of the MID service area since 1918 (MID 1996). The drainage wells are pumped to maintain

groundwater levels below the crop root zone which allows the leaching of naturally occurring salts from the root zone. The area affected by shallow groundwater has declined through the years because of the increased use of groundwater in the Modesto urban area. The use of drainage wells in areas no longer affected by shallow groundwater has been discontinued or the wells are now used as irrigation wells (MID 1996).

B.3 GROUNDWATER RESOURCES OF THE MERCED GROUNDWATER BASIN

B.3.1 Physical Description of the Merced Groundwater Basin

The Merced Groundwater Basin lies on the eastern side of the San Joaquin Valley, located entirely within Merced County, and is generally described as the eastern one-half of Merced County. The groundwater system is bounded by the Merced River on the north, the San Joaquin River on the west, and the Chowchilla River on the south, as shown in Figure 3.1-1 in Section 3.1.

Four aquifers have been identified beneath the Merced area by the United States Geological Survey (Page 1977). From deepest to shallowest, they are as follows:

- The Mehrten Formation which is a maximum thickness of 700 feet and is composed of sandstone, siltstone, and claystone. The hydraulic conductivity is low to moderate, and the TDS is greater than 2,000 ppm throughout the area.

- A confined aquifer between the Mehrten Formation and the base of the Corcoran Clay which reaches a maximum thickness of 700 feet and is composed of gravels, sand, silt and clay. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm, except in the far western portion of the area.

- An intermediate aquifer above the Corcoran Clay and below the shallow clay with a maximum thickness of 700 feet and is composed of gravels, sand, silt and clay. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm.

- A shallow unconfined aquifer with a maximum thickness of 100 feet that is composed of gravels, sand and fine sand. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm.

B.3.2 Groundwater Balance in the Merced Groundwater Basin

The total annual application of groundwater for irrigation purposes varies from year to year depending on the availability of surface water. Table B.3-1 displays agricultural water usage. Groundwater supplies an average of fifty-one percent of the total irrigation water applied to land

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within the basin, or approximately 621,000 acre-feet per year. Deep percolation of groundwater used for irrigation returns a portion of the extracted groundwater to the aquifer.

Table B.3-1: AVERAGE ANNUAL AGRICULTURAL USAGE IN THE MERCED GROUNDWATER BASIN.

	Surface Water		Groundwater		Total
Agency	AF/Yr	Percent	AF/Yr	Percent	AF/Yr
Merced Irrigation District	522,000	96.3	20,000	3.7	542,000
Individual Growers, MID, & SOI	–	0.0	510,000	100.0	510,000
LeGrand-Athlone Water District	5,000	6.8	68,800	93.2	73,800
Merquin Water District	22,000	88.0	3,000	12.0	25,000
Stevinson Water District	26,400	100.00	–	0.0	26,400
Turner Island Water District	–	0.0	–	100.0	-
Total	575,400	48.9	601,800	51.1	1,177,200
	Surface Water		**Groundwater**		**Total**
Agency	**AF/Yr**	**Percent**	**AF/Yr**	**Percent**	**AF/Yr**
Atwater Canning (effluent)	350	100.0	–	0.0	350
City of Atwater WWTP (effluent)	4,050	100.0	–	0.0	4,050
City of Merced WWTP (effluent)	7,525	100.0	–	0.0	7,525
Lipton/Ragu (effluent)	815	100.0	–	0.0	815
Total	12,740	100.0	–	0.0	12,740
	Surface Water		**Groundwater**		**Total**
	AF/Yr	**Percent**	**AF/Yr**	**Percent**	**AF/Yr**
Grand Total	588,140	49.4	601,800	50.6	1,189,940

Source: ***Merced Groundwater Basin, Final Draft Groundwater Management Plan*, 1997.**

From approximately 1890 to 1915, the city of Merced used surface water conveyed by pipeline from Lake Yosemite for its primary supply. Since about 1915, all municipal consumers within the Basin have relied solely on groundwater as the source of supply. The municipal suppliers (major utilities) within the Basin are: the cities of Merced, Atwater, and Livingstone; the Winton Water and Sanitary District; the Planada and Le Grand Community services districts; the Black Rascal Mutual Water Company and the Meadowbrook Water Company. In 1996, 36,134 acre-feet was produced by the water utilities (Table B.3-2). The city of Merced is the largest municipal water producer, with 57

percent of the total. An additional estimated 3,866 acre-feet was produced by small private residential water systems, commercial business and industrial plants not served by the major utilities.

Table B.3-2: GROUNDWATER USAGE BY MUNICIPALITIES IN THE MERCED GROUNDWATER BASIN

	1996	Annual Production		Per Capita
Agency	Population	Mil. Gal.	Percent	gpd
Black Rascal Water	320	43	0.4%	366
City of Atwater	21,133	2,367	20.1%	307
City of Livingston	10,490	1,491	12.7%	389
City of Merced	61,187	6,729	57.2%	301
Le Grand CSD	-	-	0.0%	-
Meadowbrook	3,960	359	3.0%	248
Planada CSD	3,500	275	2.3%	215
Winton Water & San.	9,000	511	4.3%	155
Total	109,590	11,774	100.00%	294
Total (acre-feet)		36,134		

Source: ***Merced Groundwater Basin, Final Draft Groundwater Management Plan*, 1997.**

The various components of the groundwater balance for the Merced Basin were estimated from data supplied in the Merced Groundwater Basin, Groundwater Management Plan (Merced ID 1997). The components included:

Groundwater extraction	637, 974 acre-feet per year
Overdraft	20,000 acre-feet per year
Perennial Yield	617,974 acre-feet per year

DWR defines overdraft as "the condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions." Perennial yield is the maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition.

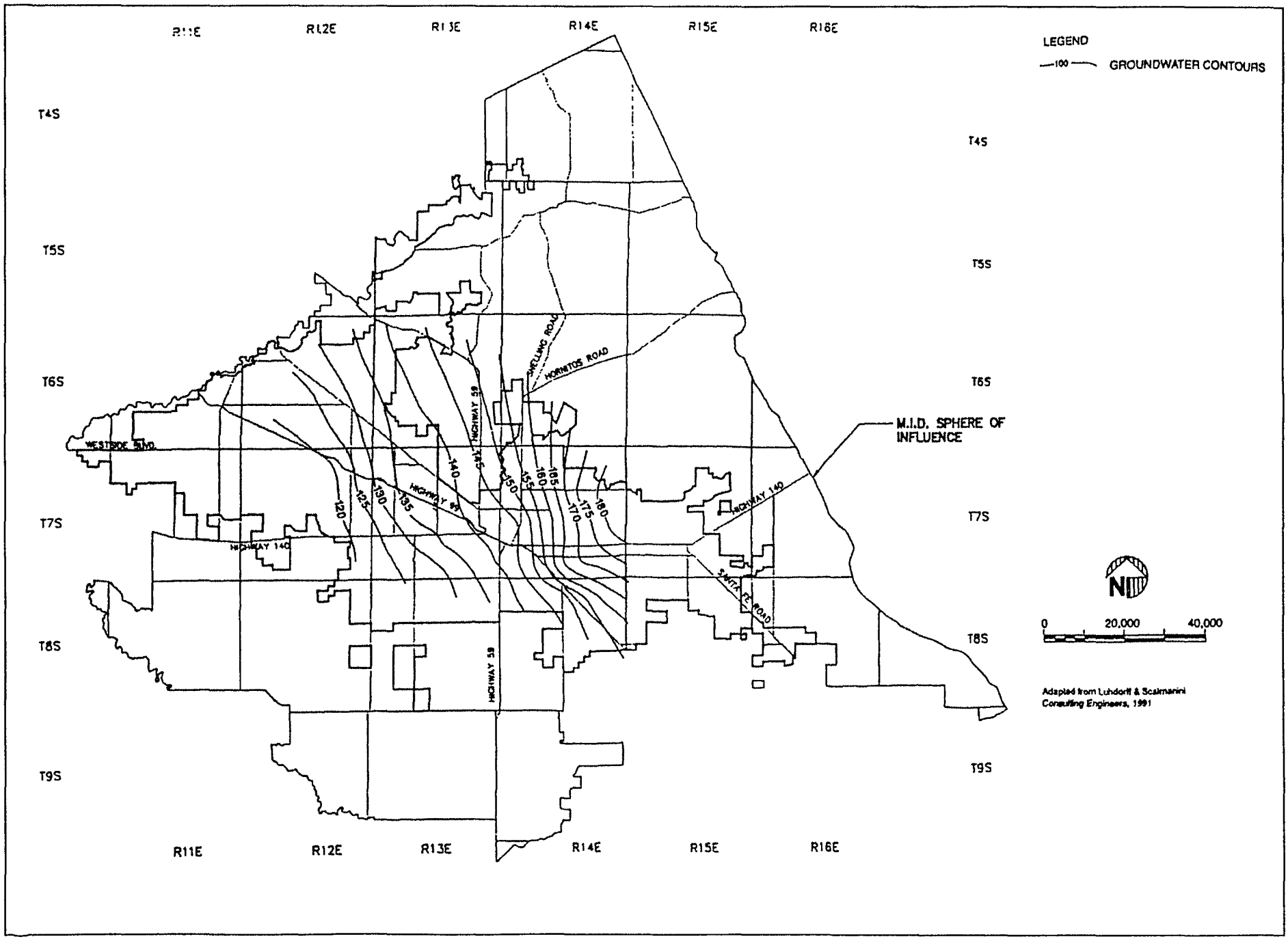

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Figure B.3-1. Contours of equal groundwater elevations, Fall 1974. *Merced County, California.*

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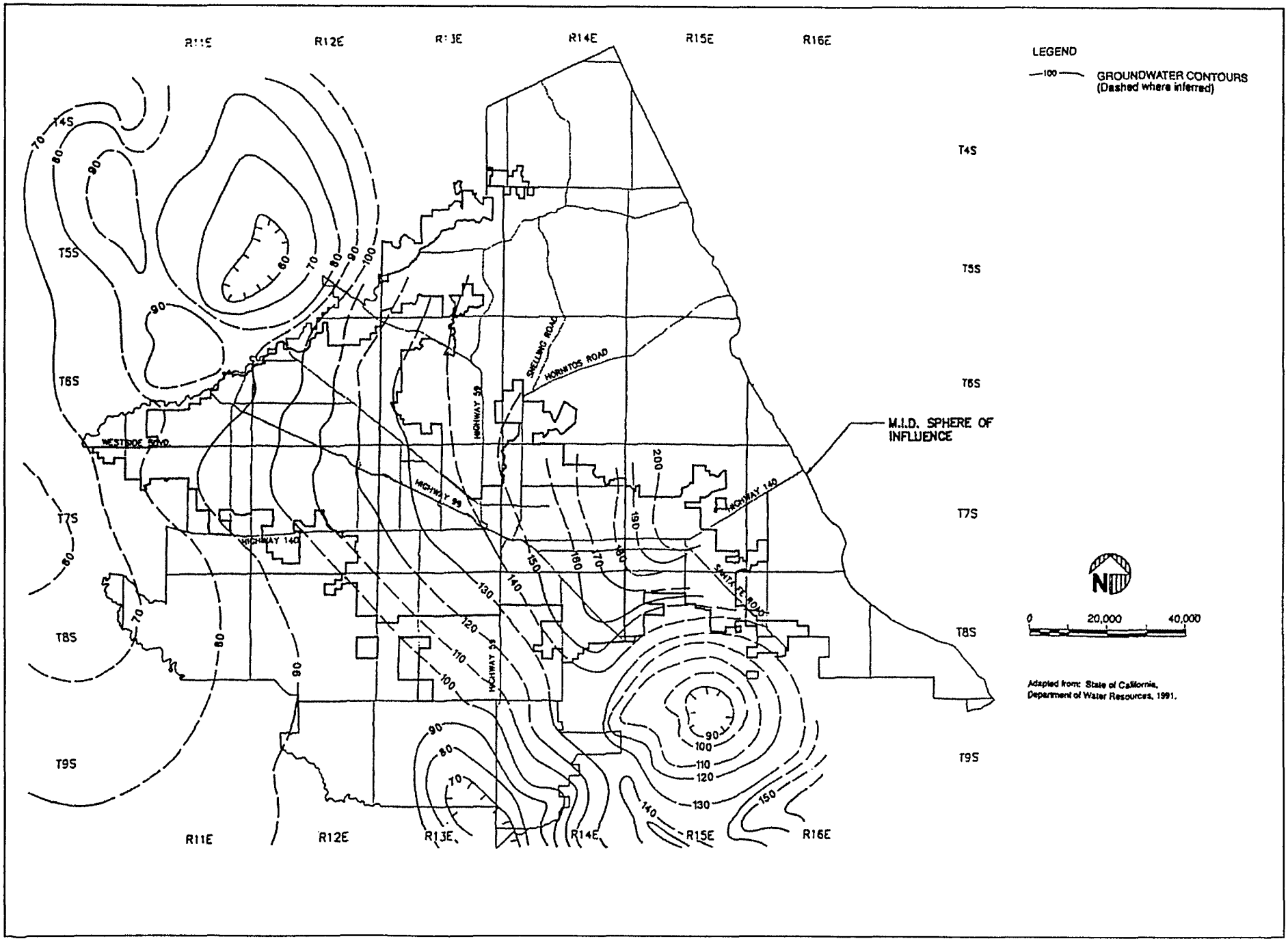

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Figure B.3-2. Contours of equal elevations of water in wells, unconfined aquifer, Spring 1988. *Merced County, California.*

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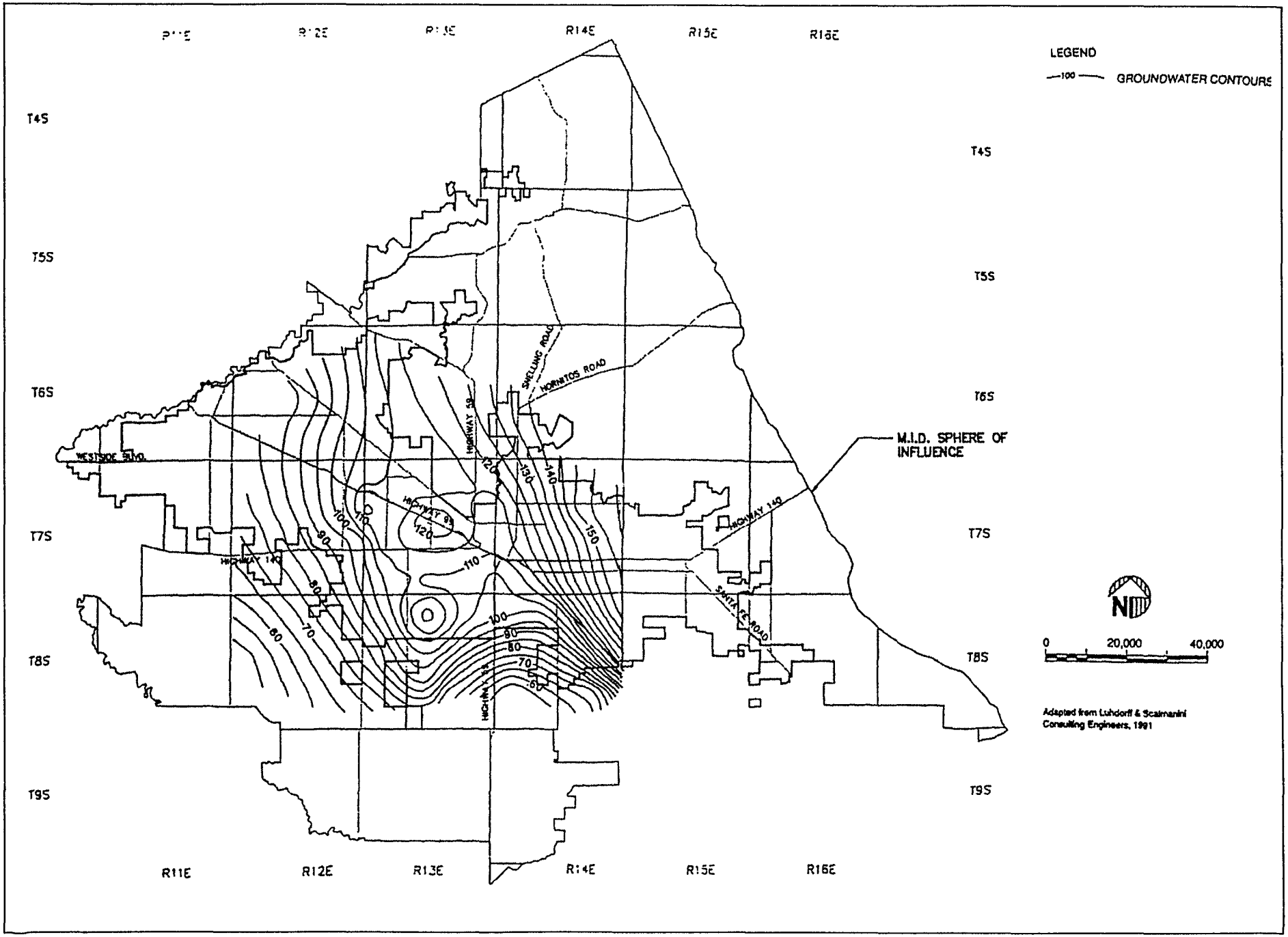

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Figure B.3-3. Contours of equal groundwater elevations, Fall 1990. *Merced County, California.*

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B.3.3 Groundwater Elevations and Flow Direction

Groundwater is found at shallow to moderate depths in the Merced Basin. Since 1982, the depths to water ranged from 1 to 15 feet bgs in the city of Merced and up to 100 feet bgs in the El Nido area.

Figures B.3-1, B.3-2, and B.3-3 show the elevations of groundwater in the fall of 1974, the spring of 1988, and the fall of 1990. The 1974 contours are believed to represent steady state conditions; the 1988 and 1990 groundwater contours are representative of drought conditions (Luhdorff and Scalmanini 1991). The 1994 contours indicate that flow is towards the west-southwest in the areas were levels were contoured. The contours are relatively evenly spaced and straight, indicating uniform flow across the contoured area.

B.3.3.1 Fluctuations in Groundwater Elevations

There is a strong seasonal variation on the order of up to 4 feet with depths to water the shallowest during the summer irrigation season. Long term water level data indicates that the Merced Groundwater Basin has experienced groundwater level declines of up to 40 feet during the period 1960-92. This decline represents depletion of storage of 404,000 acre-feet.

B.3.3.2 Recharge

The Merced Groundwater Basin is part of the larger San Joaquin Basin system, and edge effects along the boundaries of the Modesto Groundwater basin cause impacts to the Basin. The hydrologic system includes not only the groundwater system but also the agricultural and urban land surface system. The latter systems comprise all of the processes that affect the delivery, consumption, and recharge of groundwater within agricultural and urban areas. Deep percolation of applied surface water to agricultural areas, is the major sources of groundwater recharge for the Basin. Precipitation also is an important source of water to the larger hydrologic system, but only a small proportion of groundwater recharge occurs as a result of precipitation.

B.3.4 Projected Basin Water Demand

Agricultural land within the Basin uses an average of 1,272,400 acre-feet per year. On the average, the total crop-water requirement is comprised of approximately fifty percent or 640,800 acre-feet of groundwater. Overall, the Basin's agricultural acreage is expected to modestly increase, although total water use will decline because of increased water use efficiency and a trend toward cultivation of lower water use crops.

The population and developed municipal acreage are projected to triple by the year 2030 (Merced ID 1997). Using current population trends, as determined by Merced County Association of

Governments, the regional planning agency, the Basin's population is expected to increase from 180,000 in 1996 to over 540,000 by 2030 with developed acreage increasing proportionately. As a result, the average daily urban water use is expected to increase from 35.6 million gallons per day (MGD) in 1996 to 108 MGD in the year 2030. In addition, the majority of municipal/industrial demand is projected to be concentrated along the Highway 99 corridor. If groundwater remains the sole source of municipal supply, it is estimated that 72 new wells will be required to serve the cities of Atwater, Livingston, and Merced and the University of California Merced campus (Merced ID 1997).

B.3.5 Groundwater Quality in the Merced Groundwater Basin

There are numerous constituents detected in the Merced Groundwater Basin groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. The constituents identified in this section either currently impact groundwater usage within the Basin or have the potential to impact the Basin's future groundwater usage.

B.3.5.1 Total Dissolved Solids

TDS in groundwater in the eastern two-thirds of the Basin are generally less than 500 ppm. TDS increases westward towards the San Joaquin River and southward towards the Chowchilla River. In these areas, high TDS water is found in wells deeper than 350 feet. Higher quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.

Groundwater with high TDS concentrations in the Basin is principally the result of the migration of a deep, saline water body which originates in regionally deposited, marine sedimentary rocks that underlie the San Joaquin Valley. Groundwater with high TDS is present beneath the entire Basin at depths from about 400 feet in the west to over 800 feet in the east. The shallowest high TDS groundwater occurs in zones five to six miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Milam, where high TDS groundwater is upwelling.

B.3.5.2 Nitrates

Natural nitrate concentrations in groundwater range from 0.1 to 10 mg/l (Driscoll, 1986). The Meadowbrook Water Company has one well that, based on 10-year trend analysis, is expected to reach the MCL (45 mg/L) in 10 to 12 years. The Planada Community Services District has two wells that are at or near the MCL.

B.3.5.3 Arsenic

Arsenic concentrations in water from public water supply wells in the Basin are below the current MCL of 0.05 mg/l. However, the EPA is expected to lower the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which will have a considerable impact to groundwater supplies for drinking water.

B.3.5.4 Iron and Manganese

Groundwater in some areas within the Basin has elevated iron and manganese. Manganese is found near the Merced Airport at relatively shallow depths (Merced ID 1997).

B.3.5.5 Pesticides

The MCL for DBCP is 0.2 micrograms per liter (ug/l). DBCP has been detected in groundwater samples from public water supply wells in the Merced area at levels at or below the MCL. Another agricultural pesticide (nematicide) that has been detected in the Basin's groundwater is EDB. EDB was banned in the early 1980s, but has been detected in at least one public water supply well and individual wells in the Atwater/Livingston area.

B.3.5.6 Organics

Trichloroethylene (TCE) has been detected in groundwater samples from two locations within the Basin, Castle Airport & Aviation & Development Center and Merced's Eastern Industrial Park. Both sites have identified plumes and have remediation activities in progress (Merced ID 1997). One of the city of Merced's municipal water supply wells (No. 10A) was replaced in 1988 when TCE was detected in concentrations exceeding the MCL.

PCE has been detected at one time or another in some of the Basin's public water supply wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in many municipal areas, including Merced. Beginning in 1986, PCE was detected in three of the City of Merced's wells. As a result, these three wells were replaced or rebuilt in the late 1980s.

Several fuel leaks from USTs have also occurred in and around the Modesto Area. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been affected. The extent of MTBE in groundwater within the basin has not been fully evaluated.

B.3.6 Land Subsidence in the Merced Groundwater Basin

Ground subsidence is not currently a significant problem in the Merced Groundwater Basin. The groundwater basin is projected to continue to be overdrafted as a result of groundwater extraction rates exceeding recharge rates. Water levels within the Merced ID Groundwater Basin are projected to continue to decline, which could result in a loss of aquifer storage and localized land subsidence.

B.3.7 Agricultural Subsurface Drainage and Waterlogging in the Merced Groundwater Basin

The area of the Basin located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has experienced localized high groundwater levels. Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water.

To minimize these potentially adverse impacts, Merced ID provided groundwater control or "drainage pumping" in areas where groundwater levels were within 6 feet of the ground surface. Ninety-five wells, specifically designed and located for drainage purposes, were used. This localized condition within Merced ID has declined steadily over the past 10 years. As a result, many of the drainage wells are now used for irrigation during periods when insufficient surface water is available. Water pumped from these wells is typically discharged into Merced ID's water distribution where it is utilized, as much as possible, for irrigation.

B.4 GROUNDWATER RESOURCES IN THE EASTERN SAN JOAQUIN COUNTY GROUNDWATER BASIN

B.4.1 Physical Description of the Eastern San Joaquin County Groundwater Basin

The Eastern San Joaquin County Groundwater Basin (ESJCGB) is located in northeastern San Joaquin Valley, encompassing agricultural land and a few urban centers (Figure 3.1-1 in Section 3.1). The major physical features in the Basin include the Sierra-Nevada foothills, the broad alluvial plain, and the Stanislaus River. Both the Stanislaus and other tributaries draining from the Sierra Nevada flow in a southwesterly to westerly direction and discharge into the San Joaquin River which in turn flows northwestward to the Sacramento-San Joaquin Delta.

The ESJCGB contains three important hydrogeologic formations — the Victor, Laguna, and Mehrten Formations. The Victor formation is the uppermost formation ranging from ground level down to 150 feet. The Victor formation is coarser grained than the underlying formations, as a result, surface waters migrate down through the Victor Formation and enter the deeper formations (SSJID 1994). The Laguna Formation is estimated to be 600 to 1000 feet thick composed of discontinuous lenses

of unconsolidated to semi-consolidated sands and silts with lesser amounts of gravel and silt (SSJID 1994). This formation has a moderate permeability. Below the Laguna formation lies the Mehrten formation composed of semi-consolidated to consolidated silts, sands and gravels. Within the ESJCGB the formation is found 800 to 1,100 feet bgs and is approximately 600 feet thick.

The Valley Springs Formation underlies the Mehrten Formation and contains saline water of marine origin. This formation is not used for water supply.

B.4.2 Groundwater Balance of the ESJCGB

This section includes a review of groundwater pumpage estimates and water usage of the two irrigation districts within the ESJCGB — the South San Joaquin Irrigation District (SSJID) and Oakdale Irrigation District (OID). The Stanislaus River divides the OID into a northern section and a southern section. The northern section is described herein. This section also summarizes a review of a previous groundwater budget by UMA Engineering Inc, 1988. Tables B.4-1 and B.4-2 display the water budget for the SSJID and the OID.

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Table B.4-1: SOUTH SAN JOAQUIN IRRIGATION DISTRICT WATER BUDGET (1979-1998)

Water Supply	Water Budget (AF)	Groundwater Budget (AF)
Inflow to Woodward Reservoir	272,000	
Seepage from Woodward Reservoir	(20,000)	20,000*
Evaporation from Woodward Reservoir	(12,000)	
Precipitation onto Woodward Reservoir	5,000	
Net Available Water at Woodward:	**245,000**	
Canal Seepage	(10,000)	10,000
Canal Evaporation	(1,000)	
Main Canal Spills	0	
Intercepted Flows from OID	8,100	
Total Surface Water Supply:	**240,100**	
Total Rainfall	89,000	
Total Available Water Supply to Farm:	**371, 500**	
Water Uses		
Crop ET	(172,000)	
Evaporation from Soil and Water Surfaces	(23,900)	
Runoff and Surface Water Return	(57,000)	
Other Losses	(14,000)	
Deep Percolation of Rain and Applied Water	(104,600)	104,600
Subtotal:	**(371,500)**	
Other Groundwater Budget Components		
Water Table Pumping		(3,400)
Groundwater Storage Decline		4,000
Net Groundwater Outflow:		**72,800**

Source: ***South San Joaquin Irrigation District Groundwater Management Plan, 1994***
Notes: Numbers in ( ) are negative.
*Seepage flows north of district (not included in groundwater budget).

Table B.4-2: OAKDALE IRRIGATION DISTRICT STUDY AREA NORTH STANISLAUS RIVER WATER BUDGET (1970–1992)

	Water Budget (AF/Yr)	Groundwater Budget (AF/Yr)
Water Supply		
North Main Canal	114,000	
Gambini Pump	500	
Groundwater Pumping		
- Private Wells	20,000	(20,000)
- District Wells	5,000	(5,000)
- Reclamation Wells	10,000	(10,000)
Precipitation	37,500	
Water Uses		
Crop Evapotranspiration	(72,000)	
Evaporation Losses	(18,800)	
Canal Seepage	(13,000)	13,000
Surface Runoff	(33,000)	
Urban Losses	(1,000)	
Reclaimed Well Water Delivered Outside Study Area	(1,600)	
Return Flows to SSJID Canal	(6,100)	
Net Deep Percolation of Precip and Applied Water	**(41,500)**	**41,500**
Observed Change in Groundwater Storage		3,000
Seepage From Woodward Reservoir		20,000
Net Groundwater Outflow		**(36,500)**

Source: ***South San Joaquin Irrigation District Groundwater Management Plan,*** **1994**
Note: Numbers in ( ) are negative

B.4.2.1 Surface Water

The surface water supply budget for SSJID is estimated by the inflow into Woodward Reservoir. The average inflow between 1979 and 1988 was 272,000 acre-feet. Precipitation onto Woodward Reservoir contributes an additional 5,000 acre-feet. Subsurface drainage lost in the reservoir is estimated at 20,000 acre-feet per year. This is removed from the available surface water supply but is not included in the ground water budget because the water flows north, away from SSJID and towards the pumping depression east of Stockton. Another 12,000 acre-feet is lost to evaporation.

The surface water supply for OID averages 115,000 acre-feet per year. This includes 114,000 acre-feet in the North Main Canal and 500 acre-feet from the Stanislaus River. SSJID intercepts about 6,100 acre-feet of OID's return flows annually. Combining surface water gains and losses from SSJID and OID, the total available surface water supply in the Eastern San Joaquin County Basin is 355,000 acre-feet.

B.4.2.2 Groundwater

Agricultural pumping of all the irrigation wells in the SSJID produced an annual discharge of 32,400 acre-feet. The cities of Manteca, Ripon and Escalon rely entirely on groundwater and annually pump an average of 16,200 acre-feet per year (SSJID 1994).

Groundwater pumping from OID produced an annual discharge of 35,000 acre-feet. Private wells, district wells and reclamation wells produced 20,000 acre-feet, 5,000 acre-feet, and 10,000 acre-feet respectively.

Combined, SSJID and OID pump approximately 83,600 acre-feet annually. This represents a storage decline of 7,000 acre-feet.

B.4.2.3 Water Use

Consumptive use by vegetation via evapotranspiration on agricultural lands accounts for 244,000 acre-feet per year. Evaporation loss from soil and water surfaces accounts for 42,700 acre-feet per year. Surface water return flows and runoff account for 96,100 acre-feet per year. This includes urban rainfall runoff, irrigation spills, and surface runoff from rainfall. Other losses include municipal and industrial water uses. These uses consume approximately 17,200 acre-feet per year. The net groundwater outflow from the ESJCGB is the net change of all inputs and outputs. Approximately 108,800 acre-feet per year leaves ESJCGB. Much of this water migrates north to the pumping depression east of Stockton. Some of the water flows west toward the San Joaquin River (SSJID 1994).

B.4.3 Fluctuations in Groundwater Elevations

Within the ESJCGB, groundwater flows southeast to northwest (SSJID 1993). Groundwater elevations in the project area are controlled by natural recharge in the winter and spring and irrigation practices, drainage techniques, and local pumpage in the summer and fall. Since 1964, groundwater levels within the SSJID district have declined 20 to 30 feet, with about 10 feet occurring between 1987 and 1993 (Kreinberg 1994). The majority of this decline has occurred in the central and eastern areas of the district, possibly a result of the cone of depression east of Stockton. North of SSJID and the area between Manteca and Lathrop water levels in the fall dropped below sea level. Water levels south of Manteca, along the Stanislaus River, remained relatively constant between the spring and fall measurements.

Wells in the OID service area show a seasonal fluctuation of five feet between fall and spring levels.

B.4.3.1 Recharge

The groundwater under the ESJCGB is recharged from four general sources: the Stanislaus River, groundwater inflow from the foothill areas, irrigation and precipitation, and the recharge ponds within the SSJID.

B.4.4 Projected ESJCGB Water Demand

Urban growth is a significant trend in the San Joaquin drainage. Urban land use is steadily displacing agricultural land. Associated with this transition is the need for increased potable water. The Eastern San Joaquin groundwater study, October 1985, estimated the perennial yield of groundwater to be 1.0 acre-feet per acre per year. This is a general estimate for the entire county. Perennial or safe yield is the amount of ground water that can be extracted without adversely affecting groundwater levels or water quality.

Currently, the annual water usage within the cities of Ripon, Manteca, and Escalon average 2.5 acre-feet per acre per year. As a result, groundwater levels are decreasing. Most notably, there is a cone of depression forming around the town of Manteca. This urban demand is estimated to increase to over 58,000 acre-feet at build out (SSJID 1993).

B.4.5 Groundwater Quality of the ESJCGB

The municipal well supplies, as required by the Department of Health Services, monitors groundwater quality. Otherwise, groundwater quality is not monitored. The water quality monitoring show increasing levels of both organic and inorganic contaminants. The primary inorganic contaminant in the well water for the city of Manteca is nitrates. Low levels of DBCP

have also been detected. The wells supplying water for Ripon have also experienced elevated levels of nitrate. As a result, several wells have been closed. Trace levels of organic contaminants have also been detected in Ripon's wells (SSJID 1994). The town of Escalon has experienced elevated levels of nitrates and DBCP in their shallow wells (250-300 feet). Escalon has constructed several new wells, withdrawing ground water from 600 feet deep. Contaminants in the deeper wells have not been detected.

B.4.6 Land Subsidence in the ESJCGB

Ground subsidence is not reported to be a significant problem in the ESJCGB. Overdrafting in urban areas located within and adjacent to the SSJID service area water levels may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

B.4.7 Agricultural Subsurface Drainage in the ESJCGB

Agricultural subsurface drainage is not a significant problem in the ESJCGB. Agricultural subsurface drainage and the associated problems may be a problem in isolated areas immediately adjacent to the San Joaquin River.

B.5 GROUNDWATER RESOURCES OF THE EXCHANGE CONTRACTORS WATER AUTHORITY

B.5.1 Physical Description of the Exchange Contractors Service Area

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) is a Joint Powers Authority organized under the Joint Exercises of Powers Act. The member agencies are the Central California Irrigation District (CCID), Firebaugh Canal Water District (FCWD), Columbia Canal Company (CCC), and San Luis Canal Company (SLCC). The Exchange Contractors service area lies on the western side of the San Joaquin Valley, and encompasses portions of Fresno, Stanislaus, Merced and Madera counties. The service area is situated along the west bank of the San Joaquin River as shown in Figure 3.1-1 in Section 3.1; the Columbia Canal Company is on the east bank of the San Joaquin River.

The Exchange Contractors service area is located on a broad alluvial plain located approximately at the structural axis of the San Joaquin Valley formed by large coalescing alluvial fans draining the eastern slopes of the Coast Range and western slopes of the Sierra-Nevada. The San Joaquin River flows along the structural axis of the valley and is generally contained between natural and artificial levees. Many shallow natural drainage channels and sloughs meander across overflow lands adjacent to the main river channel.

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Unconfined groundwater flow in the areas west of the San Joaquin River generally moves from the southwest towards the northeast, although groundwater pumpage creates cones of depression and irrigation may cause mounding, complicating the flow patterns and causing them to change with time. The response of the aquifers to changes in pumpage and irrigation is relatively rapid, and flow directions are affected by these changes.

In 1981, groundwater was entering the upper aquifer from upslope areas along virtually all of the west and southwest boundaries of the service area (Schmidt and Associates 1997). West of a north-south line, extending from the Dos Palos Y at Highway 152, groundwater flow was primarily to the northeast or north toward the northern part of the Grassland Water District and the San Joaquin River. In the reach north of an east-west line passing through Gustine, groundwater on both sides of the river flows towards the river. A north-south trending groundwater divide was present just east of Dos Palos. A northeasterly direction of groundwater flow was indicated for the area east of this divide. Groundwater in the upper aquifer east of this divide was moving beneath the San Joaquin River and into the Madera area. This flow was due to extensive groundwater pumping in the Madera area.

In spring 1992, a period of deficient water supply was noted by the development of a cone of depression south of Crows Landing and northeast of Newman (Schmidt and Associates 1997). There was an additional groundwater cone of depression east and southeast of Mendota, which was primarily due to pumping by the Mendota Pool pumpers. The groundwater divide east of Dos Palos had migrated farther west than in Spring 1986, and near where it was located in Fall 1981. Otherwise the regional direction of flow in the upper aquifer was generally the same as in Fall 1981 and Spring 1986.

B.5.2 Groundwater Balance in the Exchange Contractors Service Area

The groundwater system in the southern San Joaquin Valley provides a supply of irrigation water when surface deliveries to the area are reduced due to hydrologic conditions. The groundwater system in the Exchange Contractors service area is divided into two aquifers divided by the Corcoran Clay. The groundwater components which influence the groundwater supply are shown in Figure B.5-1.

The long-term hydrogeographic record for the Exchange Contractors service area shows that groundwater is in balance or is rising (See Figures B.5-2, B.5-3, B.5-4 and B.5-5). Table B.5-1 summarizes the long-term water level trends in the Exchange Contractors service area. The predominant trend for water levels in groundwater production wells tapping strata above the Corcoran Clay in Sub-Areas A, B, and E is long-term constancy. In Sub-Area C, about half of the wells have rising water levels, and the remainder have relatively constant water levels. In Sub-Areas F, G, and I, the predominant long-term trend in the wells tapping strata above the

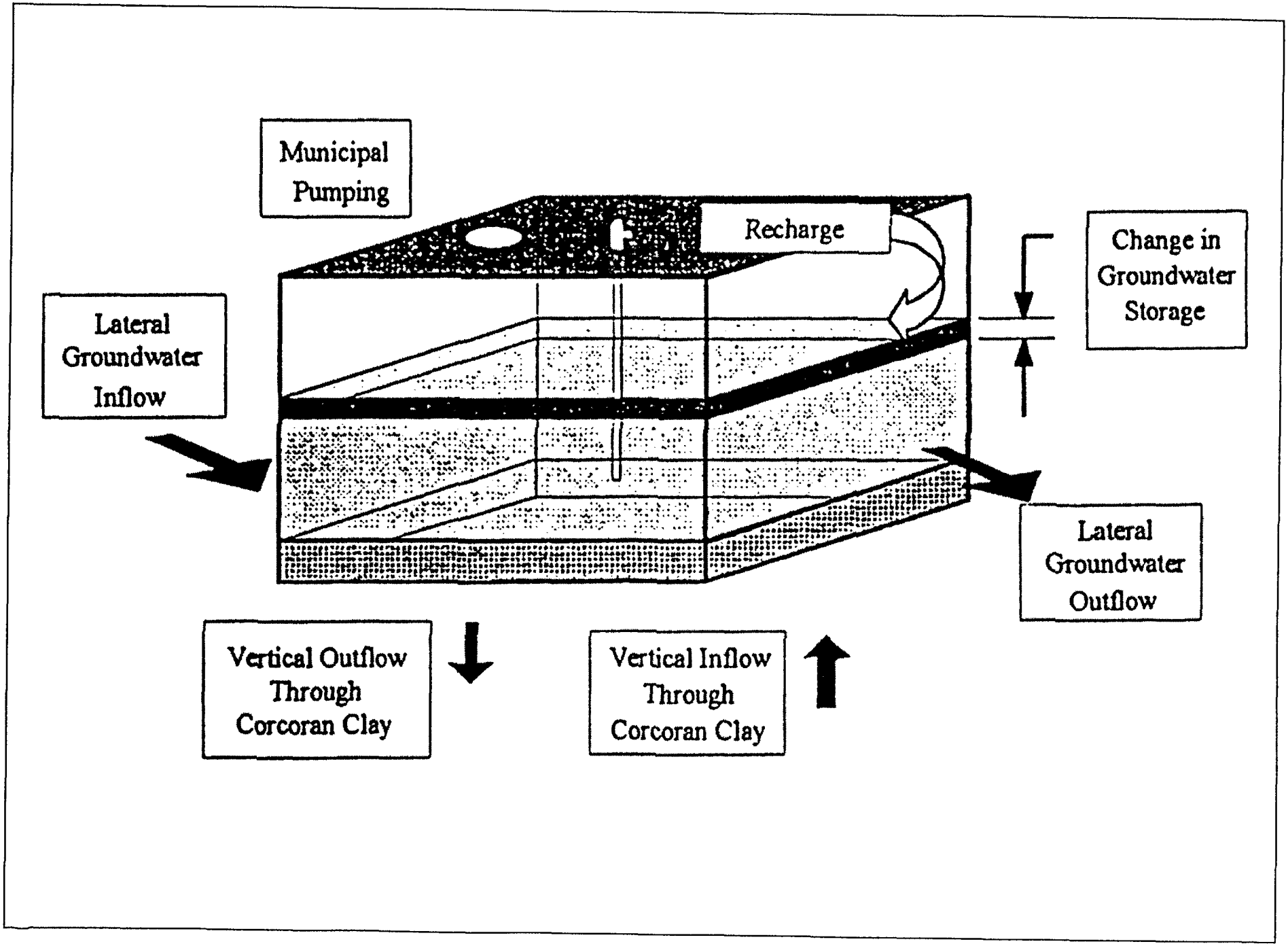

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Figure B.5-1. Groundwater components.

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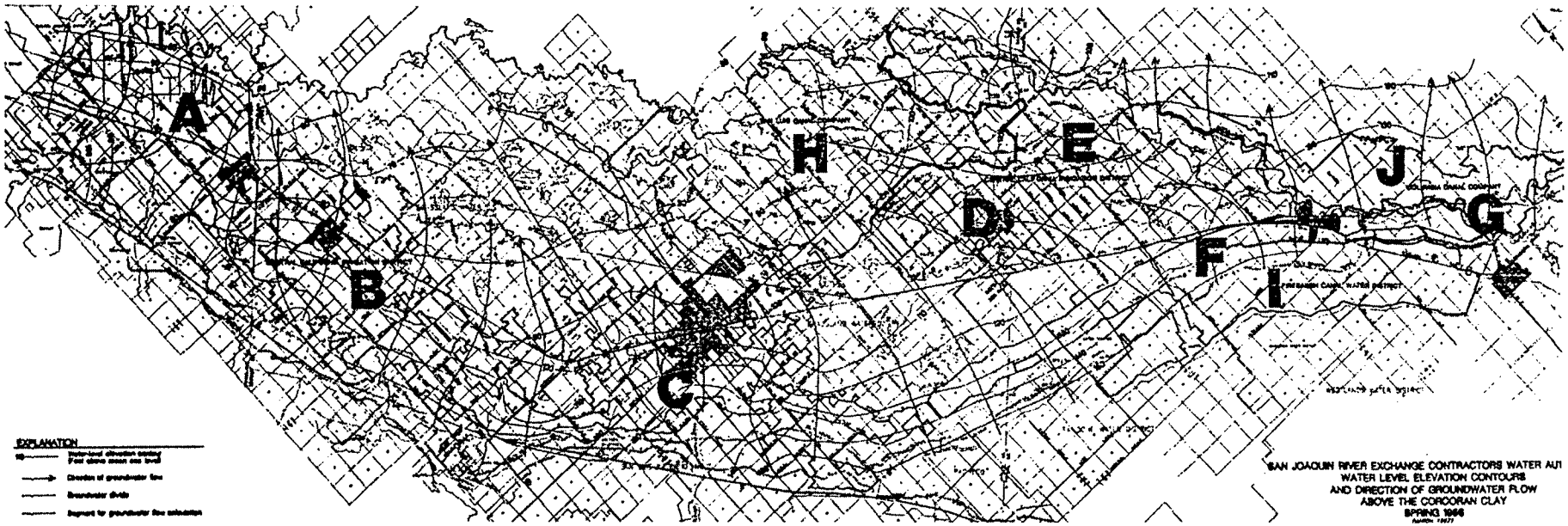

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Figure B.5-2. Water level elevation contours and direction of groundwater flow, above the Corcoran Clay, Spring 1986.

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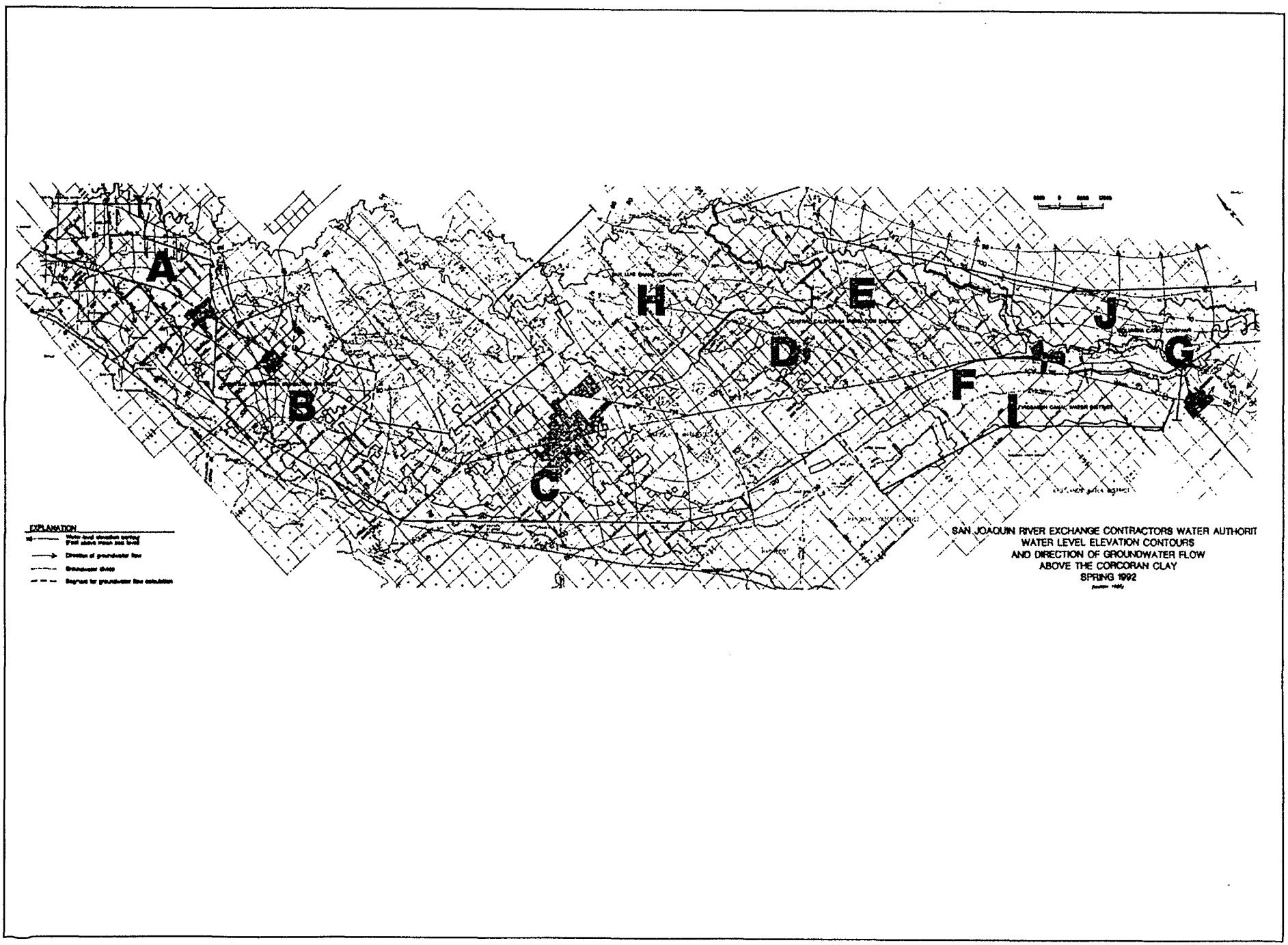

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Figure B.5-3. Water level elevation contours and direction of groundwater flow, above the Corcoran Clay, Spring 1992.

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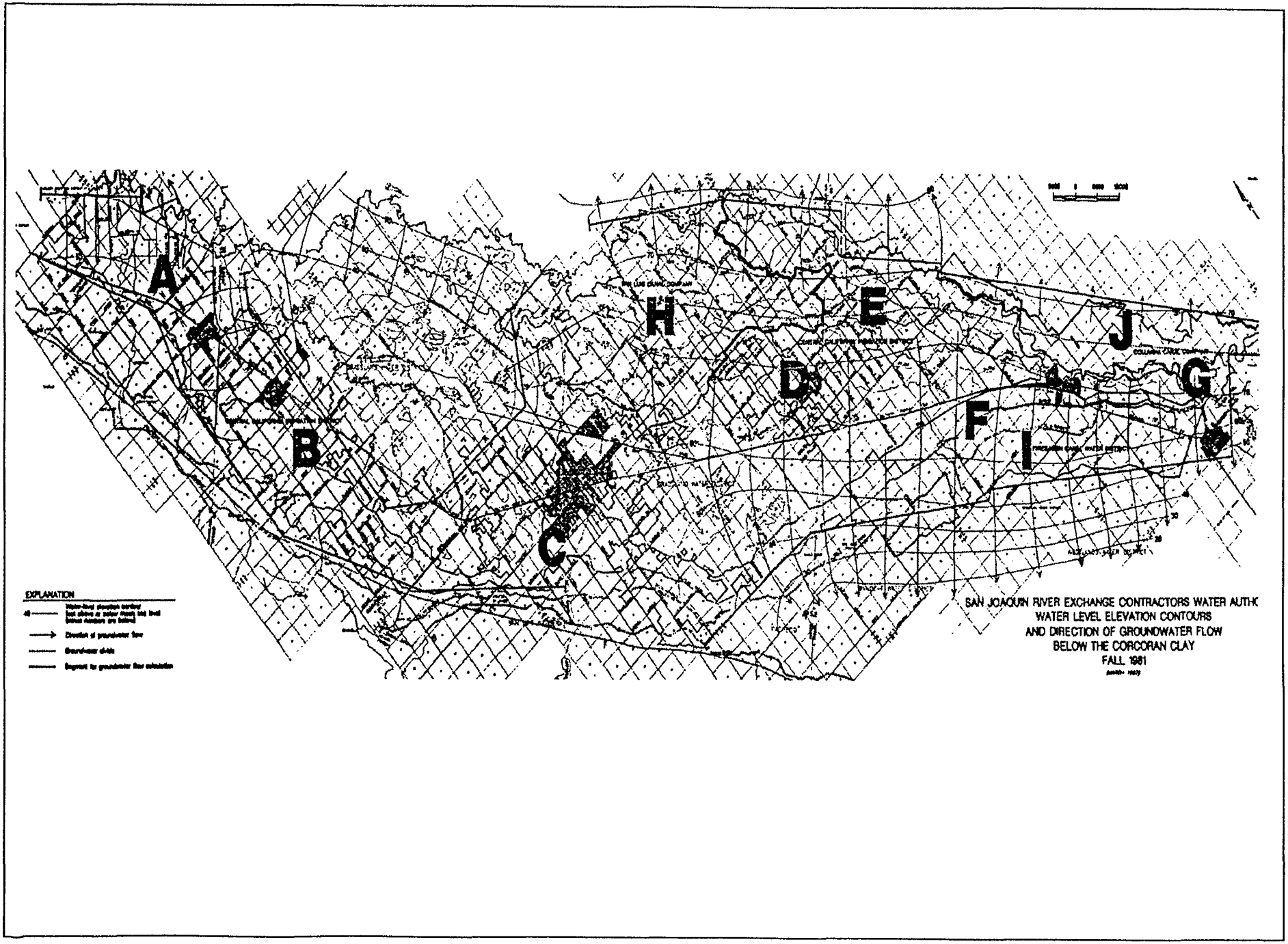

Figure B.5-4. Water level elevation contours and direction of groundwater flow, below the Corcoran Clay, Fall 1981.

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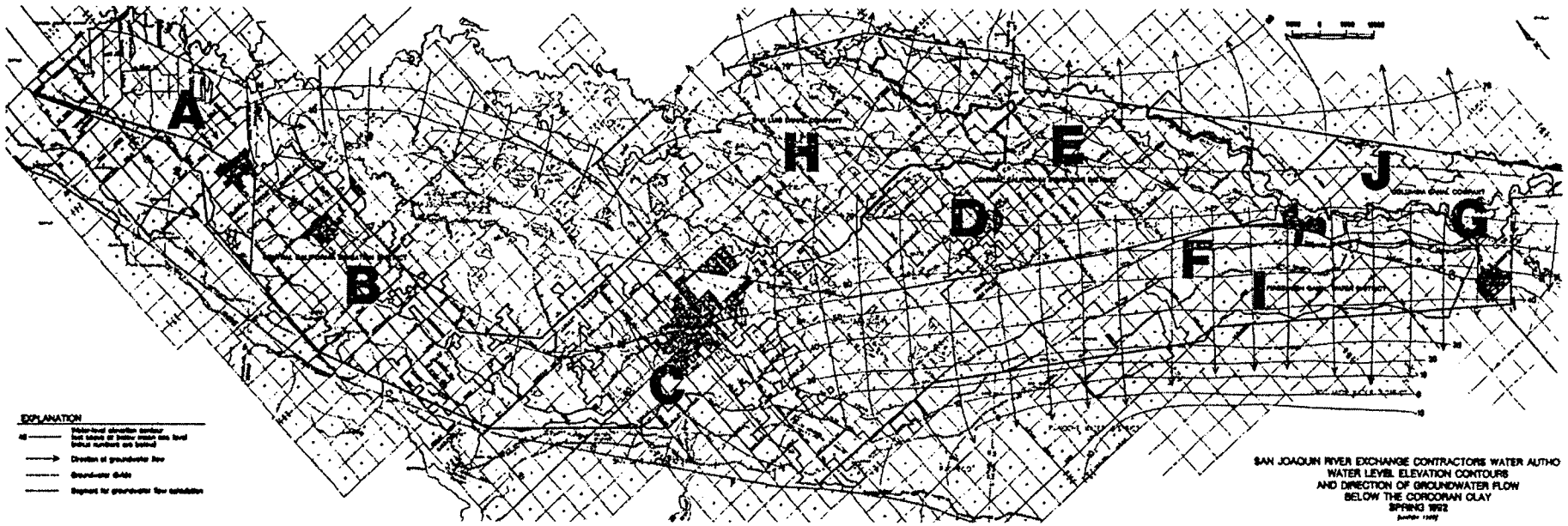

Figure B.5-5. Water level elevation contours and direction of groundwater flow, below the Corcoran Clay, Spring 1992.

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Corcoran Clay is one of rising water levels. On the long-term, water levels in most wells tapping strata below the Corcoran Clay were rising prior to 1989, except in Sub-Area B. In that sub-area, about half of the wells surveyed had no long-term water-level change. In Sub-Areas D, E, and G, little pumpage comes from the strata below the Corcoran Clay.

Table B.5-1: LONG-TERM GROUNDWATER TRENDS IN THE EXCHANGE CONTRACTORS SERVICE AREA (PRIOR TO 1990)[1]

Sub-Area[2]	Above Corcoran Clay	Below Corcoran Clay
A	80% Constant 20% Rising	33% Constant 66% Rising
B	70% Constant 20% Rising 10% Falling	50% Constant 50% Rising
C	45% Constant 55% Rising	100% Rising
D	No wells with long-term hydrographs, except very shallow	
E	80% Constant 20% Rising	No hydrographs
F&I	25% Constant 75% Rising	100% Rising
G	25% Constant 75% Rising	No hydrographs
DMC Pumpers	25% Constant 25% Rising 50% Falling	100% Rising

Source: SJRECWA 1998

1. Trends are prior to 1990, and the effects of pumpage by DMC and Mendota Pool pumpers are not known.
2. See Figures B.5-2, B.5-3, B.5-4 and B.5-5 for locations of the sub-areas.

Even during the recent drought, the groundwater basin supported significantly increased groundwater usage. The groundwater usage during droughts years averages 1.1 acre-feet per acre. Groundwater pumpage during normal years averages 0.6 acre-feet per acre.

Groundwater recharge to the Exchange Contractors service area occurs from several sources including:

- Subsurface lateral flow
- Creeks
- Surface Irrigation
- Precipitation

Table B.5-2 summarizes the annual average groundwater inflow/outflow within the service area for the period 1993-1996.

Table B.5-2: INFLOW AND OUTFLOW OF GROUNDWATER IN THE EXCHANGE CONTRACTORS SERVICE AREA (LONG-TERM AVERAGE NORMAL YEAR)

	Source	Acre-feet Per Year
Inflows	Subsurface Lateral	80,000
	Recharge (Rainfall, Creeks)	102,000
	Canal Seepage	112,000
	Deep Percolation/Leaching Rqmt.	24,500
	Total	**318,500**
Outflows	Subsurface Lateral	116,000
	Municipal Pumpage	16,500
	Vertical Through the Corcoran Clay	42,000
	Agricultural Pumpage	144,000
	Total	**318,500**
	Net Change in Groundwater Storage (Long-term Average-Normal Year)	**0**

Source: SJRECWA 1998

B.5.3 Projected Basin Water Demand in the Exchange Contractors Service Area

The projected agricultural demand for groundwater in the Exchange Contractors service area is static (SJRECWA 1998, personal communication). There are over 500 agricultural wells in the service area, and little or no expansion of the existing groundwater production well field is projected.

The Exchange Contractors project an increased demand for municipal water supply wells over the next 20 years. Currently the average annual groundwater production rate from municipal

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wells with the service area is 16,500 acre-feet. That figure is projected to double by the year 2020 (SJRECWA 1998, personal communication).

The Exchange Contractors portion of the San Joaquin River Agreement flow is estimated at 11,000 acre-feet annually. That equates generally to 11 wells pumping 1,000 acre-feet per year each or approximately two percent of the 500 wells in the service area. The amount of groundwater pumpage ranges from 0.6 to 1.1 acre-feet per year depending on the hydraulic conditions. This equates to 144,000 acre-feet (normal year) to 264,000 acre-feet (dry year). The 11,000 acre-feet ranges from eight percent to two percent, respectively, of the total pumpage depending on the year type.

B.5.4 Groundwater Quality in the Exchange Contractors Service Area

The Exchange Contractors report water quality issues within their service area occur only in urban areas. High manganese concentrations have been detected from groundwater samples collected from wells in Firebaugh and Mendota. The city of Dos Palos developed a surface water quality problem because of the poor quality of groundwater. The Exchange Contractors report that localized areas west and southwest of their boundaries contain poor quality water (SJRECWA 1997).

B.5.5 Land Subsidence in the Exchange Contractors Service Area

Subsidence occurs in the western San Joaquin Valley where land that had been used for grazing or dry farming was converted to irrigated agriculture. Subsidence in the San Joaquin Valley results from lowered groundwater elevations and the subsequent compaction of the deterred soil interstitial spaces. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than one foot. Land subsidence is a significant problem in the western San Joaquin Valley in the San Joaquin River basin. The largest of the three land subsidence areas in the San Joaquin Valley is the 2,600 square mile Los Banos-Kettleman City area which extends from Merced County to Kings County and lies within both the San Joaquin and Tulane Basins. Groundwater production prior to completion of the California Aqueduct in 1967 caused land subsidence of one foot regionally and up to 29 feet locally.

The Exchange Contractors have measured land subsidence annually within their service area from 1957 to 1962. During this period, land subsidence in their service area has ranged from less than a foot under the San Luis Water District to over four feet near the Mendota Pool. The Exchange Contractors will continue the annual subsidence monitoring within their service area. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas (DWR 1998). Recent increases in subsidence are the result of increased groundwater extraction to compensate for water supply deficiencies caused by Bay/Delta export restrictions.

B.5.6 Agricultural Subsurface Drainage and Waterlogging in the Exchange Contractors Service Area

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake regions (USBR 1997f).

The soils on the west side of the region are derived from marine sediments and are high in salts and trace elements. Irrigation of these soils has mobilized these compounds and facilitated their movement into the shallow groundwater. Since the 1950s, much of this irrigation has been with imported water, resulting in rising groundwater and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainage water frequently contains high concentrations of salts and trace elements (SJVDP 1990). Only a small portion (approximately 28,000 acres) of the Exchange Contractors service area is located within an area experiencing subsurface drainage problems.

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APPENDIX C

VEGETATION RESOURCES IN ECOLOGICAL ZONES

APPENDIX C

VEGETATION RESOURCES IN ECOLOGICAL ZONES C-1
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APPENDIX C
VEGETATION RESOURCES IN ECOLOGICAL ZONES

Vegetation resources in the project area are located in two ecological zones: San Joaquin River and East San Joaquin Basin. These zones are shown in Figure 3.5-1 and fully described in Section 3.5.1.

C.1 San Joaquin River Ecological Zone

This ecological zone is divided into four units, two of which will be potentially impacted by proposed pulse flows (CALFED 1998). The proposed project area does not include areas downstream of the San Joaquin River near Vernalis. The San Joaquin River between Friant Dam and the Mendota Pool in many years has no water, and the Mendota Pool is where some water input for the pulse flows could occur for the San Joaquin River. Therefore, the potentially affected ecological zones within the San Joaquin unit include the Vernalis Station to Merced Ecological unit, and the Merced River to Mendota Pool ecological unit. Both relevant ecological units will be treated as one because riparian vegetation is similar.

The San Joaquin River flows out of the southern Sierra Nevada foothills into the Central Valley at Friant Dam (river mile [RM] 267.5). Due to proposed project alternatives, the assessment of potential project effects is restricted to upstream of the San Joaquin River near Vernalis (RM 73) to the Mendota Pool (RM 205). Water diversion prevents the river from flowing until the Delta-Mendota Canal drains into the river at the Mendota Pool. In extremely wet water years, the Kings River is diverted north and drains into the San Joaquin River at Mendota Pool through the Fresno Slough. Twenty five miles downstream of the Mendota Pool, the Arroyo Canal (RM 182) de-waters the San Joaquin River until Bear Creek drains into it (RM 135.6). The combined effects of agriculture, levees, burning, urbanization and flow regulation have reduced riparian vegetation along California's third largest river to a shattered remnant of its former extent.

At Mendota Pool there is a 21-acre parcel on the east bank that has been reduced to a thicket of willows and exotic species in under 15 years. In 1984, the same stand had a canopy of cottonwoods that has since been burned.

Five miles downstream of Mendota Pool, riparian vegetation is continuous but is only one tree wide. On some point bars, riparian vegetation has been allowed to remain, but there are no valley oaks and few Fremont cottonwoods. Riparian vegetation is almost exclusively individual mature black willow trees, with an occasional pocket of cottonwoods. Where vegetation has not been completely removed to facilitate floodwater conveyance, it has encroached into the bankfull channel. Upstream of Firebaugh (RM 196), riparian vegetation reaches its widest point since Mendota Pool, yet at the downstream end of town near the sewage treatment facilities riparian vegetation is reduced to one tree width.

Between RM 192 and RM 190 riparian vegetation has been cleared, and mostly narrowleaf or arroyo willow resprouted. There is no continuity between riparian stands and the vegetation is sparse. Mature black willow trees have been left for their windbreak value only. Downstream of where the Arroyo Canal diverts the San Joaquin River (RM 181-182) and again dewaters the channel, the river corridor is devoid of any perceptible riparian vegetation, and grasses are all that remain.

From RM 181 to Fremont Ford (Valley Grasslands State Park), riparian vegetation consists of a line of black willow trees and grasses. This is the only region of the project area that has great valley grasslands.

At RM 171, some agriculture groundwater recharge creates ponds in the San Joaquin River channel. At the Sand Slough control structure (RM 168.7) flow is returned to the San Joaquin River, resulting in riparian vegetation with a much different character. Upstream of Sand Slough, the riparian vegetation has been cleared for ease of floodwater conveyance. Downstream of Sand Slough, riparian vegetation has not been cleared and is encroaching into the bankfull channel. Some meander lobes downstream of Sand Slough have been skimmed for gravel deposits; however, where riparian vegetation has been allowed to persist on abandoned oxbows, Fremont cottonwoods, valley oaks, and both tree and shrub form willows grow in multiple age classes with multistoried canopies.

Between RM 151-136, the river flows through several wildlife refuges. The floodway is wide but the lack of water results in riparian vegetation that is mostly grass and occasionally individual valley oaks. Because of a high soil pH and texture in this area great valley grasslands dominate riparian vegetation, and few riparian hardwoods are able to grow.

Where Bear Creek flows into the San Joaquin River, the discharge is roughly doubled, and riparian vegetation takes on a form that is consistent throughout the rest of the riparian corridor. Downstream of the Merced River confluence (RM 118.3), relic stands of valley oak border the floodway, narrowleaf willow grows in thickets within the floodway, and scroll bars are more evident. Where Orestimba Creek flows into the San Joaquin River upstream of Crows Landing (RM 109), a relic valley oak woodland with cottonwoods emerging over the oak canopy remains, and the delta deposit formed by Orestimba Creek is encroached with narrowleaf willow. In areas close to the channel, where frequently flooded agricultural land has been left fallow (RM 112, RM 108), riparian vegetation has begun to regenerate. Over the next two decades it is likely that a dense willow stand will cover them. Below the Merced River confluence, river migration is evident on aerial photographs. Migration could potentially introduce large woody debris into the channel, create fresh cut banks on the outside of meander bends, and deposit sediments on bars and floodplains creating new seed beds.

From the Merced River confluence to the San Joaquin River near Vernalis (RM 73), there are many remnant sloughs and oxbow channels. In many areas around sloughs, vegetation has been cleared;

however, where sloughs fall within the Army Corp of Engineers designated floodway, forests of willows box elders, cottonwoods and valley oaks remain. The sloughs have created islands where relic valley oak stands and cottonwoods persist. The vegetation is continuous and structural diversity varies from a multistoried canopy with 100 percent closure and a well developed understory to dense willow thickets. Over the long term, large stands (>5 acres) are in decline, and the interior of these large riparian tracts is often dying. There is no replacement of individual trees when they die.

Summary

Human disturbance, hydrology and fluvial geomorphic processes affect riparian vegetation. Currently riparian vegetation in the San Joaquin Basin is fragmented and reduced to a band often no more than a tree wide on either side of a river. Changes in river stage and land use practices could elicit a quantifiable response from vegetation. Pulse flow timing, frequency, magnitude and duration within the San Joaquin River and each tributary, combined with each species different annual life history strategy, could facilitate some natural regeneration and recovery.

C.2 East San Joaquin Basin Ecological Zone

All of the San Joaquin Rivers major tributaries are located in the East San Joaquin Basin Ecological Zone (CALFED 1998). As is more fully discussed in the aquatic resources section, this zone is divided into three ecological units, the Stanislaus, Tuolumne and Merced, which are characterized by the rivers that flow through them.

C.2.1 Stanislaus River Ecological Unit

With the closure of New Melones Dam on the Stanislaus River in 1980, the U.S. Army Corp of Engineers purchased and created a wider floodway corridor downstream of the dam. Because of this wider floodway, the Stanislaus River has the widest riparian corridor and the greatest quantity of vegetation compared to the other ecological units. However, narrowleaf willow has encroached into the low water channel. The proposed project will affect riparian vegetation downstream of Goodwin Dam (RM 58) to the river's confluence with the San Joaquin (RM 0). Between RM 36 and RM 40 the Stanislaus River's channel bed undergoes a transition from a gravelbed to sandbed. White alders grow along the bankfull channel in the gravelbedded reach and this changes to box elder in the sand bedded reach.

The effects of flow regulation are most notable on this river. Narrowleaf willow has encroached within the active channel to the low water margin throughout the entire river corridor from Knight's Ferry to the confluence with the San Joaquin. The youngest vegetation along the whole river is exclusively narrowleaf willow and box elder. On unvegetated sites only narrowleaf willow regenerates, while box elder is regenerating in the dense willow thickets due to its shade tolerance.

Urbanization and agriculture are two human disturbances that have had the greatest effects on riparian vegetation reduction on the Stanislaus River. Urban development has decreased riparian vegetation width through the city of Riverbank and Ripon (but not to the extent that the Tuolumne River suffers through Modesto). Removal of riparian vegetation for agriculture probably has caused most significant reduction in riparian vegetation coverage and diversity along the channel downstream of Knight's Ferry.

The net result of the designated floodway corridor, agriculture, flow regulation, and urban development has resulted in a riparian corridor that is wider than the other San Joaquin tributaries, but one that does not have a high species diversity, and suffers from extreme riparian vegetation encroachment into the low water channel.

The area around the confluence (RM 0) is comparable to a lush jungle contained between two levees. Three age classes of Fremont cottonwood stands are visible ranging from 10 to 75 years old. White mulberry is common in these older stands. Caswell State Park (RM 2.5- 8.5) is considered the best remaining example of great valley cottonwood and valley oaks forests still in existence. Vegetation patterns are distinct within the riparian forests at Caswell State Park. At the center of Caswell there is a stand of valley oak growing in a stellate pattern with each arm of the star being mature Fremont cottonwood stands. Riparian stands are so evolved at Caswell State Park that *Clematis* and grape lianas drape from the canopy to the ground and there is 100 percent canopy closure in many areas.

Where Caswell Park ends (RM 8.5), cottonwood and valley oak sharply decrease and are fragmented due to agricultural encroachment. Riparian vegetation is characteristic of agriculturally affected reaches: one tree width on either side of the channel. Where relic, senescent stands do occur, they are confined to pre-regulation floodplains and terraces, and are surrounded by a sea of narrowleaf willow. Narrowleaf willow is regenerating on point bar deposits within the active channel, which prevents these deposits from mobilizing during high flows.

Urban encroachment through the city of Ripon (RM 13.5-16) has reduced riparian vegetation along the channel. Riparian vegetation is contiguous with other large (> 5 acres) stands downstream. Although riparian vegetation is wider than one tree, the densest vegetation is along the low water channel margin and is limited to 125 feet in width. Upstream of Ripon, the riparian corridor is narrow but contiguous, and the dominant species is narrowleaf willow. An occasional box elder emerges, and a few pockets of valley oak remain beyond a dense band of mature narrowleaf willow.

Between Ripon and Oakdale, the combined effects of urbanization, agriculture, gravel mining and flow regulation are most pronounced. At RM 28 an old orchard has been left fallow on the left bank. The old fallow orchard is imbedded in a degenerating forest with many gaps and a few large cottonwoods and valley oaks; however, narrowleaf willow is the only plant regenerating in the orchard. By RM 30 riparian vegetation is mostly narrow leaf willow with an occasional strip of overhanging valley oaks. Although narrowleaf encroachment continues to dominate riparian

vegetation, there are a few mature or senescent Fremont cottonwoods and valley oaks. At RM 39 an inchannel gravel mining pits cleared virtually all of the original cottonwoods, valley oaks, and willows from the area around the mine. The inchannel gravel mine now has narrowleaf willow growing along the levees, and the levee has failed with the inchannel pit now taking the majority of flow from the channel. The main channel below the levee breach has been almost completely filled in with narrowleaf willow.

From Oakdale to Knight's Ferry, almost pure stands of narrowleaf willow line the low water channel, and giant reed infestations are common for the first time upstream of the Stanislaus River's confluence with the San Joaquin River. In this reach, mature and senescent vegetation has been cleared or burned. Urban development in Oakdale has reduced the riparian vegetation to one or two trees in width. Upstream of Oakdale the riparian corridor begins to widen, but it is not densely vegetated like areas near the confluence. At Knight's Ferry, for the first time since near the confluence, there is a large (>15 acre) riparian stand consisting of senescent cottonwoods with a few valley oaks.

Above Knights Ferry (RM 53), the river becomes confined in a gorge eroded by the river through a basalt lava flow. The character of the Stanislaus River from this point upstream to Goodwin Dam (RM 58) is unique. From the covered bridge at RM 54.5, riparian vegetation is restricted to small cracks and hollows in the bedrock, and is predominately arroyo willow and white alder. Narrow leaf willow encroachment occurs as soon as the river emerges from the basalt gorge and the banks become alluvial.

C.2.2 Tuolumne River Ecological Unit

The Tuolumne river is 52 miles long between La Grange Dam (RM 52) and the confluence with the San Joaquin River (RM 0). The Tuolumne River's channel bed changes from gravel dominated to sandbedded between RM 24 and RM 30, and a change in gradient also occurs in this reach. Because of the shift in substrate and gradient, white alder grades into box elder in the gravelbed to sandbed transition reach. The Tuolumne River is the only ecological unit within the project area with a major metropolitan city along its banks (Modesto). Downstream of Modesto, the river is confined between levees and agricultural activities. Upstream of Modesto, the river is affected by urban development, gravel mining, and agriculture.

From the confluence with the San Joaquin River to RM 12 there are few large (>5 acres) stands of riparian vegetation, with only a small percentage of these relic stands being valley oak. Over the past few decades, bank riprap has created a trapezoidal channel preventing channel migration and natural riparian regeneration that typically accompanies channel migration. Riparian regeneration that has occurred in this area is limited to pockets in the riprap, or on the upper edge of levees. Agriculture has eliminated any extensive riparian vegetation cover, and has reduced existing vegetation to one

tree width through much of this area. Relic valley oak and cottonwood stands remain around old oxbow channels and represent the greatest cover and structural diversity between the city of Modesto and the river's confluence with the San Joaquin River.

From RM 12 to 19.5, riparian vegetation is most affected by urban development associated with the growth of Modesto. Riparian vegetation consists of small (<2 acres) dense bands of narrowleaf willow, interspersed with senescent Fremont cottonwoods. Occasionally a valley oak delineates the break in slope between urban development and the active channel. A confined channel with no active meandering has allowed narrowleaf willow to form a dense band down to the low water channel. Relic stands of cottonwood and black willow have been burned or are degraded by human disturbance. Tuolumne River Regional Park, through the City of Modesto, has the largest stand of valley oaks; however, recent plantings do not include native tree species, and park management prevents any natural regeneration. Another effect of increasing urban development is that exotic plant species are common throughout the river corridor.

Upstream of Modesto to the city of Waterford (RM 19–31.6) there are few large stands (>5 acres) of valley oaks and cottonwoods, and regeneration is prevented by continual human activities and the change in flow regime by the New Don Pedro Project. Upstream from the city of Modesto RM 24-34), aggregate extraction adjacent to the channel and inchannel has left many solitary valley oaks or cottonwoods surrounded by exotic plants leading to decreased native hardwoods regeneration and diminished habitat quality.

Between RM 34 and 52 riparian vegetation exists along the channel and in hollows created by dredger tailings. Turlock Reservoir State Park (RM 37) preserves some of the best riparian vegetation structure and species composition along the entire river. Because of the park's location adjacent to the Tuolumne River it floods often. This flooding, in combination with mowing and exotic species removal, help facilitate the regeneration and maintenance of the park. The location and the size of the state park is excellent because it preserves a large relic stand (> 5 acres) and will be a productive seed source for future restoration efforts between La Grange Dam and Waterford. In fact, the riparian corridor along the Tuolumne River near La Grange (RM 40-46) enjoys the most extensive vegetation coverage of anywhere on the Tuolumne River. Except in the hollows between dredger tailing piles, riparian vegetation is predominately willow shrubs that create a dense thicket within the bankfull channel, and a few isolated relic stands of senescent cottonwoods and valley oaks. In a few areas along this reach, cattle grazing has eliminated riparian regeneration and denuded the banks. The most recent riparian plant regeneration has occurred in the dredger tailing hollows, because groundwater is close and the effects of grazing are minimized. The understory and gaps within relic Fremont cottonwood and valley oak stands are being invaded by tree of heaven and giant reed. Upstream of the town of La Grange, the Tuolumne River is confined to a bedrock valley similar to the Stanislaus; riparian vegetation persists in hollows and cracks along the valley walls and does not cover any area greater than 5 acres.

C.2.3 Merced River Ecological Unit

The proposed project will affect the riparian vegetation along the Merced River between the confluence with the San Joaquin River (RM 0) and Merced Falls (RM 55). The gravelbed to sandbedded channel transition occurs between RM 25 and 30, and there is again a transition from white alder to box elder where this occurs. Riparian vegetation grows in a narrow band along the river due to the combined effects of flow regulation and agriculture. Where there are large riparian vegetation stands (>5 acres), they are old, intensively managed, and senescent. These senescent "islands" are linked together by a band of vegetation seldom more than a tree wide. Exotics have proliferated and benefited by the altered flow regime and human disturbance. Native hardwood species are dwindling, incapable of competing against the exotic species and human encroachment.

Near the confluence of the Merced with the San Joaquin River, there are many shallow depressions left by previous channel migration, creating a diverse topography that is frequently inundated. However, only valley grassland stands currently grow. George Hatfield Park (RM 1-2) contains the largest relic riparian stand in this lower portion of the river, a relic stand of valley oak surrounded by agricultural activities. The reduction in spring flows combined with the park's mowing, has prevented any younger age classes of riparian vegetation or species from establishing within the park.

For the next 20 river miles upstream of George Hatfield Park, riparian vegetation is discontinuous. A few declining relic stands are connected by sporadically occurring narrowleaf willow shrubs and black willow trees. Agriculture has cleared all riparian vegetation to the upper edge of the bankfull channel, leaving discontinuous riparian vegetation with 100 to 500 feet gaps between individual trees. Just upstream of RM 11 for almost 2000 feet, there is no riparian vegetation except for a few spotty narrowleaf willows; riprap and agriculture have replaced vegetation. A vital seed source remains where native riparian vegetation has been left intact at the outside of meander bends. Unfortunately, when these declining relic stands die they will be replaced with grasslands. Currently there has been no visible valley oak or cottonwood regeneration, and what little regeneration that has occurred is restricted to two species: box elder and narrowleaf willow. Regeneration is confined to a narrow band no more than 100 feet in width, while older valley oak stands are isolated on terraces surrounded by agriculture.

McConnel State Park (RM 23.1) is a relic stand of valley oaks on the right bank of the Merced River. This park contains an old meander bend that pinched off leaving behind an oxbow with relic, pre-dam riparian vegetation. Sycamores, cottonwoods, and valley oaks form a closed canopy with connections between the different hardwood species. This is the first location of George Hatfield Park (RM 4) with a similar canopy structure. Between McConnel State Park and George Hatfield there are no sizable (>5 acre) stands with closed canopy and mixed hardwood species (i.e., not just a few valley oaks surrounded by grasses). Upstream of McConnel State Park, riparian vegetation

returns to a single tree width and valley oaks remain in the middle of grape fields, hinting at riparian vegetation's previous extent.

The gravel bed to sand bed transition occurs around RM 26, and the oxbows tend to get bigger upstream of the channel bed substrate transition. Large stands of giant reed are established in the gravel bedded zone, and inchannel gravel mining has left the riparian vegetation fragmented and with no suitable area to regenerate. Dry Creek enters the Merced at RM 31.9, and there is a well developed mixed willow stand below the creeks confluence.

Above the Dry Creek confluence to Merced Falls (RM 32 to RM 55), riparian vegetation reaches its greatest width and has some of the highest species and structural diversity of anywhere along the Merced River. Below Snelling (RM 41), young trees are establishing on surfaces that are currently functioning as floodplains. Upstream of Snelling to Merced Falls, riparian vegetation has only been able to regenerate and establish in the hollows between dredger tailings.

Upstream of Dry Creek, riparian vegetation encroachment into the active channel is far more obvious. While the riparian corridor is generally wider through this reach, it is also more encroached and scrubby, with no tree species forming identifiable stands. There is some riparian regeneration apparent on 1993 aerial photographs, but the channel is still encroached. The regeneration probably occurred two decades ago, making the vegetation mature with no age class diversity.

APPENDIX D

FEDERAL AND STATE LISTED SPECIES

APPENDIX D
FEDERAL AND STATE LISTED SPECIES

INTRODUCTION

Table D-1 documents the evaluation of the proposed action for potentially significant impacts on each of the species or critical habitats identified by the USFWS as federal or state species of concern, and it provides a brief rationale for the evaluation. These species were identified from USFWS records for each of the USGS quadrangles that are crossed by the San Joaquin River (as far upstream as Mendota Pool, and as far downstream as Vernalis), or crossed by the Merced, Stanislaus, and Tuolumne rivers (up to and including the reservoir areas) (Table D-2).

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA[1]

Class	Species (common name)	Listing Status Federal/ State[2]	Potentially Significant Impacts?	Comments
Fish	delta smelt	FT/ST	No	Delta Smelt are not found in the project area, but are present in the Delta downstream of Vernalis and are potentially affected by the project in the April-May period at the beginning of the smelt spawning season. Flows from the San Joaquin River will be increased during this period, resulting in higher flows through the Delta. Since the primary mortality factors of concern for delta smelt are reduced through-Delta flows and entrainment at the pumps, the proposed action of increased flows during April-May and October are not expected to have any significant impact on delta smelt. Operation of the pumping plants will continue in compliance with the 1995 Biological Opinion for operation of the CVP and SWP.
	Central Valley fall-run chinook salmon	FPT/SSC	No	The primary purpose of the project is to enhance survival of fall-run chinook salmon in the San Joaquin River basin using spring and fall pulse flows. Sudden decreses in flow may strand juveniles and large magnitude changes may dewater redds. Mitigation would be to implement ramping rates to ensxure that adverse impacts are avoided. With mitigation, the impact to this species is less than significant.
	Central Valley steelhead	FT/--	No	There is no conclusive evidence that steelhead are present in the Merced and Tuolumne rivers. However, proposed actions that benefit fall-run chinook salmon could benefit, to a lessor degree, Central Valley steelhead due to their similar life history and habitat requirements

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)

Class	Species (common name)	Listing Status Federal/ State[2]	Potentially Significant Impacts?	Comments
Fish (cont)	Sacramento splittail	FPT/SSC	No	Splittail utilize areas of flooded vegetation for spawning in the spring. To the extent that the additional flows provided by the project contribute to greater wetted area and floodplain inundation, there will be benefits to splittail. Ramping rates included in the proposed action will minimize the potential for stranding of fish. No significant negative impacts of the project are anticipated.
	Delta smelt critical habitat	--/--	No	The proposed actions will not adversely affect any critical habitat features that are of importance to delta smelt.
Mammals	Fresno kangaroo ratt	FE/SE	No	To date, the only known occurrence of this subspecies is at the Alkali Sink Ecological Reserve (1988) and at the Kerman Ecological Reserve (1992), both in Fresno County. These areas will not be affected by the project, and therefore this species will not be impacted.
	giant kangaroo rat	FE/SE	No	This species utilizes flat, sparsely vegetated areas with native annual grassland and shrubland habitats. It is not dependent on riparian habitats that are potentially affected by the project, and therefore will not be impacted by the project.
	riparian (San Joaquin Valley) woodrat	FPE/SSC	No	Habitat includes riparian areas with a mixture of trees and shrubs with moderate canopy and a brushy understory. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.
	riparian brush rabbit	FPE/SSC	No	This species occupies dense thickets of riparian shrubs and weedy fields adjacent to shrubs. Impacts on this species are not expected to be signficant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.
	San Joaquin kit fox	FE/ST	No	Although San Joaquin kit fox are found in the project area, they are not a riparian species that could be potentially affected by the project.

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)

Class	Species (common name)	Listing Status Federal/ State[2]	Potentially Significant Impacts?	Comments
Mammals (cont)	Tipton kangaroo rat	FE/SE	No	The current range of this subspecies is limited to small unconnected alkali habitat patches in Kings and Tulare counties, and scattered areas of Kern County between the Kern National Wildlife Refuge and the town of Delano. The alkali habitat used by this species will not be affected by the project, and therefore this species will not be impacted. In addition, the known occurrences of the species are located approximatly 50 miles south of the project.
Reptiles	blunt-nosed leopard lizard	FE/SE	No	Although blunt-nosed leopard lizards are found in the project area, they are not a riparian species that could be potentially affected by the project.
	giant garter snake	FT/ST	No	The habitat for this species includes sloughs, canals, and other small waterways. Giant garter snakes would not be adversely affected by increased flows, or minor flow alterations, in the mainstem San Joaquin River or its major tributaries.
Birds	Aleutian Canada goose	FT/--	No	Winters in the San Joaquin Valley, and forages on pastures, harvested fielsd, and wetlands. Does not heavily utilize riparian zones that could be affected by the project.
	American peregrine falcon	FE/SE	No	Although peregrine falcons may be found in the project area, they are not a riparian species that could be potentially affected by the project.
	bald eagle	FT/SE	No	Utilizes portions of the San Joaquin Valley as overwintering habitat. Flow alterations associated with the project are not expected to adversely affect foraging opportunites for this species, and therefore no significant impacts are anticipated.
	bank swallow	--/ST	No	Nests in bluffs or banks adjacent to water where the soil consists of sand or sandy loam to allow digging. Proposed flows are not likely to result in loss or alteration of the bluffs and banks used for nesting by this species.
	greater sandhill crane	--/ST	No	The open terrain near shallow lakes and freshwater marshes used by this species will not be affected by this project, and therefore no significant impacts are anticipated.

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Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)

Class	Species (common name)	Listing Status Federal/ State[2]	Potentially Significant Impacts?	Comments
Birds (cont)	Swainson's hawk	--/ST	No	This species nests in oaks or cottonwoods in or near riparian habitats. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.
	willow flycatcher	--/SE	No	Nests in willows and other dense vegetation in riparian areas and wet meadows. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.
Amphibians	California red-legged frog	FT/SSC	No	Uses permanent and ephemeral aquatic habitats such as creeks and ponds for breeding. The large river systems involved with this project do not provide suitable breeding habitat. If the rivers are used as dispersal habitat for this species, increased flows are not likely to result in impacts.
Invertebrates	Conservancy fairy shrimp	FE/--	No	The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.
	longhorn fairy shrimp	FE/--	No	The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.
	valley elderberry longhorn beetle	FT/--	No	Uses elderberry shrubs in riparian and oak savanna habitats. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.
	Vernal pool fairy shrimp	FT/--	No	The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.
	Vernal pool tadpole shrimp	FE/--	No	The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.
Plants	Chinese Camp brodiaea	FPE/SE	No	Highly localized serpentine endemic growning in foothils upstream of project area which will not be impacted by the project,

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)

Class	Species (common name)	Listing Status Federal/ State[2]	Potentially Significant Impacts?	Comments
Plants (cont)	Colusa grass	FT/SE	No	Vernal pool endemic which will not be affected by instream flows.
	Fleshy owl's clover	FT/SE	No	Vernal pool endemic which will not be affected by instream flows.
	Greene's tuctoria	FE/--	No	Vernal pool endemic which will not be affected by instream flows.
	Hairy Orcutt grass	FE/SE	No	Vernal pool endemic which will not be affected by instream flows.
	Hartweg's golden sunburst	FE/SE	No	Highly localized species growing in foothills upstream of project area which will not be impacted by the project.
	Hoover's spurge	FT/--	No	Highly localized species growing in foothills upstream of project area which willl not be impacted by the project.
	Hoover's woolly-star	FT/--	No	Grassland species; its habitat will not be affected by instream flows.
	Layne's butterweed	FT/--	No	Serpantine endemic growing in foothills upstream of project area which will not be impacted by the project.
	Rawhide Hill onion	FPT/--	No	Highly localized serpantine endemic growing in foothills upstream of project area which will not be impacted by the project.
	Red Hills vervain	FPT/--	No	Highly localized serpantine endemic growing in foothills upstream of project area which will not be impacted by the project.
	San Joaquin woolly-threads	FE/--	No	Vernal pool endemic which will not be affected by instream flows.
	San Joaquin Valley Orcutt grass	FT/SE	No	Vernal pool endemic which will not be affected by instream flows.

[1] Letter of June 11, 1998 from USFWS (David Harlow) to USBR Mid-Pacific Region Fresno Office

[2] FE=Federally listed as endangered
FT=Federally listed as threatened
FPE=Federally proposed for listing as endangered
FPT=Federally proposed for listing as threatened
SE=State listed as endangered
ST=State listed as threatened
SSC=State species of special concern

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APPENDIX E

PUBLIC SCOPING

APPENDIX E

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APPENDIX E
REPORT ON PUBLIC SCOPING FOR THE EIS/EIR ON MEETING FLOW OBJECTIVES FOR VAMP, 1999–2009

The Bureau of Reclamation (Reclamation) and the San Joaquin River Group Authority (Authority) distributed a Notice of Preparation of a Joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) on supplying water to meet the flow objectives for the proposed Vernalis Adaptive Management Plan (VAMP) on November 25, 1997 to about 160 agencies and individuals. The notice announced three public scoping meetings for January 6–8, 1998, and requested that comments on the content of the EIS/EIR be submitted by January 16, 1998. This appendix summarizes the comments received in both oral and written form on the content of the EIS/EIR.

E.1 AGENCIES WHO COMMENTED

In addition to members of the Authority (districts and law firms representing districts), the following agencies sent representatives to the public scoping meetings and/or provided written comments (in italics):

State Agencies:
Central Regional Water Quality Control Board
Department of Water Resources, SWP Operations
Department of Food and Agriculture
State Water Resources Control Board

Local Agencies:
Contra Costa Water District
San Joaquin County
San Joaquin Valley Unified Air Pollution Control District
South Delta Water Agency
Stanislaus County (by Michael G. Heaton)
Stanislaus County Environmental Review Committee
Stanislaus County Department of Environmental Resources
Stanislaus County Planning Department
Stockton East Water District (by Herum, Crabtree, Dyer, Zolezzi & Terpstra, LLP)
Tuolumne Utilities District (by Michael G. Heaton)

In the following summary of comments, a comment received in writing by the same person giving the comment orally takes precedence over the oral comment. In other words, the comment received in writing is assumed to be a more accurate version of the same comment that is reported in the minutes. The comments are provided below in Section 2 as written in a letter or as close to what was stated (from the minutes) as possible with no editing that could affect the meaning or content.

E.2 SUMMARY OF COMMENTS

Many of the questions asked were informational about VAMP or Reclamation programs. These informational questions are addressed in the minutes of the meetings and are not summarized here. Comments included here are those that affect the content or scope of the EIS/EIR.

E.2.1 Project Description

1. What are the most likely sources of water? Can you pump groundwater or purchase water from further downstream?

2. Is the EIS/EIR going to cover both the water acquisition program and VAMP itself? Presumably VAMP is not subject to CEQA and NEPA.

3. When you are putting VAMP together and the flows, are you looking also at X2?

E.2.2 Alternatives to Proposed Project

1. The New Melones operation is part of the base flow and will be providing a large portion of the flow down the river. It is the flow for the lower Stanislaus River. We also must look at the water quality requirements.

2. Recirculation of water using water released from the San Luis Reservoir and/or the Delta-Mendota Canal.

3. Releases of water from all available sources in the San Joaquin River Basin.

4. The EIS/EIR must include a range of alternatives which would avoid impacts on environmental resources related to agriculture, even if this to some degree impairs achieving the goals of the project.

5. What alternatives are available to the project and whether or not multi-use of water can be achieved rather than single purpose uses.

E.2.3 General Environmental Impacts

1. What happens during the remainder of the year, after the spring pulse flows? What are the trade-offs?

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2. The acquisition of environmental resources, such as water, and redirection of these resources to other uses constitutes a significant adverse impact on the existing environment, regardless of the new purpose or place of use.

3. CDFA supports relying on free market transactions with willing sellers rather than less voluntary approaches. However, the motives of sellers of environmental resources does not have any bearing on the requirements of CEQA to avoid, reduce, and mitigate significant adverse impacts on the environmental resources involved.

E.2.4 Specific Environmental Impacts

E.2.4.1 Water Resources (Supply/Quantity and Quality)

1. Impact on the Eastern San Joaquin Groundwater Basin from the acquisition of water on the San Joaquin river tributaries.

2. Impact on water supply availability to the Stockton East Water District from the New Melones Project.

3. What is the impact of VAMP on the long-term operations of New Melones Reservoir, and particularly, the impact of VAMP on the availability of Stanislaus River water for existing and reasonably foreseeable future Stanislaus River In-Basin needs? In other words, does the reallocation of Stanislaus River/New Melones water adversely impact the ability of local agencies such as TUD to develop future water supplies or impair the ability of local agencies to exercise their watershed, basin, or area of origin priorities? The analysis of this question would seem to depend on the relative priority of VAMP obligations as against Stanislaus River in-basin obligations.

4. To the extent applicable, there should be an analysis of the impact of reductions of use of surface water from the Stanislaus and Tuolumne rivers in Stanislaus County on groundwater usage in Stanislaus County. In other words, will the water acquisitions for VAMP be offset locally by increased groundwater pumping, and if so, what will be the impact on local groundwater resources?

5. How changes in flow schedules affect downstream water quality and quantity in the different year types.

6. How sales and transfers of water affect downstream water quality and quantity.

7. Water quality impacts in the Delta and upstream may be of interest. Modeling needs to be consistent with what the SWRCB requires.

8. We will have to analyze how VAMP may influence X2.

9. Impact on the New Melones Project's ability to meet water quality objectives at Vernalis including the impacts associated with a different release pattern/timing of releases caused by the acquisition of water on the tributaries.

10. The effects on south Delta water quality, quantity, and flow of changes in export pumping rates including the effects on the ISDP (Interim South Delta Program).

E.2.4.2 Fish and Wildlife

1. Impact of modified flows on fish and wildlife resources in the San Joaquin river basin.

E.2.4.3 Land Uses/Socioeconomic/Public Services

1. Decisions related to exports may have an economic impact. Final CEQA documentation must support two findings: (1) that such transfer will not injure any rightful user of water, and (2) that it will not have any harmful effect on fish and wildlife.

2. Impact on land uses in San Joaquin County including agricultural uses from the acquisition of water on the San Joaquin River tributaries.

3. To the extent that VAMP water acquisitions result in reductions in surface water usage in Stanislaus county which are not offset by increased groundwater pumping, there should be an analysis of "third party" impacts of such reductions in surface water use, particularly the impacts on public and social services demands, reduced tax revenues and related impacts.

4. To the extent there are unavoidable impacts on environmental resources related to agriculture, there must be measures to reduce or mitigate these impacts to insignificant levels.

5. The economic effects of items 5 and 6 in Section 2.4.1 above.

6. How sales and transfers of agricultural water supplies affect and/or contradict other public policies such as zoning and the Williamson Act.

E.2.4.4 Air Quality

1. Based on the information provided, it appears that this project will have a less-than-significant impact on the ambient air quality. However, if any construction or earth

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moving activities are planned, this project would be subject to District Regulation VIII (Fugitive Dust Prohibitions).

E.2.4.5 Cumulative Impacts

1. What is the cumulative impact of VAMP on top of other transfer activities going on? Are we going to see more groundwater pumping?

2. There should be an analysis of the cumulative impacts of VAMP together with other water acquisition and water transfer projects on the San Joaquin system and particularly the Stanislaus River. The issue is what is the cumulative impact of the reallocation of surface water supplies for environmental purposes in the Delta on local agricultural production, economic development, groundwater resources and the local environment.

3. The cumulative effects on water quality and quantity of other ongoing and proposed projects.

E.2.4.6 Other Concerns

1. The legal prerequisites to flow changes and transfer of water.

2. The environmental documents would be inadequate if they do not examine from whom sale water is purchased. The effects of transfers may vary depending on what tributary they are made.

3. The document should include a complete description of the existing conditions (e.g., CVP effects on San Joaquin River and South Delta water quality and quantity). It should be made clear that current Bureau operations as well as those proposed in VAMP anticipate violations of the Bureau's New Melones permit requirements to maintain Vernalis water quality.

4. It was stated that this EIS/EIR is for the "acquisition" of water for the VAMP fish experiments and is not for the experiments themselves per se. Since it is unknown whether of not there will be a separate EIS/EIR for the actual VAMP fish experiments, it would seem necessary for this EIS/EIR to address, in detail, the possible impacts that the fish experiments may have on South Delta water users including the SWP and CVP.

5. The EIS/EIR must not only analyze the impacts associated with the above resource areas, but must also fully analyze the related subsidiary effects of that taking the projected action will have on the related resources.

APPENDIX F

LOCAL GENERAL PLAN POLICIES

APPENDIX F

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APPENDIX F
LOCAL GENERAL PLAN POLICIES

INTRODUCTION

This appendix provides excerpts from the general plans for the following counties: San Joaquin, Stanislaus, Merced, Fresno, Madera, Mariposa, and Tuolumne.

F.1 SAN JOAQUIN COUNTY

San Joaquin County contains the lower reaches of the San Joaquin River and the lower reach of the Stanislaus River at its confluence with the San Joaquin River near Vernalis, although the Vernalis community is located in adjacent Stanislaus County.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: public/institutional, resource conservation, industrial, commercial, residential, agricultural/urban reserve, and general agriculture.

San Joaquin County General Plan (1992)

Listed below are some of the objectives and policies contained in the Vegetation, Fish, and Wildlife Habitat Element that are relevant to the proposed action.

Objective 1. To protect and improve the County's vegetation, fish, and wildlife resources.

Objective 2. To provide undeveloped open space for nature study, protection of endangered species, and preservation of wildlife habitat.

The County will strive to achieve these objectives using the following policies.

Policy 5 No net loss of riparian or wetland habitat or values shall be caused by development.

Policy 11 Fisheries shall be protected by:

(A) reducing the level of pesticides and fertilizers and other harmful substances in agricultural and urban runoff;

(B) designing and timing waterway projects to protect fish populations; and

(C) operating water projects to provide adequate flows for spawning of anadromous fish.

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Policy 12 The County shall support restoration plans for anadromous fisheries and shall work with the California Department of Fish and Game and other agencies or organizations in developing such plans.

Policy 13 The County shall encourage the restoration and enhancement of once-productive degraded ecosystems, such as historic salmon runs on the Mokelumne and Calaveras Rivers.

Listed below are the most relevant objectives and policies in the Water Resources and Quality Element.

Objective 1. To ensure adequate quantity and quality of water resources for municipal and industrial uses, agriculture, recreation, and fish and wildlife.

Objective 5. To recognize the surface waters of San Joaquin County as resources of State and national significance for which environmental and scenic values must be protected.

Policy 10 The County shall support properly timed, sufficient flows in the rivers to maintain spawning grounds, fish migration, and resident fish populations.

Policy 12 No water should be exported to other areas of the State unless the current and future needs of San Joaquin County can be met.

Policy 13 Water diversion projects shall protect the fishery, wildlife habitat, and recreation; shall ensure adequate water for County agricultural, municipal and industrial uses; and shall guarantee adequate delta outflows for salinity repulsion.

F.2 STANISLAUS COUNTY

While the New Melones Lake and Don Pedro Reservoir are actually located in Tuolumne County, part of the Stanislaus River and most of the Tuolumne River are located in Stanislaus County. Both of these tributaries join the San Joaquin River in Stanislaus County.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: planned development, urban transition, low density residential, historical, estate, residential, and agriculture. City/County boundaries extend into the rivers.

Stanislaus County General Plan (1994)

Plan goals relevant to the proposed action are:

Goal 2. Conserve water resources and protect water quality in the County.

Policy 5 Protect groundwater aquifers and recharge areas, particularly those critical for the replenishment of reservoirs and aquifers.

Goal 3. Provide for the long-term conservation and use of agricultural lands.

Goal 10. Protect fish and wildlife species in the County.

Policy 29 Adequate water flows should be maintained in the County's rivers to allow salmon migration.

The general plan also contains an Agricultural Element.

Goal 3. Protect the natural resources that sustain agriculture in Stanislaus County.

Policy 3.6 The County shall encourage the conservation of water for both agricultural and urban uses.

F.3 MERCED COUNTY

While Lake McClure is in Mariposa County, most of the Merced River is located in Merced County, where it joins the San Joaquin River. The Kesterson and San Luis National Wildlife Refuges are located here, as is San Luis Reservoir.

Merced County provided the Open Space/Conservation and Agriculture Elements of their general plan and indicated in their comment letter that these elements will not change in the current plan revision.

Merced County Year 2000 General Plan (1990)

Plan objectives and policies from the Open Space/Conservation Element that are most relevant to the proposed action are:

Objective 1.A Rare and endangered species are protected from urban development and are recognized in rural areas.

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Policy 9 Significant aquatic and waterfowl habitats should be protected against excessive water withdrawals which would endanger or interrupt normal migratory patterns.

Objective 2.B Surface and groundwater resources are protected from contamination, evaporation an inefficient use.

Policy 6 Methods to prevent the depletion of groundwater resources and promote the conservation and reuse of water should be encouraged.

Policy 7 The rehabilitation of irrigation systems and other waterworks to reduce the lost water, and improve the efficient use and availability of water should be promoted.

Plan objectives and policies from the Agriculture Element that are most relevant to the proposed action are:

Objective 4.A Measures to protect and improve water quality are supported.

Policy 1 The County favors efforts to ensure adequate surface water supplies to deficient areas.

Policy 2 The County will encourage farmers to use irrigation methods which conserve water.

Policy 3 The County will work with other responsible agencies to ensure that sources of water contamination (including boron, salt, selenium and other trace element concentrations) do not enter agricultural or domestic water supplies, and will be reduced where water quality is already affected.

Merced County provided the Open Space/Conservation and Agriculture Elements of their general plan and indicated in their comment letter that these elements will not change in the current plan revision.

F.4 FRESNO COUNTY

The San Joaquin River flows through Fresno County, which also contains the Mendota Wildlife Refuge.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: regional parkland, open space, medium and medium high density residential, multi-use open space, and recreational open space.

Fresno County General Plan (1976)

Plan objectives contained in the River Influence Area Element that are relevant to the proposed action are:

Objective 2.01 Preserve and enhance the value of the river environment as a multiple use, open space resource.

Objective 2.02 Maintain the environmental and aesthetic qualities of the area.

Objective 2.03 Protect the quality and quantity of the surface water and groundwater resources.

Objective 2.05 Conserve and enhance the natural wildlife habitat.

Plan objectives contained in the Open Space Element that are relevant to the proposed action are:

Objective 2.03 Preserve and enhance areas of significant natural resources, the retention of which is necessary to maintain the environmental quality and economic potential of the area.

Plan objectives contained in the Natural Vegetation/Wildlife Element that are relevant to the proposed action are:

Objective 2.02 Manage vegetation and wildlife resources in a responsible and productive manner.

Objective 2.03 Protect the habitats of plants and wildlife from unnecessary activities of man.

The County will strive to achieve these objectives using the following policies.

Policy 3.02 Areas that have unusually high value for fish and wildlife propagation should be preserved in a natural state to the maximum possible extent.

Policy 3.03 The County should support State and Federal programs to acquire significant fish and wildlife habitat areas for permanent protection and/or public recreation use.

Policy 3.05 Wetlands, riparian habitat, and meadows are recognized as essential habitats for birds and wildlife and should be protected to the maximum extent practicable.

Policy 3.10 Significant aquatic habitats should be protected against excessive withdrawals which would endanger fish and wildlife or would interrupt normal migratory patterns.

F.5 MADERA COUNTY

Madera County contains the upper reaches of the San Joaquin River, including the Friant Dam and Millerton Lake. The Delta-Mendota Canal meets the San Joaquin River in the southwest region of the county. In the eastern region of the county the Madera Canal runs in a southeasterly direction, meeting the San Joaquin River just below Millerton Lake.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: agricultural exclusive, agriculture, open space, new growth area, low density residential, and light industrial/business park.

Madera County General Plan (1995)

Listed below are the goals and policies from the Land Use Element that are relevant to the proposed action.

Goal 1.A. To promote the wise, efficient, and environmentally-sensitive use of Madera County land to meet the present and future needs of Madera County residents and businesses.

The County will strive to achieve this objective using the following policy which addresses natural resources.

Policy 1.A.1. The County shall promote the efficient use of land and natural resources.

Listed below are the relevant goals and policies in the Water Resources Element.

Goal 5.C. To protect and enhance the natural quality of Madera County's streams, creeks, and groundwater.

Policy 5.C.7. The County shall protect groundwater resources from contamination and further overdraft by encouraging water conservation efforts and supporting the use of surface water for urban and agricultural uses wherever feasible.

Policy 5.C.8. The County shall support the policies of the San Joaquin River Parkway Plan to protect the San Joaquin River as an aquatic habitat and a water source.

Listed below are relevant goals and policies from the Wetland and Riparian Areas Element.

Goal 5.D. To protect wetland communities and related riparian areas throughout Madera County as valuable resources.

Policy 5.D.1. The County shall comply with the wetlands policies of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed.

Policy 5.D.7. The County shall support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient catchment, and wildlife habitats. Such communities shall be restored, where possible.

Policy 5.D.8. The County shall support the goals and policies of the San Joaquin River Parkway Plan to preserve existing habitat and maintain, enhance, or restore native vegetation to provide essentially continuous riparian and upland habitat for wildlife along the river between Friant Dam and the Highway 145 crossing.

Listed below are the goals and policies adopted by Madera County to preserve fish and wildlife habitat.

Goal 5.E. To protect, restore, and enhance habitats that support fish and wildlife species so as to maintain populations at viable levels.

Policy 5.E.1. The County shall identify and protect critical nesting and foraging areas, important spawning grounds, migratory routes, waterfowl resting areas, oak woodlands, wildlife movement corridors, and other unique wildlife habitats critical to protecting and sustaining wildlife populations.

Policy 5E.5. The County shall support the maintenance of suitable habitats for all indigenous species of wildlife through maintenance of habitat diversity.

Policy 5.E.7. The County shall support the preservation or reestablishment of fisheries in the rivers and streams within the county, whenever possible.

Listed below are the goals and policies relevant to the proposed action.

Goal 5.H. To preserve and enhance open space lands to maintain the natural resources of the county.

Policy 5.H.1. The County shall support the preservation and enhancement of natural land forms, natural vegetation, and natural resources as open space. To the extent feasible, the County shall permanently protect as open space areas of natural resource value, including wetlands preserves, riparian corridors, woodlands, and flood plains.

Policy 5.H.3. The County shall support the maintenance of open space and natural areas that are interconnected and of sufficient size to protect biodiversity, accommodate wildlife movement, and sustain ecosystems.

F.6 MARIPOSA COUNTY

Mariposa County contains the upper reaches of the Merced River, which include the McSwain Dam and the New Exchequer Reservoir.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: public domain, mountain general, public sites, mountain preserve, mountain transition, general forest, commercial resort, and town planning area.

Mariposa County General Plan (1989)

Listed below are the policies and goals from the Conservation Element that are relevant to the proposed action.

The overall guiding policy is as follows:

To provide a program for the conservation and development of natural resources in Mariposa County.

The following is one of the goals supporting this policy.

Goal D. To provide for the identification, delineation, description, and maintenance of vegetative types and related wildlife habitats in order to maintain the inherent diversity of both

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vegetation and wildlife species in Mariposa County for the recreational, commercial, and aesthetic enjoyment of both present and future residents and visitors to the County.

The overall guiding policy of the Open Space Element is as follows:

To enhance the natural open space resources of Mariposa County to include preservation of natural resources, managed production of resources, outdoor recreational resources, and open space for public health and safety, for the benefit of present and future residents of the County and visitors to the area.

Some of the specific policies supporting this goal are:

Policy 1. To encourage the preservation of the County's natural wildlife, wildlife habitat, and water resources through a combination of land use policies and development standards.

Policy 2. To establish policies and standards which provide for, and support, the managed production of natural resources in the County.

F.7 TUOLUMNE COUNTY

Tuolumne County contains the upper reaches of the Stanislaus and Tuolumne rivers. The Stanislaus River system includes the New Melones Reservoir, and the New Don Pedro Reservoir is part of the Tuolumne River system.

There is no specific land use designation for riparian areas. Generalized land use categories that extend to the edge of the rivers include: urban, nonurban residential/business, timberland, agriculture, and public.

Tuolumne County General Plan (1996)

Listed below are goals and policies contained in the Water Resources Element that are relevant to the proposed action.

Goal 4.L. Conserve the quality and quantity of the County's water resources, while protecting the rights of the land owner.

Policy 4.L.8. Participate in the State and Federal sponsored CAL-FED program to develop comprehensive and long-term solutions to the problems of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (bay-delta) which is nationally recognized as both an important feature of the State's

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environment and an important component of the State's water supply system by promoting improved management of watersheds in Tuolumne County to contribute to long-term bay-delta recovery and protection.

Policy 4.L.9. Recognize that clean water is essential to the public health, safety, and welfare; fosters economic development and job creation; protects the environment; maintains fish and wildlife; and supports recreation.

Goal 4.M. Conserve public water resource areas with high recreational value for future public use.

Policy 4.M.2. Provide public access to the County's public waterways, lakes, and reservoirs in compliance with State statutes while protecting private property rights and maintaining the biological, scenic, and historical integrity of these features and lands adjacent to these features.

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APPENDIX G

MITIGATION REPORTING PROGRAM

APPENDIX G

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APPENDIX G
MITIGATION REPORTING PROGRAM

INTRODUCTION

The requirement for a mitigation monitoring or reporting program is introduced in Section 15091 of Title 14, California Code of Regulations, Chapter 3, Guidelines for Implementation of the California Environmental Quality Act. This section directs the public agency approving or carrying out the proposed project (San Joaquin River Group Authority) to make specific written findings for each significant impact identified in the Environmental Impact Report. When making the required findings, the agency shall also adopt a program for reporting on or monitoring the changes which it has either required in the project or made a condition of approval to avoid or substantially lessen significant environmental effects. These mitigation measures must be fully enforceable through permit conditions, agreements, or other measures.

Section 15097 was added to the CEQA Guidelines on October 23, 1998. It requires the public agency to adopt a program for monitoring or reporting on the revisions which it has required in the project and the measures it has imposed to mitigate or avoid significant environmental effects. Reporting or monitoring responsibilities may be delegated to another public agency or private entity. However, until mitigation measures have been completed, the lead agency (San Joaquin River Group Authority) remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with the program.

The San Joaquin River Group Authority (SJRGA) may choose whether its program will monitor mitigation, report on mitigation, or both.

- Reporting generally consists of a written compliance review that is presented to the decision-making body or authorized staff person. A report may be required at various stages during project implementation or upon completion of the mitigation measure. It is suited to projects which have readily measurable or quantitative mitigation measures or which already involve regular review.

- Monitoring is generally an ongoing or periodic process of project oversight. It is suited to projects with complex mitigation measures which are expected to be implemented over a period of time.

This mitigation program report is comprised of a matrix followed by a description of the two principal mitigation measures: the annual Operations Plan and local conjunctive use, reclamation, and water efficiency projects. The mitigation program for the Final EIS/EIR is recommended to be a reporting program on the Operations Plan and the development of conjunctive use/water efficiency projects by members of the Authority.

G.1 MATRIX

The mitigation reporting program for meeting the flow objectives for the San Joaquin River Agreement is provided in the following matrix. The matrix includes all impacts in the EIS/EIR that were identified as significant (S) or potentially significant (PS). For impacts that are less than significant, mitigation is not required by CEQA. The text of each mitigation measure is taken from the Final EIS/EIR.

For each impact and mitigation measure, the matrix identifies the implementation action required, the timing requirements for implementation, and the agency responsible for ensuring that the action occurs. In most cases, the SJRGA and its member agencies and other signatories to the SJRA are responsible for ensuring that hydrologic and biologic data are utilized in the development and implementation of the annual Operations Plan and that conjunctive use and other water conservation projects are implemented by Merced and Oakdale Irrigation Districts.

G.2 ANNUAL OPERATIONS PLAN

The San Joaquin River Agreement (SJRA), Paragraph 6.6, states that by February 15 of each year of the Agreement, the U.S. Bureau of Reclamation (USBR) and California Department of Water Resources (CDWR) shall develop, in cooperation with the San Joaquin River Technical Committee (SJRTC), an operations plan that will describe how the VAMP will be implemented in that year. Appendix B of the SJRA, Planning and Operation Coordination for the Vernalis Adaptive Management Plan, describes the process for planning and implementing operations for implementing the VAMP flows. It is incorporated in its entirety into this mitigation reporting program by reference. The focus of Appendix B is the Spring Pulse Flow. A summary of the operations planning process and key participants is provided in Section 2.1 below.

Paragraph 11.1 of the SJRA also states that "the SJRTC will be an interagency effort to successfully implement the VAMP by undertaking the activities described in Paragraph 11.2 (and summarized here) and other technical activities that its members deem appropriate to meet the goals of this Agreement." Implementation of the October flow and use of the other environmental water provided by Oakdale Irrigation District comes under this category of other technical activities. The SJRTC is to annually coordinate flow releases, export and Old River barrier operations, and the use of hatchery fish to implement the VAMP study. Other duties are: to determine best management of flow releases during the Pulse Flow Period to achieve Target Flows; to plan and oversee monitoring activities in coordination with the Interagency Ecological Program and existing monitoring programs on the San Joaquin tributaries; and to develop annually the Existing Flow calculation protocols.

Identified Impact	Mitigation Measures	Implementation Action	Timing Requirements	Reporting Responsibility
4.2.3.1 Water Deliveries Deliveries reduced to Merced Irrigation District during critically dry years and under below normal or dry hydrologic conditions under certain sequential hydrologic conditions. (PS)	Implementation of a conjunctive use program to augment surface water supplies.	Construction of conjunctive use project by Merced ID.	Annual progress reports with financial audit report.	Merced ID progress reports to SJRGA.
4.2.3.1 Water Deliveries Deliveries reduced to Oakdale Irrigation District during critically dry years. (PS)	Implementation of a conjunctive use program to augment surface water supplies.	Construction of conjunctive use project by Oakdale ID.	Annual progress reports with financial audit report.	Oakdale ID progress reports to SJRGA.
4.2.3.2 Water Storage Carryover water storage reduced for Lake McClure during all but wet hydrologic conditions. (PSU)	Partially mitigated by conjunctive use program.	None	None	None
4.3.3.1 Groundwater Overdrafting Goundwater could indirectly be used to replace surface water used for the flows from the Merced ID (up to 67,500 acre-feet, 12% of the typical annual production). (PS)	Implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.	Construction of conjunctive use project by Merced ID. Reclamation and increases in efficiencies of water use are underway.	Annual progress reports with financial audit report.	Merced ID progress reports to SJRGA.
4.3.3.2 Water Levels Groundwater from the Merced Groundwater Basin could be used to replace surface water for the flows (up to 67,500 acre-feet, 12% of the typical annual production). (PS)	Implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supples.	Construction of conjunctive use project by Merced ID.	Annual progress reports with financial audit report. Reclamation and increases in efficiencies of water use are underway.	Merced ID progress reports to SJRGA.

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Identified Impact	Mitigation Measures	Implementation Action	Timing Requirements	Reporting Responsibility
4.3.3.4 Subsidence Groundwater (up to 67,500 acre-feet) from the Merced Groundwater Basin could indirectly be used to replace surface water flows; there could be an impact on subsidence. (PS)	Limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas would reduce the impact.	Implement Water Supply Master Plan and AB3030 Groundwater Management Plan.	Annual progress reports with financial audit report. Projects are underway.	Merced ID progress reports to SJRGA.
4.5.3.3 Chinook Salmon Rapid changes in flows in the spring and fall may affect juvenile salmon and salmon redds. (PS)	Include ramping flows around the pulse and attraction flows.	SJRTC approves annual Operations Plan.	Implement in February-April of each year.	SJRTC reports to SJRGA, USBR, USFWS, and CDFG.
4.6.3.1 Agricultural Land Use Potential reduction of 104,500 acre-feet of Authority members' water to irrigation customers could adversely impact cropping patterns and productivity. (PS)	Replacement of surface water by groundwater, including conjunctive use water or carryover storage.	Irrigation customers would receive alternative water from Districts or operate own private wells.	Annually, and depending on hydrologic conditions. For SJRGA members, annual progress reports with financial audit report.	Individual districts monitor groundwater levels through AB 3030 plans. Progress reports to SJRGA.

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Identified Impact	Mitigation Measures	Implementation Action	Timing Requirements	Reporting Responsibility
4.6.3.1 Agricultural Land Use Reduced deliveries by Merced ID could adversely affect agricultural production in the short term. (PS)	Implementation of conjunctive use program and groundwater pumping by individual farmers.	Construction of conjunctive use project by Merced ID. Farmers may operate private wells.	For Merced ID, annual progress reports with financial audit report. Use of private well water would occur annually depending on hydrologic conditions.	Merced ID progress reports to SJRGA.
4.9.3.1 Reservoirs Storage capacity decreased greater than 10% at Lake McClure in critical, dry, and below normal years during power peak production months, thus decreasing potential for hydropower generation. (PSU)	Not available.	None.	None.	None.
4.9.3.2 Rivers Flows decreased by more than 10% on Merced River in above normal years in June, thus decreasing potential for hydropower generation. (PSU)	Not available.	None.	None.	None.

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G.2.1 PARTICIPANTS

The Hydrology Group of the SJRTC is responsible for the following tasks:

- Develop and exchange information concerning forecasted hydrologic conditions;
- Execute the protocols that establish the Test Flow Target and determine the San Joaquin River Group Supplemental Water (up to 110,000 acre-feet);
- Establish an operations plan for the coordination of flows; and
- Provide a post-analysis and report of operations.

The participants in the Hydrology Group are determined by the SJRTC and initially include, but are not limited to, the following: USBR, CDWR, and six members of the SJRGA (Modesto, Turlock, Merced, Oakdale, and South San Joaquin Irrigation Districts, and the Exchange Contractors). The Hydrology Group will coordinate with the SJRTC along with biologists and others involved in operations affecting San Joaquin River flows.

G.2.2 PLANNING PROCESS

G.2.2.1 Forecasting

No later than February 10, the Hydrology Group will develop a preliminary basin-wide Forecast Report of the San Joaquin River operations (without the effects of VAMP) for the February through June period. Forecasts will be provided for at least 90 percent and 50 percent probability of exceedence hydrologic runoff and water demand conditions. DWR runoff forecasts will be used as the basis of unimpaired runoff in the tributaries unless otherwise agreed. Each of the Hydrology Group participants is responsible for providing either reservoir operations plans or the information necessary to develop the appropriate reservoir operations plans for each affected tributary. Information regarding the planned operations of others affecting San Joaquin River flows to the Bay-Delta will also be acquired by the Hydrology Group.

The Forecast Report will be provided to the CALFED Operations Group, SJRA Biology Group, and local tributary groups. At a minimum, a revised Forecast Report will be provided the first week of March, mid-March, the first week of April and each week thereafter until the Operations Plan is employed. After the conclusion of the Spring Pulse Flows, the Hydrology Group will continue to share and update operations forecast information on a monthly basis so that the best available forecasts of San Joaquin River flows can be included in CVP/SWP operations plans.

G.2.2.2 Coordination with Biology Group

Although focused on test protocols that measure the survival of tagged hatchery salmon smolt, VAMP creates an opportunity to provide pulse flow conditions for smolts naturally spawned within the San Joaquin River Basin. The Biology Group will heavily influence the scheduling of the Test

Period. The VAMP Test Period of a continuous 31 days in April-May needs to coincide with the peak period of time when naturally spawned smolts are migrating out of the San Joaquin River Basin. Trade-offs in the scheduling of VAMP will be required to recognize the practicalities of hatchery operations, monitoring activities, barrier operation, and flow and export operational constraints.

The Biology Group is to provide its initial estimate of the preferred period for the VAMP flow beginning in February, coincident with the Hydrology Group's Forecast Report, and provide an updated estimate coincident with each revised Forecast Report. Coincident with the mid-March Forecast Report, the Hydrology and Biology Groups will jointly identify the Tentative Test Period for use in subsequent planning efforts.

Concerning the release of water on the Merced River for the fall attraction flow and the release of Oakdale Irrigation District water from New Melones on the Stanislaus River, the timing of these releases will be adjusted to hydrologic conditions including water temperature. The Hydrology Group will coordinate with the Biology Group and the U.S. Fish and Wildlife Service (USFWS), CDFG, and National Marine Fisheries Service (NMFS) to forecast releases around the Spring Test Flow Target for ramping and to forecast the fall attraction flow release. Table G-1 summarizes existing and proposed stations for flow and water quality monitoring in the lower San Joaquin River Basin. Data from these stations will be used to define the release schedule.

G.2.2.3 VAMP Study Results

The Operations Plan will be developed annually and over the February-April period based on the hydrology forecast reports. It will consider the previous year's fishery monitoring activities, including the results of the VAMP sampling activity during the 47-day April 15 - May 31 monitoring period and other results of the ongoing studies presented in Table G-2. VAMP not only documents the numbers of juvenile Chinook salmon but also other species collected. In addition, during the 47-day sampling period, temperature monitoring within the lower San Joaquin River from Mossdale to Chipps Island will be conducted. A documentation report will be prepared by December 1999 and in subsequent years.

G.2.3 OPERATIONS PLAN IMPLEMENTATION

The SJRGA members and USBR will carry out the Operations Plan using best efforts to make control point releases match the Operations Plan forecast of releases. Actual operations and hydrologic conditions will be tracked during the Test Period, and the information disseminated along with a projection of conditions anticipated for the remainder of the Test Period. The Hydrology Group will confer weekly to review schedules, beginning in late March. Storms, flood control, or other unforeseen events may require more frequent schedule changes. In order to maintain a stable flow, an effort will be made to keep flows within a specified range above and below the target flows. In coordination with U.S. Fish and Wildlife Service (USFWS) and California Department of Fish

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APPENDIX G
MITIGATION REPORTING PROGRAM

TABLE G-1. EXISTING AND PROPOSED STATIONS FOR FLOW AND WATER QUALITY MONITORING IN THE LOWER SAN JOAQUIN BASIN (HOURLY AND/OR DAILY DATA)

STATION	RIVER MILE	AGENCY	REALTIME STATUS	CDEC CODE	FLOW	WATER TEMP.	E.C.	D. O.	TURBID-ITY	SEDI-MENT
SAN JOAQUIN RIVER SYSTEM (excluding major eastside tributaries)										
BELOW FRIANT DAM	268.1	USGS	CDEC	SJF	XT					
JAMES BYPASS		USGS			X(T)					
NEAR MENDOTA	202.1	DWR	CDEC	MEN	XT		(PT)			
EL NIDO BYPASS		DWR	CDEC	ELN	XT					
NEAR STEVINSON (LANDER AVE.)	132.8	USGS/DWR	CDEC	SJS	XT	X	X			
SALT SLOUGH AT LANDER AVE.	(?)	USGS/DWR	modem		XT	XT	XT			
AT FREMONT FORD	125.1					(PT)	(PT)	(PT)	(PT)	(P)
SAN LUIS DRAIN ABOVE MUD SLOUGH	(?)	USBR	modem		XT		XT			
MUD SLOUGH NEAR GUSTINE	(?)	USGS	modem		XT	XT	XT	(PT)	(PT)	(P)
Merced River Confluence	118.2									
NEAR NEWMAN	118.0	USGS	CDEC	NEW	XT	X(T)	X(T)			
ORESTIMBA CREEK NEAR NEWMAN	(?)	USGS	CDEC	ORE	X					
ORESTIMBA CREEK AT RIVER RD.	(0.8)	USGS	modem	ORM	XT	XT	XT			
AT CROWS LANDING BRIDGE	107.1	USGS	modem		XT	XT	XT			
AT PATTERSON BRIDGE	98.5	USGS/DWR	CDEC	SJP	XT	X(T)	X(T)	(PT)	(PT)	(P)
DEL PUERTO CREEK NEAR PATTERSON	(?)	USGS			X					
AT DOS RIOS RANCH	86.2	TMID				R				
Tuolumne River Confluence	83.7									
ABOVE GARDNER COVE	80.0	TMID				R				
AT MAZE ROAD BRIDGE	77.3	DWR	CDEC	MRB	XT	(PT)	(PT)	(PT)	(PT)	
Stanislaus River Confluence	74.9									
NEAR VERNALIS	72.5	USGS/DWR	CDEC	VER/VNS	XT	X(T)	XT	(PT)	(PT)	X
MOSSDALE	56.2	DWR	IEP		tide gage	XT	XT	XT		
Head of Old River	53.4									
MERCED RIVER										
NEW EXCHEQUER - LAKE McCLURE	62.5	Merced Co. ?	CDEC	EXC	XT					
BELOW EXCHEQUER DAM	~62	DFG				R				
BELOW MERCED FALLS	55.0	Merced Co. ?	CDEC	MMF	XT					

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APPENDIX G
MITIGATION REPORTING PROGRAM

TABLE G-1. EXISTING AND PROPOSED STATIONS FOR FLOW AND WATER QUALITY MONITORING IN THE LOWER SAN JOAQUIN BASIN (HOURLY AND/OR DAILY DATA)

STATION	RIVER MILE	AGENCY	REALTIME STATUS	CDEC CODE	FLOW	WATER TEMP.	E.C.	D. O.	TURBID-ITY	SEDI-MENT
MERCED RIVER HATCHERY	~51	DFG				R				
NEAR SNELLING	46.2	DWR	CDEC	MSN	XT	(PT)				
GALLO RANCH	~36	DFG				R				
AT SHAFFER BRIDGE [1]	32.5	USGS			X(?)					
DRY CREEK NEAR SNELLING [2]		DWR	CDEC	DSN	XT					
AT CRESSEY	27.7	DWR	CDEC	CRS	XT	(PT)	(PT)			
NEAR STEVINSON	4.7	DWR	CDEC	MST	XT	XT(m)	XT(m)	(PT)	(PT)	(P)
AT RIVER ROAD	1.1	USGS				X	X			
TUOLUMNE RIVER										
BELOW LA GRANGE DAM	51.8	USGS	CDEC	LGN	XT	X(T)				
RIFFLE 3B	49.0	TMID				R				
RIFFLE 19	43.4	TMID				R				
RUDDY BRIDGE	36.7	TMID				R				
AT HICKMAN BRIDGE	31.6	DWR			X(T)	(PT)				
HUGHSON SEWER PONDS	23.6	TMID				R				
AT SANTA FE BRIDGE	21.6					(PT)	(PT)		(PT)	
DRY CREEK AT CRABTREE ROAD	(~38)	TMID			XT*					
DRY CREEK AT MODESTO	(5.4)	DWR	CDEC	DCM	XT					
AT MODESTO (9th ST. BRIDGE)	16.2	USGS	CDEC	MOD	XT	X(T)	X(T)		(PT)	
SHILOH BRIDGE	3.4	TMID				R	(PT)	(PT)	(PT)	(P)
STANISLAUS RIVER										
BELOW TULLOCH POWERPLANT	60.2	USGS				X				
BELOW GOODWIN DAM	57.5	USGS	CDEC	SKF	XT	X(T)				
KNIGHTS FERRY	~54	DFG				R				
AT ORANGEBLOSSOM BRIDGE	46.9	DWR/DFG	CDEC	OBB	XT	R(T)				
YAHI ARCHERY RANGE	~44	DFG				R				

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APPENDIX G
MITIGATION REPORTING PROGRAM

TABLE G-1. EXISTING AND PROPOSED STATIONS FOR FLOW AND WATER QUALITY MONITORING IN THE LOWER SAN JOAQUIN BASIN (HOURLY AND/OR DAILY DATA)

STATION	RIVER MILE	AGENCY	REALTIME STATUS	CDEC CODE	FLOW	WATER TEMP.	E.C.	D. O.	TURBID-ITY	SEDI-MENT
AT OAKDALE	41.2	USGS				X(T)	(PT)		(PT)	
AT MCHENRY BRIDGE	29.6					(PT)	(PT)		(PT)	
AT RIPON	15.8	USGS/USBR	CDEC	RIP/RPN	XT	X(T)	XT			
AT KOETITZ RANCH	9.4	DWR			X			(PT)	(PT)	(P)
X = EXISTING STATION; R = Ryan or other thermograph			AGENCY:	USGS = U. S. GEOLOGICAL SURVEY						
XT = EXISTING AND TELEMETERED (* - telemetered to TMID; m = modem)				USBR = U. S. BUREAU OF RECLAMATION						
X(T) = EXISTING PARAMETER PROPOSED FOR TELEMETERING				DWR = CALIF. DEPT. OF WATER RESOURCES						
(P) = PROPOSED PARAMETER; (PT) = PROPOSED TELEMETERED PARAMETER				DFG = CALIF. DEPT. OF FISH AND GAME						
CDEC = Calif. Data Exchange Center; IEP = Interagency Ecological Program				TMID = TURLOCK AND MODESTO IRRIGATION DISTRICTS						
				DFG = CALIF. DEPT. OF FISH AND GAME						
1 = No records above 200 cfs.				TMID = TURLOCK AND MODESTO IRRIGATION DISTRICTS						
2 = Dry Creek is a tributary to Merced River that flows into the Merced River										
immediately downstream of Shaffer Bridge. The Dry Creek near										
Snelling gage is located approximately 14 miles upstream of the										
Dry Creek-Merced River confluence.										

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Table G-2: FISHERIES MONITORING ACTIVITIES IN THE SAN JOAQUIN RIVER BASIN

Stanislaus River	
Spawning	Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts
Seining	No seine sampling currently being done.
Smolts	Rotary screw traps used to monitor fall-run salmon and steelhead smolt migration and survival. Up to three sampling locations; upper, middle, and lower river. Began in 1993 with lower river trap only. Expanded to three traps in 1995. Traps operated January thru June (if possible) by OID/SSJID and USFWS.
Steelhead	No specific sampling for steelhead is done in addition to rotary screw traps. However, CDFG initiated sampling in 1997 to collect steelhead for genetic analysis
CWT	No CWT releases of fall-run chinook salmon have been made in the Stanislaus since approximately 1989.
Other Species	No specific sampling for other species done on a regular basis. Some snorkeling observations may be available. A predator population study may be proposed by USFWS.
IFIM	Most recent IFIM conducted by USFWS in 1993.
Temperature Model	Temperature model developed by USBR. Model has been designed to incorporate chinook salmon biological data to predict impacts to early life stages of salmon in the Stanislaus. Thermographs were placed at six locations along the river in January 1998 by S.P. Cramer & Associates. A new temperature model is being developed by OID, SSJID, and others.

Table G-2: FISHERIES MONITORING ACTIVITIES IN THE SAN JOAQUIN RIVER BASIN (Cont.)

Tuolumne River	
Spawning	Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts. Surveys conducted annually since 1971.
Seining	Annual seine sampling at seven locations (five on Tuolumne River, two on San Joaquin River, above and below confluence) to determine density of fall-run salmon fry and smolts. Bi-weekly sampling from January to June. Sampling conducted by EA for TMID since 1986.
Smolts	Rotary screw traps used to monitor fall-run salmon smolt migration and survival. Up to three sampling locations; upper, middle, and lower river. Began in 1995 with lower river traps only. Traps operated by TMID and CDFG.
Steelhead	No specific sampling for steelhead, however annual spawning surveys, seining, and screw traps results provide some indirect monitoring during October to June.
CWT	Annual CWT releases of fall-run chinook from Merced River Fish Facility (occasional releases from out of basin hatcheries) by CDFG in spring, since 1986.
Other Species	No specific sampling for other species since summer flow studies conducted by EA for TMID from 1988-1994. Predator population study conducted by EA for TMID in 1989-1990. Seining provides some indirect monitoring during January to June
IFIM	Most recent IFIM conducted by USFWS in 1992.
Temperature Model	SNTEMP model developed by EA for TMID; operates on a 5-day time step.

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Table G-2: FISHERIES MONITORING ACTIVITIES IN THE SAN JOAQUIN RIVER BASIN (Cont.)

Merced River	
Spawning	Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts. In addition, approximately 50% of adult spawners are used annually by the Merced River Fish Facility for hatchery production of smolts. The hatchery has been in use since 1970 with a current production capacity of up to 1 million smolts.
Seining	No seine sampling currently being done.
Smolts	A single rotary screw trap near the mouth of the river is used to monitor fall-run salmon smolt migration and survival. Trap is operated by CDFG during spring months and began sampling in 1995.
Steelhead	No specific sampling for steelhead, however annual spawning surveys, hatchery observations, and screw trap results provide some indirect monitoring during October to June.
CWT	Annual CWT releases of fall-run chinook from Merced River Fish Facility (occasional releases from out of basin hatcheries) by CDFG in spring
Other Species	No known sampling for other species done on a regular basis
IFIM	Most recent IFIM conducted by USFWS in 1995.
Temperature Model	Data for temperature model collected by Jones & Stokes for CDFG. Calibration and verification of model results not yet available.
San Joaquin River above Vernalis	
Seining	USFWS has conducted seining in the river. Monitoring also is done for the river from Stockton to Highway 132 as part of the Interagency Ecological Program.

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and Game (CDFG), the Operations Group should develop and adopt a Best Management Practice (BMP) for supplying ramping guidelines (both up and down ramp) governing the release of attraction and pulse flows to ensure and maximize the protection of salmon.

G.3 CONJUNCTIVE USE AND WATER RECLAMATION/EFFICIENCY PROJECTS

The SJRGA is to be paid $4,000,000 annually (escalated annually by the Consumer Price Index) by the USBR and CDWR so long as the SJRGA and its members perform under the terms of the San Joaquin River Agreement (SJRA). The funds paid to the SJRGA are intended to be substantially used to enhance efficient water management within the districts including, but not limited to, water reclamation, conservation, conjunctive use, and system improvements. Use of these funds by the public agencies will be documented in each agency's annual financial audit report. The funding is established for implementation of conjunctive use and other water efficiency projects that will mitigate potentially significant impacts to agricultural water users and to groundwater conditions.

The EIS/EIR identified two districts that may experience potentially significant reductions in water deliveries to their customers under below normal or dry/critically dry hydrologic conditions: Merced Irrigation District (Merced ID) and Oakdale Irrigation District (OID). The maximum amount of groundwater that could be pumped directly to ensure that each district meets it water obligation under the SJRA is 67,500 acre-feet for Merced ID and 15,000 acre-feet for OID. Because groundwater is typically used to replace much of the shortfall in surface water supplies, water delivery reductions resulting from the proposed project could result indirectly in an increase in groundwater pumping with subsequent potential impacts on overdraft, water levels, and subsidence in portions of the project area as discussed in Section 4.3 of the final EIS/EIR. Merced ID and OID service areas are the principally affected areas for which mitigation is required to reduce the impacts to water deliveries and groundwater conditions to less-than-significant levels. Their projects are described below.

In addition, the other willing sellers involved in the proposed project have implemented and/or are planning to implement water efficiency projects consistent with AB 3616 and in coordination with groundwater management plans (AB 3030) and current water supply plans (Modesto Irrigation District, Turlock Irrigation District, South San Joaquin Irrigation District, and San Joaquin River Exchange Contractors Water Authority).

G.3.1 MERCED IRRIGATION DISTRICT

The Merced Water Supply Plan (1995) calls for the stabilization of groundwater at 1992 levels. This is being accomplished by constructing and operating direct recharge facilities including a new conjunctive use project by the District. A pilot project for groundwater recharge involves three test basins. One recharge basin has been completed on City of Merced property near Farhen's Park. For the conjunctive use project, a groundwater aquifer will be selected to act as a reservoir. In dry years, groundwater will be used to make up for the shortfall in surface water deliveries, and the aquifer will

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be replenished during wet years with surface water from the Merced River. Studies to select a site have been completed with completion of the entire conjunctive use project within ten years. Most of the recharge of the Merced Groundwater Basin occurs from irrigation water diverted from the Merced River. Implementation of recharge facilities will replenish depleted groundwater supplies from ongoing activities as well as the direct and indirect impacts from the proposed project. Also, canal seepage contributes to recharging the Basin's aquifers.

To reduce reliance on groundwater, Merced ID has implemented three programs to encourage groundwater pumpers to convert their systems to surface water: In-Canal Surface Water Incentive Program, On-Farm Low-Volume Incentive Program, and the Highlands Pilot Project (an agricultural water treatment plant). Expansion of these programs will also contribute to reductions in groundwater usage.

G.3.2 OAKDALE IRRIGATION DISTRICT

OID has several water efficiency projects underway and planned (OID/SSJID 1997).

- In conformance with the *Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Suppliers in California,* OID is developing a Water Management Plan (WMP) which includes implementation of Efficient Water Management Practices (EWMPs). EWMPs include, but are not limited to: designation of a Water Conservation Coordinator, provision of water management services to water users, evaluation of institutional policies, and evaluation of groundwater pumps to improve efficiency.

- OID has already upgraded its tailwater recovery system so that captured return flows are available for use. The District is coordinating the operation of its tailwater reclamation pumps to increase the efficiency of the system and to further maximize the recovery system yield.

- OID is implementing a Supervisory Control and Data Acquisition system to closely monitor water delivery operations on a real time basis. Installation of the system began in 1996 and the District is currently adding approximately five monitoring/control sites per year.

- The District trains its Ditchtenders on the proper operation of its delivery system which includes training in water measurement as well as the proper documentation of where the water is being delivered.

- OID has purchased land for the installation of one regulating reservoir and is in the process of acquiring land for a second reservoir at the end of each main canal. These reservoirs will be used not only as re-regulating points but also for groundwater recharge.

- OID operates under its AB3030 Groundwater Management Plan (1996) which includes implementation of groundwater recharge and deep well pumping. The District has a conjunctive use plan that will allow for increases in groundwater use from surface water stored in aquifers.

Contacts:
Stanislaus River - Doug Demko, SP. Cramer and Associates
Tuolumne River - Tim Ford, Turlock Irrigation District
Merced River - Dave Vogel, Natural Resource Scientists
IFIM - Craig Fleming, U.S. Fish and Wildlife Service

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APPENDIX H

RESPONSES TO COMMENTS

APPENDIX H

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APPENDIX H
RESPONSES TO COMMENTS

INTRODUCTION

The Draft EIS/EIR was sent to the State Clearinghouse as required by CEQA (SCH# 98092062). The Clearinghouse submitted the document to selected state agencies for review. None of the state agencies provided comments to the Clearinghouse.

Comments received in writing are presented first, followed by transcripts of the two public hearings held in October 1998.

H.1. COMMENT LETTERS

Written comments were received from the following federal, state, regional, and local agencies and private organizations and individuals:

Federal Agencies

National Marine Fisheries Service
Environmental Protection Agency, Region IX
Fish and Wildife Service

State

Department of Water Resources
Water Resources Control Board

Regional and Local

Central Delta Water Agency
Contra Costa Water District
Oakdale Irrigation District
Regional Council of Rural Counties
Sacramento Municipal Utility District
South Delta Water Agency
Stanislaus County Chief Executive Office
Stanislaus County Department of Planning and Community Development
Stanislaus County Sheriff's Department
Stockton East Water District

Organizations and Individuals

Earl Eckert
Environmental Defense Fund
Lorens M. Foard
State Water Contractors

The following sections include a copy of each comment letter in the order presented above, followed by a response to that letter. Extensive exhibits provided with the letter from the South Delta Water Agency are not included with their letter, and they are on file with the lead agencies.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95402

November 10, 1998 SW04:LXH

Mr. Michael Delamore
Program Manager
Bureau of Reclamation
South-Central California Area Office
2666 North Grove Industrial Drive, Suite 106
Fresno, CA 93727-1551

Subject: Comments on the Draft EIS/EIR for Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010

Dear Mr. Delamore:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement/Report for Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010 (DEIS). Based on a review of the DEIS and a meeting on October 15, 1998 to discuss technical issues in the document, The National Marine Fisheries Service (NMFS) is providing the following general and specific comments.

General Comments

1 The DEIS generally indicates that the preferred alternative (VAMP) would result in less-than-significant impacts to streamflow in the San Joaquin Basin tributaries. However, NMFS has met with the Bureau of Reclamation (USBR) and the San Joaquin River Group and requested additional information regarding flows and temperatures in the tributaries. This additional information is needed by NMFS to evaluate potential upstream impacts to fall-run chinook spawning, incubation, rearing, and emigration habitat and life history stages. We are anticipating this information soon and may provide additional comments to you following our review. Furthermore, we understand that the document will describe the assessment methodology used to determine the significance of impacts. This information needs to be evaluated by NMFS before a Final Environmental Impact Statement is released.

2 The National Marine Fisheries Service and the Bureau of Reclamation discussed the need to complete section 7 consultation pursuant to the Endangered Species Act for threatened Central Valley steelhead. The Final EIS/EIR must acknowledge the need for the USBR to comply with section 7.

3 The National Marine Fisheries Service has NOT accepted the installation and continued operation of the Merced River Fish Facility as compensation for very low instream flows in the Merced River.

Specific Comments

4 *Section 2.4.1, Description of Each Alternative, Page 2-11.* It is our understanding that the responsibility was non-discretionary for meeting Vernalis flow objectives in the Ecological Fair-Share alternative. Each tributary would be responsible for contributions based on their portion of the unimpaired flow to the San Joaquin River. Within each tributary, water could come from willing sellers/willing buyers.

5 *Section 3.5.3.1, Page 3-81.* No mention is made of the extirpation of spring-run chinook in the San Joaquin Basin. We recommend that there be some discussion of this historical fact, given its importance in the context of the decline of salmon runs in the Basin.

6 This section should also discuss the migration of fall-run chinook fry under certain water year types. During the high flows of 1998, many fall-run fry emigrated from the San Joaquin tributaries to the lower San Joaquin River and Delta in January and February. Acknowledging this migration timing strategy will be helpful in determining the adequacy of the timing and the duration of the proposed spring pulse flow. Protecting this life stage may be crucial in maintaining their genetic viability over time.

7 Fry emerge from the gravel primarily during the period from January through March and may emigrate from the tributaries into the Bay/Delta estuary soon after emergence. Additional information on fall-run chinook life histories is necessary to comply with NEPA requirements. A good reference is McBain and Trush's (1998) "Draft Tuolumne River Corridor Restoration Plan, Stanislaus County, CA." Based on discussions during the October 15, 1998 meeting, it is our understanding that an adequate description of fall-run life history will be added to the document.

8 *Section 3.5.3.1, Page 3-81.* Change aelvins to alevins.

9 *Section 3.5.3.1, Page 3-85.* Additional factors leading to the decline of salmon populations include inadequate flow conditions during smolt emigration and adult immigration, and excessive water temperatures during spawning, incubation, and rearing life stages.

First paragraph. "...particularly black bass and striped bass,..."

10 *Section 3.5.3.2, Steelhead/Rainbow Trout, Page 3-86.* In addition to the rewording of the paragraph on steelhead agreed to at the October 15th meeting, NMFS recommends the preparation and implementation of an adequate presence/absence, abundance and distribution monitoring program.

11 *Section 4.5.1, Aquatic Resources, Key Impact Issues and Evaluation Criteria, Page 4-63.* The criterion used to determine the level of riverine impact (percent change to streamflow) assumes that higher flows are always beneficial to resources using the river. This is not always the case. In fact, above some threshold, flows may reduce carryover storage for temperature control, reduce spawning and rearing habitat quantity and quality, alter salmon growth rates, and cause premature salmonid outmigration. Additional flow-related parameters limiting production of anadromous fish (e.g., flow fluctuations, redd dewatering, stranding of juveniles, and water temperatures) should be assessed to evaluate impacts.

12 *Section 4.5.2.3, Page 4-67, Chinook Salmon.* In the first paragraph, a more complete sentence would be, "At a certain stage of growth and development, they begin a process of *physiological* transformation for emigration out of the river to the ocean (smoltification). The last sentence of the same paragraph does not adequately describe the purpose of spring pulse flows.

Section 4.5.2.3, Page 4-74, Chinook Salmon. The National Marine Fisheries Service has NOT accepted the installation and continued operation of the Merced River Fish Facility as compensation for very low instream flows in the Merced River.

13 In the Merced River, reductions in flow associated with the proposed action may be significant and adverse to spawning fall-run chinook, incubating eggs, and fry due to elevated temperatures, stranding, and redd dewatering. In fact, according to CALFED's ERPP, spawning and rearing flows are too low to meet spawning and rearing needs, and stream temperatures often exceed temperature tolerances for salmon spawning and egg incubation.

The assessment method in the DEIS is inadequate for determining true impacts to these life history stages of chinook salmon. Temperature models exist for all three east-side tributaries and should be used to evaluate temperature changes in spawning and rearing reaches resulting from changes in flow. Existing and predicted flows and temperatures should be documented in the DEIS, and they should be compared to AFRP and ERPP flows and temperatures.

14 Although the expectations of attracting adult spawners to spawning reaches with stressful temperature levels might be low, impacts could still be high. To reduce these impacts, a Best Management Plan (BMP) should be developed. This BMP would use predicted water temperatures to determine the appropriate timing of the fall attraction flows.

15 Changes in flow over a shorter time scale than monthly are likely to occur and could adversely affect fisheries. Can short-term changes in flows associated with the project proposal be predicted and assessed?

NMFS supports the document's recommendation for developing and adopting a BMP for supplying ramping guidelines governing the release of attraction and pulse flows to ensure and maximize the protection of salmon.

We look forward to cooperating with the Bureau of Reclamation and the San Joaquin River Group Authority to produce a complete Final Environmental Impact Statement/Environmental Impact Report. If you have any questions about these comments, please contact Laura Hamilton at (707)575-6082 or Gary Stern at (707)575-6060.

Sincerely,

Jim Bybee
Habitat Conservation Manager
Northern California

cc: Dick Jewell, USFWS, Sacramento
Scott Spaulding, USFWS, Stockton
Bill Loudermilk, CDFG, Region IV, Fresno

NATIONAL MARINE FISHERIES SERVICE (NOVEMBER 10, 1998)

1. The Final EIS/EIR includes best available information including material developed for your specific comments below. In particular, see response 11 on the assessment methodology and response 13 on temperature data and analysis.

2. The following language has been added to Section 5.1.2, end of paragraph four: "Reclamation will complete any consultation requirements pursuant to Section 7 of the Endangered Species Act for threatened Central Valley steelhead."

3. The text on Draft EIS/EIR page 4-74 has been revised and the following language deleted from the first paragraph: "This low flow condition has been accepted by the resource management agencies because of the installation and continued operation of the Merced River Fish Facility, a state operated hatchery."

4. Technically, the Ecological Fair Share (EFS) approach is not based on willing sellers/buyers, and this part of the approach was not addressed. What was borrowed from this approach was the concept that the flow in each tributary was based on its portion of unimpaired flow to the San Joaquin River. Given these flows, a number of willing seller/buyer combinations would be possible given multiple water rights holders in each tributary.

5. Text in Section 3.5.3.1 has been revised to include the following sentence in paragraph two: "Spring-run chinook salmon in the San Joaquin Basin became extinct following the construction of impassible dams on major tributaries."

6. Text in Section 3.5.3.1 has been revised to include the following sentence in paragraph one: "In high flow years, fry may be displaced downstream or begin to migrate downstream earlier than in other years. For example, during the high flows of 1998, many fall-run fry emigrated from the San Joaquin tributaries to the lower San Joaquin River and Delta in January and February."

7. Text in Section 3.5.3.1 has been revised to include the following sentences in paragraph four: "As adult salmon migrate upstream, water must be cool enough and have sufficient dissolved oxygen to avoid stressing the fish. If these conditions are not met, adult fish may delay their migration (USFWS 1995b). Adult chinook salmon in the San Joaquin Basin typically spawn in upper reaches of the major tributaries. They select areas with gravel substrates and prefer loose, clean gravel about 1 to 4 inches in diameter, with preferred water depths ranging from 0.5 to 3.0 feet, and preferred water velocities of 1 to 3 feet per second (USFWS 1995b). For optimal development of embryos and survival of alevins, water should contain high concentrations of dissolved oxygen and range in temperature from 41 to 55 degrees Fahrenheit (Vogel and Marine 1991)."

8. Spelling correction noted; changed aelvins to alevins.

9. Comment noted. Text in Section 3.5.3.1 has been revised to include the following changes to sentence in paragraph two. "These pools provide habitat for salmon predators, particularly ~~smallmouth bass~~ black bass, and are believed to be responsible for significant losses to out-migrating smolts (EA 1992)." Note that the suggestion of including striped bass as an in-river predator was not implemented. Predation by striped bass occurs, but has been noted to occur primarily in the Delta, and near areas where hatchery smolts are released.

   Also, text has been revised to include the following paragraph between paragraphs two and three. "Additional factors leading to the decline of salmon populations include inadequate flow conditions during smolt emigration and adult immigration, and excessive water temperatures during spawning, incubation, and rearing life stages."

10. Text in Section 3.5.3.2 has been revised to include the following changes, resulting in re-writing of paragraph five to read: "Historically, winter-run steelhead are the only race found in the Central Valley and are native to the Sacramento and San Joaquin River Basins (USBR 1997g). In the San Joaquin River Basin, steelhead populations have been reduced to remnant levels. However, there is some evidence of a distinct anadromous run of steelhead in the Stanislaus River. Large rainbow trout are present in the upper reaches, and juvenile rainbow trout showing signs of smolting are trapped in the lower reach during studies designed to sample emigration of salmon smolts. Genetic studies are underway to determine whether these fish are part of a reproducing steelhead population within the Stanislaus River, strays from another basin, or resident rainbow trout (CALFED 1997). Past monitoring efforts have been inconclusive in determining the presence or absence of steelhead populations in the Tuolumne and Merced rivers, or the San Joaquin River upstream of the Stanislaus River. Recently, Central Valley steelhead were listed by the Federal government as a threatened species (USFWS 1998)."

    Comments noted regarding NMFS recommendation of monitoring plan for steelhead. Ongoing sampling programs will continue, and genetic studies are needed to evaluate presence or absence of steelhead.

11. The assessment methodology to determine the significance of impacts was selected specifically to address anadromous salmonids. As a result, it accounts for the important flow-related parameters which could potentially limit the production of anadromous fish in the San Joaquin River System. The way in which it incorporates potential limiting factors is described in more detail below.

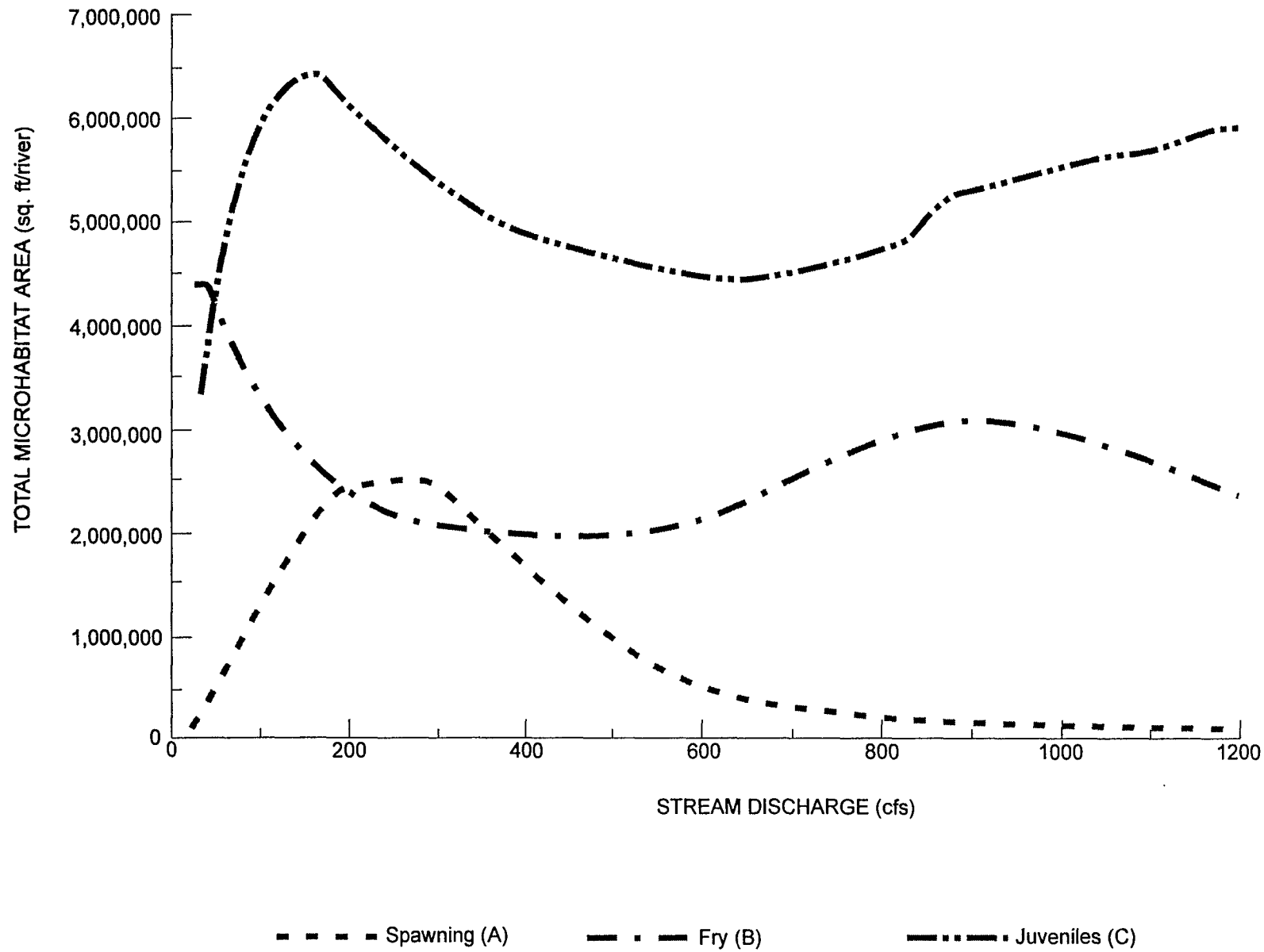
    In selecting the methodology, the hydrological consequences of the proposed action were considered. The proposed action would, in general, result in increased flow in the spring

(April-May) and fall (October-November) and decreased flow during the winter/early spring (December-March) as reservoirs are refilled. The environmental consequences of these actions on anadromous salmonids depends upon the relative magnitude of the change in streamflow, the life-stages present within the river system at the time of the changes, and how rapidly the changes are implemented.

The magnitude of change was characterized by determining the average percentage change in streamflow from the base case, sorted by water year type (which effects streamflow magnitude). This index allows one to directly appraise the magnitude of streamflow change relative to the base condition. The water-year-type sorting accounts for one of the major sources of variability within the hydrological system: differences in flow associated with annual variations in rainfall. This sorting implicitly incorporates information on base case conditions. Finally, the streamflow changes associated with the proposed action generally occur during periods of relatively high flow in the San Joaquin River System (winter/spring), thus limiting the usefulness of knowing the specific magnitude of the base case flows. A table of base case conditions is included in the Final EIS/EIR as Table 4.5-1(B).

The following life stages of anadromous salmon are present at the time of flow alterations: spawning adults (October-November), eggs, fry, juveniles, and smolts. It is important to realize that the operational constraints, contained within the proposed action, include the negotiated minimum flow standards protecting the anadromous fish resources within the tributaries of the San Joaquin River. This means that during implementation of the project, sufficient flows always exist to provide protection for all of the above life stages — i.e., redds would not be dewatered, water temperatures would be suitable, etc. These minimum flow standards are based upon an accepted and thoroughly reviewed analysis of the important flow-related parameters limiting the production of anadromous fish in the tributaries of the San Joaquin River.

Fishery scientists often utilize physical habitat versus instream flow relationships to establish minimum flow standards. These curves generally behave such that habitat quantities increase very little (i.e., "flatten out") or even decrease at high instream flow values. As an example, Figure H-1 shows habitat versus instream flow curves for various fall-run Chinook salmon life-stages for the lower Tuolumne River (U.S. Fish & Wildlife Service 1994). Note the following: In curve A, spawning habitat shows very little change at high flows (above 900 cfs); Curve B, fry habitat decreases at high flows (900–1200 cfs); and, Curve C (juvenile habitat) exhibits a gradual increase at high flow (900–1200 cfs). Consequently, a decrease in flow of 20 percent at a 1200 cfs discharge (i.e., from 1200 to 960 cfs) would cause little to no change in spawning habitat, an increase (of approximately 17 percent) in fry habitat, and a modest decrease in juvenile habitat (approximately 7 percent). The resulting changes in habitat are small, less than the percentage change in flow and non-limiting to the population (i.e., well above the minimum flow). This example illustrates the reasoning used



Source: USFWS (1994c)

F:\Projects\13386.02\Master\Graphics\2130\Fall_Run.cdr

Figure H-1. Total habitat area for fall-run chinook salmon in the lower Tuolumne River, California.

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to establish the numerical significance criteria. The general behavior at high flows of physical habitat versus discharge curves supports the conclusion that reductions in flow between -10 percent to -20 percent result in less-than-significant changes in habitat. This is important since the proposed action could result in reduced instream flow during high flow periods.

As one approaches changes in flows of 10 percent or less it becomes difficult to even accurately measure the difference, especially at high flows where the stage-discharge relationship of the stream gauge could have wide confidence intervals (due to the relative scarcity of measurements at high flows and the inherent difficulty of getting accurate discharge measurements). This line of reasoning led to the establishment of the significance criteria identified in the Draft EIR/EIS.

Finally, the increased flows during the fall (attraction flows) and spring (pulse flows) are specifically identified as water management actions which are beneficial to anadromous fish. The attraction flows are intended to aid in successful migration of adults from the Sacramento–San Joaquin River Delta into their target tributaries. The pulse flows are intended to trigger and promote the successful out migration of anadromous smolts from their tributary of origin through the Delta on their way to the ocean. This premise, that the attraction and pulse flows will be of benefit to the anadromous fish populations, is being tested by means of a monitoring program independent of the San Joaquin River Agreement. For the purposes of this EIR/EIS, which deals with the water acquisition and release alternatives, it is sufficient to report that these flow changes are expected to have a beneficial impact to the anadromous fish resource.

The EIR/EIS also evaluates how rapidly the attraction and pulse flows are released, since this could potentially affect anadromous juveniles and smolts. Flow fluctuations and juvenile stranding are considered potentially significant impacts which are evaluated and specific mitigation measures identified to reduce impacts to less-than-significant levels.

In summary, the method used to evaluate impacts of upstream flow changes, associated with implementation of the proposed project and its alternatives, is adequate to identify the probable consequences of the proposed action on anadromous fish. The relative magnitude of the instream flow change, its timing with respect to the life stages present, and how rapidly water is released are all analyzed The method incorporates, either implicitly or explicitly, the important flow-related parameters limiting the production of anadromous fish in the San Joaquin River and its major tributaries.

12. Text in Section 4.5.2.3 has been revised to include the following rewrite of a sentence in paragraph three. "At a certain stage of growth and development, they begin a process of

physiological transformation to prepare for emigration out of the river to the ocean (smoltification)."

Also, text has been revised to include the following sentences at the end of paragraph three: "Pulse flows can mimic natural storm events that increase streamflow and stimulate emigration. Pulse flows usually result in increased turbidity and lower water temperatures. Both of these factor serve to reduce the impact of predation on emigrating smolts. Additionally, pulse flows may provide the necessary means to increase the survival of chinook salmon smolts by moving them out of tributaries where water temperatures typically increase occur over the summer months and eliminate suitable rearing habitat. The Vernalis Adaptive Management Plan is an experimental study to determine the proper level for the pulse flows."

13. See response 3 above regarding the fish facility. Concerning water temperatures on the Merced River, the following text has been added to Section 4.5.2.3, Chinook Salmon at the end of the discussion of impacts of the Proposed Action.

Existing records, data, and modeling efforts addressing water temperature issues for the Merced River are not sufficient at this time to allow comprehensive quantitative analysis of the potential for impacts of the proposed actions on Merced River temperatures. However, a qualitative examination of projected changes in average monthly Lake McClure water storage levels provides a useful approach for better understanding the potential for impacts on river temperatures.

The storage level of Lake McClure is a primary factor affecting the temperature of water released into the Merced River at New Exchequer Dam. Along with season of the year, annual runoff pattern, and annual air temperature variations, reservoir levels affect the temperature of water at the dam's outlet. The level of the reservoir affects the volume of cold water in the hypolimnion which forms in the deepest layers of the reservoir upon thermal stratification during the late spring, summer, and early fall months. Surface water warmed by the air and solar radiation during the spring and summer "floats" on top of the cooler, denser water of the hypolimnion. The depth of this warmer surface layer can vary but is generally between 15 and 30 feet deep in most California reservoirs. Once thermal stratification breaks down during the early fall months, the warmer surface and cooler hypolimnion waters mix and reservoir temperature becomes almost uniform throughout its depth and comes to a dynamic equilibrium with inflow and air temperatures until stratification reoccurs in spring.

Given this general relationship between a lake's temperature profile and depth, differences in lake level can be used as a proxy indicator for potential differences in temperature at the reservoir outlet. Figures 4.5-1 through 5 provide graphical representation of the differences

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in average monthly lake levels between the Proposed Actions (April and May scenarios) and the No Project alternative and suggests that minimal effects on the temperature of water released into the Merced River may be expected. The difference between the two proposed action operations is negligible. Differences between the proposed action (April and May scenarios) and No Project alternative are small. The magnitude of these differences vary between water year type and over the course of individual water years, but are generally less than 30 feet different in depth. Such a small difference between the alternatives, relative to total depth of the reservoir at any one time, would not be expected to have much effect on release temperature when compared to the No Project alternative, except perhaps during the early fall months in dry and critically dry water years when total storage may be limited. The extent of such an impact on water temperature in the Merced River would be dependent on the degree of cooling provided by decreasing seasonal air temperature which dominates release temperature in affecting river temperature in the lower Merced River during the fall and early winter months.

The AFRP and ERPP flow objectives have not been adopted formally. Comparing VAMP flows to them provides no meaningful analysis of the effects of the proposed action.

14. Comment noted. The SJRA provides for coordination among the agencies to develop and implement the annual Operations Plan for the timing of the pulse flows. Monitoring data for water quality including temperature is to be evaluated in developing the Operations Plan. See the Mitigation Reporting Program contained as Appendix G in this Final EIS/EIR.

15. The pulse flows may or may not occur as a series of pulses. Changes in flows will be planned and evaluated by the Operations Group on a real time basis as they occur. Constant flow at Vernalis is produced by short term adjustments in the tributaries. We are meeting the required flows as explained above in Response 11.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

NOV 9 1999

Mr. Michael Delamore
Bureau of Reclamation
2666 N. Grove Industrial Drive
Suite 106
Fresno, CA. 93727

Dear Mr. Delamore:

The Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the project entitled **Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010.** Our review is pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

The Bureau of Reclamation (Reclamation) and San Joaquin River Group Authority (Authority) propose to meet the flow objectives for the Draft San Joaquin River Agreement (Agreement) over the period 1999-2010. The Agreement developed as an alternative to the San Joaquin River flow objectives contained in the State Water Resources Control Board's 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP). Debate over the flow objective led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies to support that plan. The process of developing the Vernalis Adaptive Management Plan (VAMP) resulted in the Agreement in April 1998. The Agreement identifies where the water to support the VAMP study would be obtained, specifically from the San Joaquin River Group Authority whose members are willing sellers.

The purpose of the proposed action is to acquire water identified in the Agreement and use the water for: 1) a pulse flow for a 31-day period at Vernalis during April and May, and 2) other flows to facilitate migration and attraction of anadromous fish including fall attraction flows. This water is needed to support the VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement is to change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The Agreement provides for up to 137,500 acre-feet of water. The EIS evaluates the potential environmental impacts resulting from implementation of the Agreement, the State Water Right Priority System, and no action.

EPA supports the Vernalis Adaptive Management Plan (VAMP), as long as it is implemented in a manner that does not degrade existing conditions or limit future management options. We commend the Authority for their willingness to provide water to support this 12 year study. It is clear that additional data is required to ensure appropriate protective measures are implemented for fall-run chinook salmon and other sensitive fisheries in the San Joaquin River. EPA will continue to participate actively in implementation of the VAMP and a long-term fishery management program for the San Joaquin River.

While we support the purpose and need for the proposed project, we have concerns regarding potential impacts to water quality, groundwater, and riparian habitat. We are especially concerned with potential effects to groundwater due to the existing problem of groundwater overdraft in the San Joaquin River basin. In addition, we are concerned with the limited comparison of the two action alternatives. While we recognize these alternatives may not be directly comparable, we believe additional discussion and evaluation of the qualitative differences between alternatives may better serve decisionmakers and the public. As stated by NEPA, the EIS should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public [40 CFR Section 1502.14].

Because of the above concerns, we have classified this DEIS as category EC-2, Environmental Concerns - Insufficient Information (see attached "Summary of the EPA Rating System"). We appreciate the opportunity to review this DEIS. Please send two copies of the Final EIS to this office at the same time it is officially filed with our Washington, D.C. office. If you have questions or wish to discuss our comments, please call Ms. Laura Fujii, of my staff, at (415) 744-1579.

Sincerely,

David J. Farrel, Chief
Federal Activities Office
Cross Media Division

Enclosure: (3 pages)

Filename: vampdes.wpd
MI003029

cc: USFWS, Sacramento
Laura Hamilton, NMFS, Santa Rosa
SWRCB
Dan Fults, Friant Water Users Authority

COMMENTS

Water Quality and Groundwater

1. The DEIS appears to evaluate only the total dissolved solids and salinity at Vernalis (pg. 4-16). Furthermore, there is no evaluation of the potential effect on existing and future temperature conditions in New Don Pedro or Lake McClure reservoirs or the ability to meet temperature objectives for the lower Merced, Tuolumne and Stanislaus Rivers. Since carryover storage in these reservoirs would be significantly negatively affected by the proposed action (pg. 4-16), downstream temperature management may become more difficult. Improved temperature management in these rivers during the fall months are critical for fall-run chinook salmon spawning and incubation. The FEIS should provide an analysis of temperature effects and how these impacts may affect reservoir management options that reduce downstream water temperatures during critical periods for fisheries.

2. The FEIS should also provide additional information regarding upstream base streamflow conditions and potential impacts on flow-related parameters which limit the production of anadromous fish (e.g., flow fluctuations, stranding of juveniles, redd dewatering). Given the sensitivity of fishery resources to flows, we also recommend consideration of an alternative method for assessing stream flow impacts which would evaluate short-term changes in flows (shorter than monthly).

3. It is not clear whether South San Joaquin Irrigation District will utilize groundwater to replace the 11,000 acre-feet of surface water provided for the VAMP study (pg. 4-24). If there is a possibility that groundwater would be used as replacement water, the FEIS should evaluate the potential impacts of this on groundwater levels and water quality.

4. Evaluation of potential impacts to groundwater quality under the alternative action, State Water Resources Control Board Water Right Priority System, is scarce due to the inability to determine the volume of groundwater that may be pumped by junior water right holders to replace lost surface water deliveries (pg. 4-36). We recommend Reclamation consider an evaluation of a "worse case" scenario, whereby it is assumed that the entire amount of lost surface water is replaced by pumping from the most likely groundwater basins. Such an evaluation would provide some indication of the potential to adversely affect already stressed groundwater basins.

5. Given the overdraft condition within the San Joaquin River basin, we urge Reclamation to work with the Authority and their member Irrigation Districts to minimize the use of groundwater as replacement of the lost surface water. We advocate an approach which relies first on conservation, water reuse, and other creative methods of

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providing replacement water prior to pumping additional groundwater or developing new water sources.

6. The FEIS should provide a firm and clear commitment to mitigation for potential impacts to water quality, groundwater and flows. For instance, the FEIS should identify who will develop and implement the ramping guidelines proposed to minimize adverse flow impacts to fisheries (pg. 4-74).

Riparian Vegetation

7 Although the DEIS clearly describes a number of negative impacts which could affect riparian vegetation (pg. 4-54 to 4-57), these impacts were only considered significant if they affected one or more threatened or endangered plant species (pg. 4-57). We believe this threshold of significance is too narrow given the importance of riparian vegetation as critical habitat for fish and wildlife. We strongly recommend that additional thresholds of significance be considered which would provide an indication of potential impacts to the habitat values of riparian vegetation. For instance, the potential percent mortality or loss of habitat functions which could be caused by desiccation, flow ramping, or scour.

General Comments

8 1. To provide a more accurate comparison of alternative impacts, we recommend including the No Action alternative(s) in Table ES-1: Summary Comparison of Alternative Impacts.

SUMMARY OF EPA RATING DEFINITIONS

This rating system was developed as a means to summarize EPA's level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the EIS.

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

ADEQUACY OF THE IMPACT STATEMENT

Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

ENVIRONMENTAL PROTECTION AGENCY (NOVEMBER 9, 1998)

1. Comment noted. Concerning temperature conditions, the drawdown of New Don Pedro is small, a 1 percent decrease over No Action and only an 11,000 acre-feet decrease on average in storage. The largest decrease in storage of 24,000 acre-feet would only produce a drop of 2.6 feet. Lake McClure would sustain the largest drop in carryover storage, a 10 to 13 percent reduction. Lake levels could drop as much as 28.5 feet, and the lake levels vary from 727 feet to 863 feet during the summer months and depending upon water year type (Table 4.5-2). Surface water warmed by the air and solar radiation during the spring and summer floats on top of the cooler, denser water of the hypolimnion. The depth of this warmer surface layer is generally between 15 and 30 feet deep in most California reservoirs. See response to NMFS comment 13.

   The issue of water temperature in the rivers and potential impacts to chinook salmon and steelhead from the Spring and October flows are discussed in Section 4.5.2.3. Additional text specific to the Merced River has been added. An analysis of the potential for impacts to temperature in the Merced River was added and based on the differences in lake level due to a lack of temperature modeling data at this time. See response to NMFS comment 13.

2. Upstream base streamflow conditions can be interpreted as meaning those flows in the upper reaches of the San Joaquin River and major tributaries below the reservoirs. These reaches are part of the defined project area, and as such, base flow conditions would be represented by the No Action alternative. Upstream base streamflow conditions can also be interpreted as meaning those flows entering reservoirs from outside of the defined project area. These flows, although not specifically required to be evaluated in the EIS/EIR, combine to determine the water year type (e.g., wet, normal, dry, etc.) and affect the release requirements and operation of reservoirs. Both streamflow and reservoir impact analysis is done by water year type in the EIS/EIR.

   Potential flow related impacts to anadromous fish species, including flow fluctuations, stranding of juveniles, and redd de-watering, are addressed for fall-run chinook salmon in Section 4.5.2.3, by tributary and with recommendations for establishing a Best Management Practice (BMP) that would govern the rate of flow changes in order to maximize the protection of this species.

   The models used to simulate stream flow cannot produce data more detailed than monthly, so the impact assessment methodology relied on monthly flow data. However, additional information on the methodology to relate stream discharge to microhabitat area is provided in the response to NMFS comment 11.

3. Table 2.1-1 explains that SSJID does not propose to use groundwater to meet its contribution to the Spring pulse flow. Table 4.1-1 indicates that their 11,000 acre-feet would come from carryover storage/conservation or from reduced deliveries to irrigation customers. Groundwater would not be pumped by SSJID to replace the surface water provided. No additional analysis of impacts to groundwater levels or to water quality is necessary.

4. Evaluation of a "worst case" scenario is impractical and not required under NEPA. Given the total volume of water for the alternative action (greater than the proposed action's 137,500 acre-feet) and its withdrawal from basins previously described, the result would likely be a significant impact. The additional information would probably not result in a different conclusion.

5. Comment noted. Reclamation is working with the Authority and its members as you suggest. See Appendix G which was added to this EIS/EIR.

6. The commitment to mitigate all significant and adverse impacts that are not unavoidable is contained in Appendix G, Mitigation Reporting Program.

7. Additional thresholds of significance have been included in the EIS/EIR as suggested. The text in Section 4.4.1.1 has been revised to include the following:

   Determining whether an alternative had a negative or positive impact on riparian vegetation depends upon how an alternative flow schedule interacts or impedes each species life history. The following thresholds of significance criteria were defined for determining potential impacts:

   - Discharges during April 1-June 1 (spring) created potential impacts if:

     1. The magnitude and duration of flows are sufficient to inundate floodplains during seed dispersal period and initiation period, potentially creating a positive impact.

     2. Stage decreased at a rapid rate after May 1, primarily during flowramping, potentially creating a negative impact to germinating and establishing Fremont cottonwood seedlings.

     3. Stage increased during, or after, Fremont cottonwood seed dispersal period, drowning newly initiated plants potentially creating a negative impact.

   - Discharges during June 1-Sept 30 (summer) created potential impacts if: Summer base flows were achieved by June 15 and did not have wide day to day variation over

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the three month period, thereby encouraging narrowleaf willow encroachment along the low water channel potentially creating a negative impact.

- Discharges during October 1-March 31 (fall/winter) created potential impact if: Bedload mobilization thresholds were reached, discouraging narrowleaf willow encroachment, thereby potentially creating a positive impact.

The revised impact analysis in Section 4.4.2.1 is for the Tuolumne River only, as this data was readily available. For all of the new text and figures, refer to the main text of the FEIS/FEIR.

8. The summary comparison in Table ES-1 reflects the impact of each alternative in comparison to the No Action. A comparison of the No Action to itself would not be relevant.

RECEIVED
BUREAU OF RECLAMATION
FRESNO, CA
DEC 10 2 22 PM '98

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

IN REPLY REFER TO

December 8, 1998

Memorandum

To: Program Manager, Bureau of Reclamation
South-Central California Area Office, Fresno, California
Attention: Mr. Michael Delamore

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office,
Sacramento, California

Subject: Comments on the September 25, 1998 Draft Environmental Impact Statement / Draft Environmental Impact Report - Meeting Flow Objectives for the San Joaquin River Agreement, 1999 - 2010

The Sacramento Fish and Wildlife Office has reviewed the Draft document and we have three main concerns to be addressed: a) an unclear identification of the proposed uses of the water to be acquired from the Oakdale Irrigation District; b) lack of evaluation of impacts to downstream and south-of-Delta water users as a result of a temporal redistribution of flows and/or changes in reservoir carryover storage; and c) related to b) above, a discussion of who will have the responsibility for making up any secondary impacts to users. These concerns are discussed in more detail below.

The Draft document does not clearly identify the use of the water proposed for acquisition from the Oakdale Irrigation District. The preferred alternative outlines three blocks of water being made available as follows:

1. Vernalis Adaptive Management Plan (VAMP) flow of up to 110,000 acre-feet from the San Joaquin River Group Authority for a 31-day pulse flow in April / May of each year.

2. Merced River release of 12,500 acre-feet above the existing flow for fall attraction during October of all years.

3. Oakdale Irrigation District obligation of 15,000 acre-feet in every year of the Agreement, plus the difference between the water made available by the district for the VAMP pulse flow (11,000 acre-feet) and the amount actually used. This water would be released at times other than during the pulse flow period.

The water identified in numbers 1 and 2, above, are clearly identified for fish and wildlife purposes. However, the discussion on the use of water identified in number 3, above, needs to be more clear.

It is alternately described as being used for ramping, spawning and attraction flows, water temperature control, or other environmental needs (page 1-6) or for any authorized purpose of the New Melones Project (page 2-5).

Since the most probable source of funds and authority for acquisition of this block of water is the Central Valley Project Improvement Act Section 3406(b)(3), which is to "supplement the quantity of water dedicated to fish and wildlife purposes...", we suggest that fish and wildlife purposes be identified consistently throughout the document as the intended use of the water. The following text changes should be made:

Section ES.2, Page ES-2, 1st Paragraph, 2nd bullet; and
Section 1.2.1, Page 1-3, 1st Paragraph, 2nd bullet

> "other flows identified by the CVPIA water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows, and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area."

Section ES.4, Page ES-4, 1st Paragraph, 3rd bullet

> "OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water committed to the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID will be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes will be made by the Service annually."

Section 1.3, Page 1-6, 1st Paragraph, 3rd bullet

> "The Agreement also provides for Oakdale Irrigation District (OID) to sell 15,000 acre-feet in every year of the Agreement, plus the difference between the water made available by OID for VAMP pulse flow (11,000 acre-feet) and the amount actually used. The additional water from OID could be used for ramping around the Spring or October pulse flows or at other times to supplement spawning flows or control water temperature on the Stanislaus River. The final decision for the use of this water for fish and wildlife purposes will be made by the Service annually."

Section 2.1.1, Page 2-1, 1st Paragraph, 3rd bullet

> "OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water made available for the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID will be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows,

1 temperature control in the lower Stanislaus River during the summer and fall periods and improving carryover storage in New Melones Reservoir (banked) for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes will be made by the Service annually."

Additionally, the Draft document on page 2-6 erroneously states that full use of the water acquired for environmental purposes may result in New Melones Project supplies being available for other purposes. This is incorrect. Any water acquired from Oakdale Irrigation District would be in addition to the existing obligations of the New Melones Project, including the minimum instream flows identified pursuant to Section 3406(b)(2) of the Act, and any downstream water quality requirements. Hence, it would not free up New Melones supplies for other purposes. The language in the document should be revised to reflect this, as follows:

Section 2.1.3.3, Page 2-5 and 2-6, 2nd Paragraph

2 "If this water is purchased under the authority of the Central Valley Project Improvement Act (CVPIA) Section 3406 (b)(3), its uses would be to "--- supplement the quantity of water dedicated to fish and wildlife purposes---". This water provided by OID will be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and improving carryover storage in New Melones Reservoir (banked) for the purpose of using the additional water to augment flows in subsequent dry years. The final decision on the use of this water for fish and wildlife purposes will be made by the Service annually. If this water is to be used for other purposes authorized by the New Melones Project, it will be purchased under another authority."

The document also should identify that there may be impacts to downstream and south-of-Delta water users caused by a temporal redistribution of flows and/or reductions in carryover storage in San Joaquin River Group Authority agency reservoirs. Meeting the target flows during the spring pulse period will either: a) result in foregone usage of that water by the San Joaquin River Group Authority agencies that provide the water; b) result in reduced releases and instream flows later in the current water year, after the spring pulse flow period; or c) cause their reservoirs to be at lower storage levels at the end of the water year than they would have been without the VAMP, increasing the risk of their failing to fill for the coming water year. Either b) or c) could
3 seriously impact downstream and/or south-of-delta water users. The long term modeling indicates significant re-operation (temporal redistribution of flows) as evidenced by reduced flows later in the year, after the spring pulse flow period increased flows in the spring (when there are greater delta export pumping restrictions) followed by commensurate decreases in flow in the summer (when Delta export pumping restrictions are relaxed) can lead to significant net reductions in exports which would impact State Water Project and Central Valley Project customers. Similarly, reduced carryover storage in San Joaquin River Group Authority agency reservoirs could, depending on the hydrology of the coming winter, result in less storage available in the next water use season. This could also affect downstream and south-of-delta water users. The level of significance of these two types of re-operation is difficult to ascertain from the information presented. Additional modeling detail is needed and a more thorough discussion of impacts presented in the document.

4 Additionally, the Draft document has not made it clear whose responsibility it will be to make up any secondary impacts to the State Water Project and the Central Valley Project resulting from the operational changes described above. The Draft document has not made it clear that the San Joaquin River Group Authority agencies would be responsible for making up these secondary impacts. This should be discussed and explicitly identified.

Thank you for the opportunity to review this Draft document. We hope our comments are helpful. We would like to review how these issues were addressed before the final document is released. If you have any questions or need clarification, please contact Dick Jewell or Jim McKevitt at (916) 979-2760.

Dale A. Pierce

Dale A. Pierce

U.S. FISH AND WILDLIFE SERVICE (DECEMBER 8, 1998)

1. In Sections ES.2 and 1.2.1, ...other flows identified by the CVPIA... assumes Service recommendations or concurrence. The following changes have been made to the text: "...other flows identified by the CVPIA water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area."

   In Section ES-4, the following changes have been made to the text: "...OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water committed to the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID will be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes will be made by the Service annually, following consultation with other Federal and State agencies."

   In Section 1.3, the following changes have been made to the text: "...The Agreement also provides for Oakdale Irrigation District (OID) to sell 15,000 acre-feet in every year of the Agreement plus the difference between the water made available by OID for VAMP pulse flow (11,000 acre-feet) and the amount actually used. The additional water from OID could be used for ramping around the Spring or October pulse flows or at other times to ~~(to~~ supplement spawning flows or control water temperature on the Stanislaus River~~, or meet other environmental needs consistent with the New Melones Interim Plan of Operation and future long-term operations plan).~~ The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies."

   In Section 2.1.1, the following changes have been made to the text: "...OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water made available for the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID would be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus River during the months when fish are present, ramping of flow changes on the Stanislaus River following

high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes will be made by the Service annually, following consultation with other Federal and State agencies."

2. The comment is correct that the water acquired would be to "...supplement the quantity of water dedicated to fish and wildlife purposes... as provided under CVPIA Section 3405 (b)3)." However, CVPIA Section 3406(b)(2)(D) states "If the quantity of water dedicated under this paragraph, or any portion thereof, is not needed for the purposes of this section, based on a finding by the Secretary, the Secretary is authorized to make such water available for other project purposes." It is clear by this language that if the acquired water when added to the dedicated 3406(b)(2) water exceeds the purposes of the dedicated water, then some b(2) water may be made available for other project purposes. The statement that, "Full use of the acquired OID water for environmental purposes may result in New Melones Project supplies being available for other purposes", while unlikely, is correct. The reference in Section 2.1.3.3 has been changed to read 3406 (b)(3).

3. Similar to the potential effect Vernalis flow modifications may have on other Delta tributary flows, the flow changes at Vernalis due to the proposed project could lead to modified Delta export operations. However, at this time no evaluation can be made of this circumstance especially in the context of the many other factors potentially affecting CVP and SWP operations. (See Comment 2 to DWR.) Potential impacts to export uses would not necessarily be caused by the proposed action's acquisition of flows alone, but instead potentially caused by combining the acquisition of flows with export reductions concerning the VAMP, which is not within the scope of this documentation.

4. The Bureau of Reclamation is the lead agency for NEQA and the San Joaquin River Group Authority is the lead agency for CEQA. Both NEPA and CEQA have regulations addressing the responsibilities of the lead agencies that must be adhered to. Be assured that these regulations will be met for the proposed project.

STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

November 23, 1998

Mr. Michael Delamore
U.S. Bureau of Reclamation
South-Central California Area Office
2666 North Grove Industrial Drive, No. 106
Fresno, California 93727-1551

Mr. Dan Fults
Friant Water Users Authority
1521 I Street
Sacramento, California 95814

Department of Water Resources' Comments on the Draft Environmental Impact Statement and Environmental Impact Report for Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010

Thank you for the opportunity to comment on the Draft Environmental Impact Statement and Environmental Impact Report for Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010. As you know, the Department of Water Resources generally supports the proposed San Joaquin River Agreement. We signed the Letter of Support for the Agreement on July 1, 1998, which, among other things, commits DWR to fund over $1 million per year for up to twelve years.

1 This Agreement provides for a study involving a spring pulse flow in the San Joaquin River coupled with a specified level of exports, referred to as the Vernalis Adaptive Management Program (VAMP). It also provides for a San Joaquin River attraction flow in October. The Draft EIR/S analyzes only the impacts associated with providing the Agreement flows. It does not address impacts associated with the export levels contained in the VAMP. VAMP export reductions have the potential to significantly reduce the amount of water supply south of the Delta. The scope of the analysis contained in the Draft EIR/S is, however, acceptable to DWR. We continue to maintain the position held throughout the Agreement negotiations: Our cooperation in implementing the VAMP is contingent upon there being no significant impact to water supplies.

2 Another concern related to potential impacts to export water supply involves the storage of fall or winter flows in reservoirs in the San Joaquin River watershed which would not occur in the absence of the proposed pulse flows. This occurrence is referred to as a "refill impact" because flows that would have gone to the Delta and possibly been available for export are being retained upstream. We recommend that the Final EIR/S analyze, in detail, the potential for this impact to occur.

2 An analysis of this type would also show the possible changes in instream flows on the Sacramento, Feather, and American Rivers that could be expected to occur during the VAMP and October attraction flow. We also do not expect these changes to be significant but, to assure the EIR/S adequately covers all potential impacts, we recommend an analysis be included.

3 An additional concern related to the proposed water acquisition is the potential impact it will have upon the water quality at Vernalis. The report's analysis concludes the potential impact is beneficial overall. The discussion in the Draft EIR/S (Table 4.2-11) is limited to monthly water quality levels averaged over the 71-year hydrologic period. Averages of this type can mask significant negative events and, conversely, positive occurrences. We recommend a more detailed analysis of monthly water quality at Vernalis be included in the document. This discussion should include a description of monthly water quality over the full range of the 71-year period and for each of the five water-year classifications. In addition, the condition under which the greatest degradation occurs (by month and year) should be disclosed and mitigation measures, if possible, should be identified.

4 A related issue is the potential for the proposed project to reduce flows on the San Joaquin River at Vernalis during summer months. The analysis in the draft EIR/S does not show any meaningful reductions in summer flows at Vernalis due to the project; however a recent analysis of the potential implications of the project during 1999, provided by the U.S. Bureau of Reclamation during a meeting of the CALFED Operations Group, clearly showed that these reductions could occur. DWR will participate in the development of annual operations plans for the proposed project, should it go forward, to ensure the potential for such effects is minimized. However, we also recommend that this issue be clearly identified in the Final EIR/S and addressed in more detail.

5 Our final concern relates to the potential for increased withdrawals from a groundwater basin that is already being overdrafted. To assure the Draft EIR/S captures the greatest potential negative impact, it is assumed the maximum, annual surface water diversion for increased flows from the Merced Irrigation District (67,500 acre-feet) results in reduced water supply deliveries which, in turn, are replaced by ground water. This withdrawal is estimated to be about 12% of the annual groundwater production rate from the Merced Groundwater Basin and is identified as a potential significant impact to the basin.

6 Mitigation actions, such as conservation, pumping regulation, and groundwater supplementation, are identified but no specific commitment is made to implement any of these actions. We recommend that the analysis of the impact be done in more detail to assure the level of impact is accurate. In addition, if the level of impact remains significant after re-evaluation, a much stronger commitment to mitigation actions should be contained in the document. The funds paid to the San Joaquin River Group Authority for the water acquisition are intended to enhance efficient water management within the districts. A commitment to implement such mitigation actions could be very convincing if more specificity about the use of these funds and the actions to be taken for improving the management of the groundwater basin is provided in the report.

7 Annual operation plans can be developed to help minimize the negative impacts to export water supply related to the VAMP export curtailments and reservoir refill, as well as Vernalis water quality. We will rely upon the Technical Group and the Management Group, as defined in the Agreement, and the CALFED Ops Group to develop operation plans that will address these concerns on an annual basis.

Attached are several additional comments related to technical aspects of the report. If you have any questions about these comments please contact me at (916) 653-1099 or Mike Ford at (916) 653-7247.

Sincerely,

Katherine F. Kelly, Chief
Office of SWP Planning

Attachment

ADDITIONAL TECHNICAL COMMENTS

8 1. The comparison between the "No Action" and the "Proposed Action" does not show significant differences in summer flows at Vernalis during the June through September period. This may be due to assumptions made about summer releases from reservoirs on the San Joaquin River and its tributaries for hydropower generation. The assumptions for summer reservoir operations should be described in detail and compared with recent summer historical operations.

9 2. There is no reference to the development levels used in the hydrologic data for PROSIM-SANJASM-STANMODAM simulations, nor the source of the hydrologic data.

10 3. Tables 4.2-4 and 4.2-5 appear to be labeled incorrectly.

11 4. Figure 4.4-5 doesn't appear to include all scenarios.

DEPARTMENT OF WATER RESOURCES (NOVEMBER 23, 1998)

1. Comment noted.

2. The "potential" for refill impacts to occur can be found within the technical appendix (Appendix A report, and model output available by request) in the EIS/EIR. In certain hydrologic sequences, releases for the proposed action can result in a reduced reservoir carry-over storage condition which will subsequently be refilled, at times in an immediately following year, and sometimes several years later. The modeled frequency and magnitude of these occurrences can be estimated through investigation of the change in flows at Vernalis between the "Proposed Project/Action" flows and the "No-action" flows. Flow changes less than zero (negative values) indicate when either a re-operation between months or a refill between seasons/years occur.

   Evaluating potential changes to other Delta tributary streams as affected by changes in flow at Vernalis due to the proposed action is beyond the scope of this documentation. The effect of potential refill impacts to other Delta tributary streams requires the establishment of a multi-year operations plan for the CVP and SWP which will acknowledge the Vernalis flow regime in the context of their other commitments concerning Bay-Delta responsibilities, the CVPIA and AFRP actions, CalFed objectives, ESA and the Coordinated Operating Agreement. Refill impacts may or may not occur as a result of the proposed action, but in any case cannot be described further at this time.

3. The technical appendix of modeling results provides full disclosure of the monthly water quality at Vernalis under the proposed action/project and no action scenarios. Table 4.2-11 has been enhanced to provide a more robust illustration of anticipated water quality changes due to the proposed action.

4. The 71 years of modeled hydrology do not show an instance where summer-time flows are affected significantly by the proposed action except on the Merced River in above normal years (Table 4.9-6). Text has been added to Section 4.9.2.2 to indicate your concern. "Under certain circumstances of hydrology and operational objectives (not modeled) there could occur an operation whereby flows from the reservoir operators that would otherwise have been released at their discretion during the summer may, as the result of the proposed action, no longer be released. The likelihood of these instances is considered rare, and its effect, if any, on Vernalis flow is complicated due to the potential reaction of New Melones Reservoir operations to flow and resultant water quality changes at Vernalis."

5. Comment noted.

6. The commitment to implement actions to mitigate potentially signifiant impacts to groundwater is contained in Appendix G, Mitigation Reporting Program. Funds received by the SJRGA and its members are to be used to implement water conservation projects. The SJRA requires an annual audit of each affected district to ensure that the monies are spent on such projects. We have not completed more detailed analyses because the conclusion reached is supported by data taken from recent groundwater management plans prepared by each district. OID and Merced ID's conjunctive use, groundwater recharge, and other projects are explained in Appendix G.

7. Comment noted.

8. The actions likely to be exercised by the proponents under the proposed action would result in little difference in summer-time flows. Typically, during the summer reservoir operations will be meeting minimum summer-time instream flows. Under the proposed action, this circumstance would remain the same. Comparing historical operations with the analysis will likely have limited value. Many changes and circumstances have recently occurred that will not provide a meaningful comparison. These circumstances and changes include the recent 6-year drought that affected how water is managed in the San Joaquin Valley and the recent FERC decision for minimum flows on the Tuolumne River. Limiting the historical record even more is the fact that the recent years have mostly been wet, thereby providing no recent record of operations under a range of year types.

9. Since the proposed action is near-term, e.g., for a duration of 12 years, all simulations used Reclamation's "current level of development" data sets.

10. The labels for Tables 4.2-4 and 4.2-5 have been revised to "Average End-of-Year Storage (TAF) in Project Reservoirs for No Action - April* " and "Average End-of-Year Storage (TAF) in Project Reservoirs for No Action - May".

11. The scenarios are technically included in figure 4.4-5, but the figure does not reproduce well. The different lines are "superimposed" because the values for No Action and the April project are essentially the same. The similarities can be seen in Table 4.5-1B.

State Water Resources Control Board

John P. Caffrey, Chairman

Peter M. Rooney
Secretary for Environmental Protection

Division of Water Rights
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Pete Wilson
Governor

NOVEMBER 13 1998

Mr. Michael Delamore
U.S. Bureau of Reclamation
2666 N. Grove Industrial Drive, Suite #106
Fresno, CA 93727

Mr. Alan Short
San Joaquin River Group Authority
c/o Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95252

COMMENTS ON THE DRAFT EIR/EIS TITLED: MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT: 1999-2010

The State Water Resources Control Board (SWRCB) staff has reviewed the Draft EIR/EIS titled *Meeting Flow Objectives for the San Joaquin River Agreement: 1999-2010.* The document was issued jointly by the U.S. Bureau of Reclamation (USBR) and the San Joaquin River Group Authority (SJRGA). The preferred alternative is a long term water purchase agreement between the USBR and the SJRGA to supply instream flow to support the Vernalis Adaptive Management Plan (VAMP) during the 31 day April-May pulse, and other flows at other times as specified in the agreement.

1 As indicated on page 2-9, the SJRGA must petition the SWRCB pursuant to Water Code sections 1700 et seq. for a change in purpose and place of use. The SJRGA would be the CEQA lead agency in that proceeding and the SWRCB would be a responsible agency. Before approving the petition, the SWRCB must make a finding that such a change will not injure any legal user of water.

General Comments:

The document analyzes three alternatives; the preferred alternative, a no action alternative as defined on page 2-10, and SWRCB flow Alternative 3 as defined in the draft EIR for implementation of the 1995 Bay/Delta Plan. The document attempts to compare the relative impacts of the three alternatives. We feel that this comparison is problematic for several reasons.

2 1. The simulation models used in the analysis of the no action and the preferred alternatives differ from those used by the SWRCB. Therefore, the results are not directly comparable.

3 2. The document compares SWRCB Alternative 3 to SWRCB Alternative 2, saying that SWRCB Alternative 2 comes closest to the no action alternative. However, the SWRCB modeling of Alternatives 2 and 3 uses a Stanislaus River operation which differs substantially from the no action alternative in the document. As the base cases are not directly comparable, conclusions regarding the relative impact of the preferred alternative and SWRCB Alternative 3 are questionable.

4 3. The SWRCB alternatives are designed to meet the 1995 Bay/Delta Plan San Joaquin River flow objectives, whereas the no action alternative does so only to the extent that flows are met incidentally through the Interim Stanislaus Operation Plan.

5 As a result of these differences, it is not possible to compare SWRCB Alternative 3 with the no action alternative and the preferred alternative. Therefore, the conclusion that one alternative is preferable to another is questionable.

Thank you for allowing an extension on your comment period. If you have questions concerning these comments, please contact Nick Wilcox, of my staff, at (916) 657-0446.

Sincerely,

Victoria A. Whitney

Victoria A. Whitney, Chief
Bay/Delta and Compliance Section

STATE WATER RESOURCES CONTROL BOARD (NOVEMBER 13, 1998)

1. Comment noted. Section 1707 petitions have been filed December 10, 1998.

2. Comment noted. This point is made in the text in Section 4.1.4.

3. Comparing SWRCB Alternative 3 to SWRCB Alternative 2 is an appropriate and meaningful impact analysis approach, because it removes any potential confounding effects of different flow targets and operation models. The only difference between the SWRCB alternatives is the allocation of responsibility for achieving flows in the San Joaquin River at Vernalis. That is, since both SWRCB alternatives achieved the same target flows at Vernalis and were analyzed with the same operation model, the relative differences between these two alternatives cannot be attributed to these factors. Instead the relative difference is due to the methodology by which the Vernalis flow target was apportioned among the water rights holders in the San Joaquin River system.

   Comparing the preferred alternative to the No Action alternative removes the confounding effects of different operation models and accounts for different flow targets at Vernalis. The differences between the alternatives results from the allocation of responsibility for achieving flows in the San Joaquin River at Vernalis and the difference in flow targets between the alternatives. The No Action alternative is designed to meet the 1995 Bay/Delta Plan San Joaquin River flow objective to the extent that flows are met incidentally through the Interim Stanislaus Operation Plan. The preferred alternative hits flow targets specified in the San Joaquin River Agreement. Analysis of the relative differences between these two alternatives allows one to assess the environmental consequences of both differing targets and allocation of flow among the water rights holders in the San Joaquin River system.

   Using the above approach, comparing the relative impacts of the preferred alternative to the relative impacts of the SWRCB Alternative 3 is both appropriate and meaningful. Differences in relative impacts are attributable to differences in flow targets and allocation of responsibility among the water rights holders of the San Joaquin System.

   Finally, to the extent that the SWRCB Alternative 2 and the No Action alternative are the same, then the flow targets are the same. It is not clear from the material that the SWRCB has presented in their public documents that the two alternatives are substantially different as they claim. It remains true that the closest SWRCB alternative to the No Action alternative is SWRCB Alternative 2. Differences between the base cases would not substantially affect the impact analysis. Comparison of the relative impacts are primarily affected by the differing flow allocation methods which are analyzed and described in this document.

4. Comment noted.

5. Comment noted. We recognize that we do not have exactly comparable studies; however, the studies are adequate for these purposes.

DIRECTORS
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November 9, 1998

Via Facsimile # (209) 487-5130
and Regular U.S. Mail

Mr. Michael Delamore
U.S. Bureau of Reclamation
South-Central California Area Office
2666 North Grove Industrial Dr., #106
Fresno, CA 93727-1551

Re: Comments on the Draft EIS/EIR on Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010.

Thank you for the opportunity to comment on the above matter. As with all significant upstream water acquisitions, the Central Delta Water Agency ("CDWA") is concerned about the potential impacts that the proposed upstream water acquisitions will have on its downstream water users. In particular, the CDWA is principally concerned with the potential adverse impacts the proposed water acquisition will have on the water quality in the Lower San Joaquin River from Vernalis down to Turner Cut.

The California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) require lead agencies to adequately investigate, analyze and discuss the potential environmental impacts from their proposed projects prior to the adoption of those projects. The CDWA believes the lead agencies of the proposed project (The Bureau of Reclamation and the San Joaquin River Group Authority) have failed to adequately fulfill their respective obligations pursuant to CEQA and NEPA.

The CDWA wishes to concur in the statements and concerns expressed in the South Delta Water Agency's comments on the proposed project. The CDWA hereby supplements the concerns stated therein.

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C-096269

C-096269

I. The EIS/EIR has Failed to Adequately Identify, Discuss and Analyze the Extent to Which the Proposed Project Will Adversely Impact Water Quality at Vernalis.

The CDWA believes violations of the Vernalis Salinity Standard (0.7 EC from April thru August, and 1.0 EC from September thru March) constitute significant adverse impacts under both CEQA and NEPA and as such must be adequately investigated, analyzed, and discussed in the EIS/EIR. The CDWA further believes the EIS/EIR has wholly failed to adequately investigate, analyze and discuss the extent the proposed project will cause or exacerbate Vernalis Salinity Standard violations.

While the EIS/EIR acknowledges at pg. 4-16 that "[w]hen there is insufficient water in New Melones Reservoir to meet all of the demands, salinity objectives cannot be met," the EIS/EIR fails to discuss the important impact that flows upstream of Vernalis have on the Vernalis Salinity Standard. It is common knowledge that the flows from the Merced, Tuolumne, and Stanislaus rivers, for example, have a significant impact on the salinity at Vernalis. The much higher quality water draining from these tributaries into the main stem of the San Joaquin River dilutes the much poorer water quality which drains into the main stem of the San Joaquin River from areas West of the San Joaquin River and elsewhere.

Unfortunately, while the EIS/EIR further acknowledges at pg. 4-17 that "the greatest number of months with exceedences [of the salinity objectives], and the largest magnitude of exceedence, occur during the low flow summer period," the EIS/EIR wholly fails to investigate or explain whether the proposed project will result in a transfer of upstream water from the summer months (when it is most needed for salinity dilution) to April, May and/or October. Thus, while Tables 4.2-10 and 4.2-11 on page 4-17 depict substantial (and unacceptable) numbers of exceedences of the Vernalis Salinity Standard under the proposed project, without an adequate understanding of whether or not the proposed project will result in a transfer of summer flows to April, May and/or October, the exceedences depicted in these tables do not fairly represent the extent of Vernalis Salinity Standard violations which will result from the proposed project. As such, the EIS/EIR fails to fulfill its fundamental purpose of providing decision makers with adequate information upon which to make informed decisions.

A proper and meaningful analysis of the potential impacts on downstream water quality would necessarily involve the determination of when, where, and how the transferred water would have been used in the absence of the transfer. For example, the EIR should identify and discuss the extent to which in the absence of the proposed transfers the transferred water would have been used for agricultural purposes, for groundwater

recharge, etc., or would have remained in storage for future use. Only after such a determination has been made can a proper and meaningful analysis of the potential impacts from the proposed project take place. Unfortunately, the Water Quality impacts analysis on pages 4-16 thru 4-19 and the Hydrologic Analysis in Appendix "A" have wholly failed to conduct this determination.

1

A. **The EIR Should Adequately Assess the Potential Reduction of Return Flows to the San Joaquin River as a Result of the Proposed Transfer, and Evaluate the Potential Impacts from Such a Reduction on the Water Quality in the Lower San Joaquin River from Vernalis Down to Turner Cut.**

To the extent the transferred water would have been used for agricultural purposes in the absence of the proposed transfer, the EIR should assess the potential reduction of return flows to the San Joaquin River as a result of the proposed transfer. Such an evaluation should include, but not be limited to, the following:

(1) Quantification of the participants' historic (i.e., without the proposed project) contribution of return flows--surface and subsurface, etc.--to the Lower San Joaquin River from Vernalis down to Turner Cut in the particular days and months of particular year types (the use of annual, average measurements is not sufficient).

(a) This analysis should include a detailed description of the method and data by which the amount of return flows is calculated, including an identification of the various locations on the canals and other waterways where surface and subsurface return flows are measured.

2

(2) Quantification of the amount these return flows will be reduced as a result of the proposed project (i.e., as a result of the project's anticipated tailwater recovery and/or conservation, etc.) during each particular day and month of each particular year type (the use of annual, average measurements is not sufficient).

(a) This analysis should likewise include a detailed description of the method and data by which the participants use to determine the amount return flows will be reduced by the various conservation measures.

(3) Quantification of the degree to which the given reductions in return flows will affect water quality in the Lower San Joaquin River from Vernalis down to Turner Cut in particular days and months of particular year types (the use of annual, average measurements is not sufficient).

(a) Again, this analysis should fully set forth in

detail both the method and data used by the participants to arrive at their estimations.

(b) Furthermore, particular attention should be given to potential impacts during the peak irrigation season (May-September) of drier year types since during these periods (1) the water quality in the Lower San Joaquin is often the poorest, and since (2) a given reduction in return flows would be expected to constitute a higher proportion of the total flow in the Lower San Joaquin River. For these reasons and others a given reduction in return flows during these periods would likely have the greatest impact on water quality in the Lower San Joaquin River.

2

II. Violations of the Vernalis Salinity Standard Constitute Significant Adverse Environmental Impacts Under CEQA and NEPA.

As was stated above, the CDWA believes violations of the Vernalis Salinity Standard constitute significant adverse impacts under both CEQA and NEPA and as such must be adequately investigated, analyzed, discussed, and mitigated in the EIS/EIR. It is inappropriate and improper for the EIS/EIR to base its findings that the proposed project will not have a significant adverse impact on the Vernalis Salinity Standard on a comparison of the proposed project to a base case (or "no project alternative") which itself contemplates significant violations of the Vernalis Salinity Standard.

CEQA Guidelines section 15126(d)(4) states in pertinent part:

3

> "The 'no project' analysis shall discuss the existing conditions, <u>as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved</u>, based on current plans and consistent with available infrastructure and community services." (14 Cal. Code of Regs. section 15126(d)(4), emphasis added).

Thus, since the SWRCB is in the process of adopting an Implementation Plan to fully implement the 1995 Water Quality Control Plan (which contains the Vernalis Salinity Standard), the no project analysis should assume (since it is reasonably expected) that the Vernalis Salinity Standard will be met and maintained throughout the duration of the proposed project. When the proposed project is compared to a base case which fully complies with the Vernalis Salinity Standard, it is clear that the contemplated violations of the Vernalis Salinity Standard which would result from the proposed project are significant adverse impacts which must be adequately mitigated to the extent

feasible. Since the EIS/EIR has wholly failed to discuss, much less analyze, feasible mitigation measures which would reduce or
3 eliminate the substantial numbers of exceedences of the Vernalis Salinity Standard depicted in Tables 4.2-10 and 4.2-11, the EIS/EIR has wholly failed to fulfill its fundamental purposes.

III. **The EIS/EIR Should Adequately Assess the Potential Water Quality Impacts from the Substitution of Groundwater in Lieu of the Transferred Surface Water.**

The EIS/EIR should also analyze the extent to which the participants will increase their use of groundwater for agricultural purposes in particular months of particular year types to make up for the loss of surface waters transferred
4 pursuant to the proposed project. Since the groundwater would be expected to be of lower quality than the surface water, the EIR should examine the extent to which the return flows associated with the use of the lower quality groundwater will return poorer quality water compared to return flows from the use of surface waters. To the extent the return flows from the substituted use of groundwater return poorer quality water into the San Joaquin River, the impacts from this poorer quality water on the water quality in the Lower San Joaquin River from Vernalis down to Turner Cut should be adequately analyzed, quantified, and mitigated.

IV. **Conclusion.**

For the foregoing reasons in addition to the comments submitted by the South Delta Water Agency, the lead agencies have thus far failed to fulfill their obligations under CEQA and NEPA to the environment, the public and to downstream water users.

Very truly yours,

Dante John Nomellini, Jr.
Co-counsel for the
Central Delta Water Agency

DJR:djr

P.S. Pg. 3-28 states "SWRCB, Central Valley Region." It appears that "SWRCB" should be replaced with "Regional Water Quality Control Board" or "RWQCB."

CENTRAL DELTA WATER AGENCY (NOVEMBER 9, 1998)

1. See the response to DWR Comment 8 regarding summer flows and CDWA Comment 2 below. The commenter is directed also to Section 4.2.2.3 of the EIS/EIR where results of the water quality analysis is presented. As described in the EIS/EIR, water quality standard violations at Vernalis would be reduced by the proposed action. This occurs because the water acquisition program will provide Reclamation additional water to allocate to authorized New Melones purposes, and because additional water will be provided in the fall from the Merced River.

2. The EIS/EIR discusses when, where, and how transferred water would be used in the absence of the transfer. Table 2.1-2 presents potential sources of water by each agency participating in the proposed project. Section 4.1.3 describes water uses potentially affected, and Section 4.2 describes in detail the environmental consequences of the proposed project and compares that to the No Action alternative. Due to changes in hydrological conditions from year to year, it is impossible to predict with any degree of accuracy whether water would have been used for agricultural purposes, ground water recharge, or would have remained in storage.

   The commenter is arguing with the statements of the project participants as to the source and nature of the acquired water. Specifically, the commenter argues a hypothetical reduction in summer time return flows as a result of the proposed action. The participants who are providing flows for the proposed action have stated that the majority, if not all of the flow provided would not affect the flow leaving their respective systems via surface returns. To the extent that such flows are affected, no regulatory basis exists to require maintenance of such flows. And, to the extent that modified flows affect the water quality at Vernalis, the operation at New Melones will offset that impact up to the amount accommodated by the Interim Operations Plan or by the New Melones long-term plan as it may be developed. The proponents do not anticipate the occurrence of reduced summer-time return flows as a result of the proposed action; therefore, evaluation of such an occurrence is not required.

   The commenter's focus on the proponent's "contribution of return flows ... to the Lower San Joaquin River from Vernalis down to Turner Cut" seems to be mis-informed. Flows controlled by the project's proponents do not enter the San Joaquin River within the named reach. Regarding how San Joaquin River flow modifications affect water quality at the boundary location at Vernalis, see Section 4.2.2.3. Water quality conditions downstream of that location will be affected by many other factors including pumping from the southern delta, diversions and returns by in-Delta water users, and the configuration and operation of barriers in the Delta, all of which are beyond the scope of this documentation.

3. See response to CDWA Comment 1. The purpose of the project is not to meet the Vernalis water quality objective adopted in the 1995 WQCP. The commenter is incorrect in that the

SWRCB is not adopting an implementation plan for the 1995 WQCP in the current Bay-Delta proceeding. The implementation plan was approved as part of the 1995 WQCP when the SWRCB adopted the plan in 95-1 WR and as required under Water Code § 13242. We have no way to predict what alternative the SWRCB will adopt or whether the alternative selected will fully implement the 1995 WQCP. In fact, none of the flow alternatives proposed by the SWRCB fully implement the Vernalis water quality objective. In addition some of the SWRCB's proposed water quality alternatives fail to fully implement the Vernalis water quality objective without additional dilution water from New Melones.

4. The extent to which participants may increase their use of groundwater to substitute for water made available as part of the project is described in Section 4.3. Of the participants, only Oakdale Irrigation District, Merced Irrigation District, and the Exchange Contractors project that they may substitute all or a portion of the water made available to the project with increased use of groundwater. In each case, the increased use is a relatively minor proportion of existing groundwater use and would have no discernable effect on the quality of return flows from these districts.

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Subject: CCWD Comments on Draft EIS/EIR for Meeting Flow Objectives for the San Joaquin River Agreement, 1999 - 2010

Dear Mr. Delamore and Mr. Short:

Contra Costa Water District (CCWD) appreciates the opportunity to comment on the September 25, 1998 Draft Environmental Impact Statement and Environmental Impact Report (DEIS/EIR) for Meeting Flow Objectives of the San Joaquin River Agreement, 1999 - 2010. CCWD has followed the development of the proposed San Joaquin River Agreement and has the following comments on the DEIS/EIR.

In general, the District supports negotiated settlement agreements between water users. Negotiated agreements are clearly superior to lengthy contentious water right hearings or litigation. In adopting negotiated agreements, however, it is critical that any and all impacts to third parties are fully disclosed. There must be sufficient analysis prepared for each agreement to ensure that other water users not party to the agreement do not have to provide additional water because of the agreement or that the agreement does not cause water quality degradation for a third party.

DEIS/EIR Does Not Address Impacts of Meeting Delta Outflow Obligations Under The San Joaquin River Agreement

1 The major tributaries to the Sacramento-San Joaquin Delta are the Sacramento River and the San Joaquin River. These two rivers provide the majority of the inflow to the Delta that is either consumptively used in the Delta, exported from the Delta, or contributes to Delta outflow. The 1995 Water Quality Control Plan (WQCP) has specific Delta outflow requirements and instream flow requirements upstream of the Delta. The WQCP also includes a Rio Vista flow objective, met using Sacramento River flows, and a Vernalis flow objective, to be met using San Joaquin River flows. The DEIS/EIS addresses the San Joaquin River Group Authority's (SJRGA) contribution toward meeting the Vernalis flow objective during the period of the VAMP experiment, 1999-2010, but does not address any obligation that SJRGA or other signatories to the San Joaquin River Agreement may have to meet the WQCP Delta outflow objectives.

For example, in the executive summary on page ES-1, the DEIS/EIR states that the SJRGA "*is working with the State and Federal governments to facilitate meeting these needs as related to the San Joaquin River: increased instream flows, compliance with*

1 *the 1995 State Water Resources Control Board Water Quality Control Plan flow objectives at Vernalis, and compliance with the Delta smelt Biological Opinion.*" There is no mention of meeting the Delta outflow objectives of the WQCP.

On Page ES-4, the DEIS/EIR compares alternatives for meeting the equivalent Vernalis flow objective in the WQCP. One alternative considered is Flow Alternative 3 (the Water Right Priority System Alternative) in the SWRCB's Draft Environmental Impact Report for Implementation of the 1995 Bay/Delta Water Quality Control Plan. The SJRGA's DEIS/EIR, however, does not properly represent Flow Alternative 3. On Page ES-4, the DEIS/EIS states that this "*alternative has the capabilities to meet the SWRCB's 1995 Water Quality Control Plan Vernalis flow objectives assigned to water right holders based on a water right priority system....This alternative would involve different water right holders than the proposed action and different quantities of water being released into the San Joaquin River system.*" Flow Alternative 3 in the State Board's Draft EIR deals with much more than meeting the Vernalis flow objective; the Water Right Priority System Alternative includes flow releases to help meet the Delta outflow objectives of the WQCP. The proposed San Joaquin River Agreement states that the United States Bureau of Reclamation (USBR) and, as appropriate, the California Department of Water Resources (CDWR), shall assume responsibility for the 1995 WQCP objectives for the San Joaquin River Basin share of Delta outflow. The DEIS/EIR fails to adequately address the impacts of the San Joaquin River Agreement because it does not analyze the impacts of meeting Delta outflow objectives (including the X2 requirements), whether from purchase of additional water in the San Joaquin Basin, reduction in CVP and SWP exports, or
2 releases from CVP and SWP reservoirs outside of the San Joaquin Basin.

The comparison between SWRCB Flow Alternative 3 and the proposed San Joaquin River Agreement is inadequate because the DEIS/EIR alternative for implementing the Agreement only attempts to meet equivalent Vernalis flow objectives and not the Delta outflow objectives.

CCWD believes that Vernalis Adaptive Management Program (VAMP) is a worthwhile experiment to help understand the relationship of San Joaquin River flows and Delta exports to the survival of migrating salmon. The VAMP program may or may not provide an equivalent level protection and the Vernalis flow objective in the 1995 WQCP. However, CCWD believes that the water users on the San Joaquin River have an obligation to help meet the Delta outflow requirements of the WQCP, and that additional flows during other times of the year may be needed to help meet those requirements. Even if those responsibilities are transferred to the CVP and SWP through the proposed Agreement, the impacts of meeting those additional flow requirements are part of the San Joaquin River Agreement and must be analyzed as part of the DEIS/EIR.

If the lead agencies propose that the impacts of meeting Delta outflow requirements under the San Joaquin River Agreement be addressed in other or subsequent environmental documents, those documents should be identified in the EIS/EIR and affected parties should be given the opportunity to review and comment on these documents and develop a complete understanding of the full impacts of the San Joaquin River Agreement.

DEIS/EIR Does not Address Impacts on Delta Water Quality

3 The DEIS/EIR is inadequate because it fails to address the potentially significant water quality impacts of the San Joaquin River Agreement on the Delta. The summaries of the Affected

Environment in the DEIS/EIR are discussed under the usual headings: surface water resources, groundwater resources, terrestrial resources, aquatic resources, land uses, cultural resources, recreation, etc., but does not separately discuss water quality. Water quality is included under surface water resources and groundwater resources, but only in terms of surface water quality in the San Joaquin River Basin (Chapter 3.2.4).

3 Any of the potential operational actions that may be implemented under the San Joaquin River Agreement to meet the 1995 WQCP objectives for the San Joaquin River Basin share of Delta outflow (purchase of additional water in the San Joaquin Basin, reduction in CVP and SWP exports, or releases from CVP and SWP reservoirs outside of the San Joaquin Basin) could have significant impacts on the water quality in the Delta and at CCWD's drinking water intakes at Rock Slough and Old River near Highway 4. These impacts need to be identified in the EIS/EIR and mitigation provided.

The District is particularly concerned about "*the potential use of agricultural return flow water by OID/SSJID and by the Exchange Contractors to meet their SJRA commitments ...*" (DEIS/EIR, page 4-18). Table 2.1-2 on page 2-7 suggests that up to 35,000 acre-feet of the water made available by the San Joaquin River Group could come from Tailwater Recovery. This agricultural drainage recovered from irrigated lands is likely to contain contaminants that will 4 impact water quality in the San Joaquin River and the Delta. The DEIS/EIR, on page 4-18, also notes that the conclusion that the impacts of such agricultural return flow discharges are small "*assumes that the growers would not exploit the increased flows to flush increased releases of agricultural drain water into the San Joaquin River and its tributaries.*" These statements further reinforce CCWD's request that the water quality impacts of the San Joaquin River Agreement on CCWD and other users of Delta water, including total dissolved solids, boron, selenium, pesticides, and other contaminants, be fully analyzed in the DEIS/EIR.

Because groundwater will likely be used to replace some of the water released to meet Vernalis flow obligations under the San Joaquin River Agreement, water quality problems impacts related 5 to boron, nitrates, arsenic and dibromochloropropane (see for example, Section 3.3.4.4 on page 3-27) may also occur. These impacts need to be analyzed in the EIS/EIR and mitigation provided.

DEIS/EIR Fails to Accurately Characterize The Delta Protection Act of 1959

The DEIS/EIR, on page 6-8, offers a brief but misleading description of the Delta Protection Act (Water Code sections 12200 et seq.). The Delta Protection Act establishes statutory priority for Delta water users in addition to the priorities already provided by the county of origin and watershed of origin statutes. The Delta Protection Act was added to the Water Code in 1959, four years after the California Attorney General's opinion interpreting the county and watershed of origin statutes was published (25 Ops.Calif.Atty.Gen. 8). In enacting the Delta Protection 6 Act, the Legislature added two new substantive measures to protect in-Delta water users. The first measure was salinity control, which was extensively litigated in regard to Decision 1485 and discussed at length in the "Racanelli Decision" (United States v. State Water Resources Control Board (1986) 182 Cal.App.3d 82; see particularly the discussion at pages 138-144).

The second substantive protection added to the Water Code by the Delta Protection Act concerns maintenance and provision of "*an adequate water supply*" for in-Delta users. Section 12202 mandates that:

> Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operations of the Federal Central Valley Project, shall be the provision of salinity control and an **adequate water supply** for the users of water in the Sacramento-San Joaquin Delta (emphasis added).

Section 12203 further adds that:

> It is hereby declared to be the policy of the State that no person, corporation or public agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users **within** said Delta are entitled (emphasis added).

Section 12204 adds that:

> In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections
6 12202 and 12203 of this chapter.

The mandate to provide "*an adequate water supply*" is separate from the salinity control directive. While in-Delta users are subject to the same constitutional, public trust, and public welfare doctrines as are other water users, the Delta Protection Act gives them an additional statutory priority which is not available to water users located outside the Delta and which must be taken into account by the projects in their water supply reliability and water transfer policies. In other words, based on the Delta Protection Act, before the SWP and CVP can deliver water to contractors in export areas, it has an obligation to meet the adequate water supply needs of its water supply customers within the Delta or in "an area immediately adjacent thereto which can conveniently be supplied with water therefrom" (Water Code section 11460 which is cross-referenced in sections 12201 and 12202).

In other words, the Act of 1959 requires adequate water supplies within the Delta (Section 12203) and not as stated in the DEIS/EIR, "*within the Delta and for export.*" Indeed, section 12204 specifically limits exports to ensure an adequate water supply for in-Delta users.

If you have any questions about the enclosed comments, please me at (925) 688-8187.

Sincerely,

Richard A. Denton
Water Resources Manager

RAD/WJH

CONTRA COSTA WATER DISTRICT (NOVEMBER 9, 1998)

1. Under the terms of the San Joaquin River Agreement, DWR and USBR have agreed to meet the San Joaquin River portion of the Delta outflow requirement. The two projects could meet the Delta outflow objective by the purchase of additional water in the Sacramento or San Joaquin River basins, increasing releases from upstream project reservoir storage, decreasing exports, or any combination of the three. The analysis of the operational alternatives available to DWR and USBR for meeting the San Joaquin River portion of the Delta outflow requirement is beyond the scope of this EIS/EIR. The range of impacts was discussed in the SWRCB's Draft EIR for implementing the 1995 WQCP.

   Because it would be impossible to meet, the SJRGA would have no obligation for the Rio Vista flow objective on the Sacramento River.

2. The purpose of the SJRA is not to meet the Delta outflow requirements of the 1995 WQCP. CCWD's belief that San Joaquin River water users have an obligation to meet Delta outflows is a legal position of CCWD. The obligation of upstream water users, including those on the San Joaquin River, to meet Delta outflow is much debated. The SWRCB has yet to determine in the ongoing Bay-Delta proceedings what obligation, if any, upstream water users have towards meeting Delta outflow objectives.

   The scope of the EIS/EIR is not intended to evaluate the impacts of the SJRA upon a yet-to-be-determined implementation of the 1995 Water Quality Control Plan. The commenter responds to its own comment by recognizing that the impacts of the proposed action upon such a separate action may be addressed in other or subsequent environmental documents. The requested analysis falls under the SWRCB's Bay/Delta water rights proceedings and the DEIR on the 1995 WQCP (SWRCB 1998) which was revised to include the SJRA as Flow Alternative 8.

3. The DEIS/DEIR limited the scope of its water quality assessment to the San Joaquin River basin, ending that information at point reflective of the San Joaquin River at Vernalis. It is concluded that no adverse water quality impacts occur (at the boundary of the study area, Vernalis) due to the proposed action of acquiring flows. The in-Delta potential water quality impact assessment suggested by the commenter concerns actions that are not within the scope of this documentation and will be addressed in other processes. This document addresses the water acquisitions associated with the SJRA.

4. Table 2.1-2 indicates that up to 31,000 acre-feet made available by the San Joaquin River Group could come from Tailwater Recovery. As stated in Section 2.1.4, tailwater would be recaptured into the surface supply system and reused within the boundaries of the agencies from which it originated, thereby replacing supplies made available to the project. Reuse of

this water in the originating districts is a minor component of their respective supplies and would have no discernable effect on the quality of return flows from these districts.

The referenced paragraph on page 4-18 of the DEIS/DEIR has been revised to more accurately reflect the potential impact. In particular, the cited statement regarding "*the conclusion assumes ...*" has been removed as, in fact, the conclusion relies on no such assumption.

5. The extent to which groundwater may be used to substitute for water made available as part of the project is described in Section 4.3. Of the participants, only Oakdale Irrigation District, Merced Irrigation District, and the Exchange Contractors project that they or their customers may substitute all or a portion of the water made available to the project with increased use of groundwater. In each case, the increased use is a relatively minor proportion of existing groundwater use and would have no discernable effect on the quality of return flows from these districts. Water quality standards for return flows and well water are set by the Districts. For example, the TDS standard for the Exchange Contractors is 300-1,200. This water would be blended with canal water prior to reaching the San Joaquin River.

6. Comment noted. The commenter's legal analysis and conclusion is inconsistent with Water Code § 12201 in which the Legislature specifically found that the maintenance of an adequate water supply in the Delta for in-Delta uses and as a source of fresh water for export was necessary to the peace, health, safety, and welfare of Californians.

O'Laughlin & Paris LLP

Attorneys at Law

November 9, 1998

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Re: Comments on DEIS/EIR for Meeting the San Joaquin River Flow Objectives

Dear Mr. Delamore

This letter represents the comments of the Oakdale Irrigation District ("OID") on the "Draft Environmental Impact Statement/Environmental Impact Report for Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010," dated September 25, 1998 ("DEIS/EIR"). I am sending this letter to you via facsimile; the original letter will follow in the mail.

In general, OID is pleased with the quality and thoroughness of the DEIS/EIR. As one of the proponents to the San Joaquin River Agreement ("SJRA"), OID believes that the flows represented by that agreement will provide a real benefit to salmon during their migration through the Bay-Delta system, and also will provide high-quality data on the relationship between flows in the San Joaquin River at Vernalis, the barrier at the head of the Old River, and rate of export by the State Water Project and the Central Valley Project. The information provided from VAMP will provide invaluable assistance in determining how best to manage the San Joaquin River while seeking to enhance the health of salmon stocks. As the DEIS/EIR demonstrates, implementation of the SJRA, reached through unprecedented cooperation between the San Joaquin River Group Authority, the Department of the Interior, and agencies of the State of California, can be achieved with minimal impact to the environment. While generally pleased with the DEIS/EIR, OID does has some concerns with specific aspects of the document.

1 First, OID is concerned about the treatment of steelhead in the DEIS/EIR. OID continues to maintain that there is no good evidence of a existing indigenous run of anadromous steelhead on the Stanislaus River, or in the entire San Joaquin Basin. OID maintains that both the National Marine Fisheries Service and CALFED do not have sufficient information to support their conclusions, referenced on pages 3-86 of the DEIS/EIR, that either the Stanislaus River, or the San Joaquin River basin in general, supports an indigenous anadromous run of steelhead. The few trout captured in San Joaquin River Basin that exhibit smolting characteristics of steelhead

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1 are more readily explained as strays from other streams and rivers outside the San Joaquin River Basin, or as resident rainbow trout demonstrating some anadromous steelhead characteristics.

Second, OID is concerned with the presentation of the data on impacts. Largely as an artifact of the computer simulations used to model the environmental impacts, the data on likely impacts is presented for April alone and for May alone. (See chapter 4 generally). However, the pulse flow period is expected to normally occur between April 15 and May 15, for a total of 31 days. This leads to several questions:

2

- Does the data for April and the data for May represent the bounds of the possible range of impacts? Stated differently, will all the impacts from the pulse flow fall within the range of values from April to May? While this is implied in the discussion of the impacts, and seems like a logical inference from the models, it does not seem to be explicitly discussed, either in the text or in Appendix A.

- If the pulse flow is 31 days, but there are only 30 days in April, does the data from April provide a sufficiently accurate basis for the analysis of impacts?

The DEIS/EIR should address these issues, either through an explanation in the text or in Appendix A.

Third, OID noticed some minor errors in the DEIS/EIR, as follows:

- Page 3-87. The DEIS/EIR cites "Demko 1995" for data from 1996-1997, which is incorrect. Douglas B. Demko and Steven P. Cramer have produced two reports entitled "Outmigrant Trapping of Juvenile Salmonids in the Lowert Stanislaus River Caswell State Park Site," on report for the 1996 period, published June, 1997, and one report for the 1997 period, published June 1998. It is the June, 1998 report which contains the data and observations cited in the DEIS/EIR. However, this report was supplemented by a memo dated June 29, 1998, from Steven P. Cramer, one of the reports authors, which added important qualifications to the conclusions in the report concerning steelhead. A copy of that memo is attached for your reference. OID would be happy to provide the report itself if needed, as well. 3

- Page 3-89. Near the end of the first paragraph on this page, there is a reference to "10-18 ppt sea water." Is this a reference to the salinity of the water?

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Thank you for the opportunity to comment on the DEIS/EIR. Please contact me if you have any questions about these comments, or would like a copy of the Demko and Cramer report published in June, 1998.

Very truly yours,

O'LAUGHLIN & PARIS LLP

By: _____
Michael D. Corrigan

Enclosure
CC (w/enclosure): Dan Fults
CC (w/o enclosure): Wayne Marcus
Richard Martin
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MEMO

TO: Recipients of 1997 Caswell Report
FROM: Steve Cramer
DATE: June 29, 1998
SUBJECT: Clarification of conclusion #7 in the report: "Outmigrant Trapping of Juvenile Salmonids in the Lower Stanislaus River Caswell State Park Site 1997," by Douglas B. Demko and Steven P. Cramer

I am writing to clarify a question that has been raised for conclusion #7 (page 42) in the above referenced report. We have been asked if this conclusion implies that a native anadromous run of steelhead occurs in the Stanislaus River.

Although small numbers of rainbow trout/steelhead showing advanced smolting characteristics were collected in the rotary screw traps sampling at the Caswell site in both 1996 and 1997, the parental origin of these fish is unknown. The presence of these fish in our samples raises several questions. Are these fish anadromous or non-anadromous? Are these fish native or non-native? These are important questions, given the ESA listing of steelhead in the Central Valley. The question of stock origins can best be answered by genetic analysis. We recommend that genetics samples be collected from any rainbow/steelhead with smolt characteristics that are captured during this sampling in the future.

Please insert this clarification into your copy of the 1997 Caswell Report.

RECEIVED

O'LAUGHLIN & PARIS

O'LAUGHLIN & PARIS FOR OID (NOVEMBER 9, 1998)

1. Comment noted. We agree that the evidence for indigenous steelhead is more anecdotal than scientific and that genetic studies are needed to determine the type and origin of the fish that have been reported as steelhead. The text in Section 3.5.3.2 recognizes the status of existing evidence.

2. The use of both an April and May simulation provides a reasonable envelope for impact assessment. The target pulse flow period could occur as early as April and as late as May coincident with the peak out-migration of salmon. Therefore, evaluating the project on a basis of April-only or May-only is appropriate. This modeling approach also provides a reasonable range of potential water supply impacts. Between the two modeling studies of target flows (71 years of historical hydrologic events, with the pulse flows targeted for April or May), many different hydrologic circumstances were simulated. The results are viewed to represent an adequate range of potential hydrologic sequences and outcomes.

   Within the modeling, the target test flow deficit was determined on a rate (cfs) basis which compared the "existing flow" to the "target flow". After determining the deficit in flow (cfs), the volume of required supplemental water was determined for a 31-day period. That volume of water was carried into the modeling studies. Therefore, the studies are correctly modeling the volume of water associated with the SJRA.

3. The June 1998 report by Demko and Cramer is the correct citation for the EIS/EIR. The reference to "10-18 ppt sea water" on page 3-89 does indicate salinity. However, because the structure of the sentence includes the phrase "saline waters" and because the reference to "10-18 ppt sea water" is parenthetical and not cited, it has been removed. The technical range of salinity tolerance for splittail is not a major issue for this document. Both the text and the References chapter have been revised.

MICHAEL B. JACKSON
ATTORNEY AT LAW
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November 4, 1998

COMMENT LETTER ON VAMP D.E.I.S.

1 This comment letter is on behalf of the Regional Council of Rural Counties, a 27-county association of California county supervisors. RCRC is a participant in the SWRCB Water Rights Hearing in which the project studied in this EIS is one potential alternative for meeting Bay-Delta water quality standards. RCRC asks that the Bureau and the San Joaquin River Group Authority parties to this EIR incorporate the SWRCB's Draft EIR into this environmental process.

2 The E.I.S./E.I.R. is inadequate at many levels and upon many grounds. We hereby incorporate the comments of all citizens who commented alleging inadequacy on items that are not contained herein.

3 The DEIS does not contain a reasonable range of alternatives. At a minimum, all alternatives considered in the concurrent SWRCB hearings in Phase 2A must be addressed in this document. The VAMP project is not the environmentally preferable alternative for the San Joaquin River for all of the reasons found in the record of the on-going SWRCB proceedings. Furthermore, the SWRCB alternatives themselves are only part of the reasonable alternatives possible for implementing the 1995 Bay-Delta water quality standards.

4 Alternatives should be drafted for this project that include meeting Vernalis water quality standards for fish and water quality at all times of the year. This document fails to disclose that the preferred alternative relies on changing or violating water quality standards at Vernalis during many year-types.

5 Alternatives should be drafted using water flow from Friant Reservoir, from New Don Pedro and Hetch Hetchy Reservoir, or from a combination of the two. NEPA/CEQA can only protect what they can see, and failure to disclose available data about this project from the SWRCB hearing record and exhibits keeps the individual reader in the dark about existing environmental conditions and potential solutions to them. The State Board EIR used Flow Model 5 to model releases from Friant and could be modified to model the Tuolumne as well.

6 The SWRCB Water Rights Priority System Alternative is an inappropriate choice as the only alternative to your preferred alternative. This alternative violates California water rights and water quality laws, and this EIR fails to disclose or analyze

obvious legal roadblocks to its implementation. This alternative prejudges the question as to whether the Friant-Kern Diversion from the San Joaquin River is in-basin or export use, which determines Friant's priority in Friant's favor. Please use both of the SWRCB Water Rights Priority Alternatives and perform an analysis of the results. 6

We do agree that the base case - no action - is SWRCB Flow Alternative 2 as described in your draft, p. 4-7. We particularly agree that Flow Alternative 2 "represents the closest approximation to the existing flow and operational conditions" that could be obtained from the SWRCB Draft E.I.R. analysis. We don't believe that this draft EIR reflects the evidence received in the SWRCB hearing which discloses that the preferred alternative results in less water being released in months other than the VAMP spring study period. In fact, the average amount of depletion in months outside the spring pulse flow seems to be 50,000 acre/feet. Please review the testimony by Dan Steiner in the Hydrologic Analysis in Appendix A and his testimony in the SWRCB hearing and explain the environmental implications of less flow at Vernalis. Please also disclose and address the fact that the Delta water quality standards for Vernalis would be exceeded by the proposed project. This failure to disclose important facts prejudices the choice of alternatives throughout this environmental document. 7

The draft's environmental review of existing conditions does not allow a reader to understand the environmental consequences of this project. The project relies on a barrier system at the head of Old River on the San Joaquin. The U. S. Fish & Wildlife Service has recently testified in the State Water Resources Hearing that the South Delta barrier system would result in a finding of jeopardy for the E.S.A. listed Delta smelt. Please disclose, analyze, and draw conclusions from this information prior to releasing a final decision on this project. 8

SWRCB Flow Alternative Two, herein the No Action Alternative, is consistent with California water law, the priority system, and the Reasonable Use section of the California Constitution. The Preferred Alternative is not. RCRC understands why the senior water rights holders on the San Joaquin River developed the Preferred Alternative. The Central Valley Project, and the federal parties in the SWRCB hearing, have a gun to the head of California agriculture and seem willing to use regulatory power to force senior water rights holders to "share the pain" in meeting Delta water quality standards. A fair analysis of the No Action Alternative would reveal that the present "pain" is caused by the federal parties at their export pumps in the South Delta and that the existing situation can be changed by the Bureau of Reclamation at any time. RCRC chooses to support traditional California law, particularly since its exercise will result in better environmental conditions in the Delta than will any new alternative. 9

TOTAL P.03

REGIONAL COUNCIL OF RURAL COUNTIES (NOVEMBER 4, 1998)

1. The SWRCB's Draft EIR has been used extensively in the preparation of this EIS/EIR. Specifically, we used two of their alternatives in our impact analysis in Chapter 4: Alternative 2 as a surrogate for the base case and Alternative 3 as the other reasonable alternative in addition to the proposed action. Of course, the SWRCB's Flow Alternative 7 is similar to this EIS/EIR's proposed action (November 1997) and is based on the Letter of Intent, while Alternative 8 represents the Draft SJRA and was added later (March 1998).

2. Comment noted. The commenter is referred to all of the responses to comments contained in this Appendix H.

3. The determination of reasonable alternatives uses specific criteria developed from the project's purpose and need as well as other environmental considerations that would be fatal flaws to implementation. It is sufficient under CEQA and NEPA to have only three alternatives when the other alternatives cannot meet the reasonableness test as explained in Section 2.4. In fact, CEQA's emphasis is to focus on alternatives that would be environmentally superior to the proposed project. In this EIS/EIR, the proposed action is environmentally superior because it has fewer significant impacts than does the State Water Right Priority System alternative. Alternatives that are remote or speculative, or the effects of which cannot reasonably be predicted, need not be considered.

   Section 2.4 presents an analysis of 23 other alternatives (in addition to the no action, proposed action, and State Water Right Priority System) which include alternatives similar to those considered in the SWRCB DEIR for the San Joaquin River Region, such as the Ecological Fair Share (similar to SWRCB Flow Alternative 5). The SWRCB Flow Alternative 6 "...assigns responsibility for meeting the Bay/Delta Plan flow objectives solely to the SWP and the CVP". It is most similar to a combination of the EIS/EIR alternatives 4: Combined Federal Releases and 25: State Water Project re-operation.

   See also responses to comments made by Mr. John Herrick representing the South Delta Water Agency (SDWA), in particular response IV.A.2.

4. The proposed action does not violate water quality standards contained in the 1995 WQCP. Rather violations of the standards occur under existing conditions, and the proposed action results in fewer violations as discussed in Section 4.2.2.3. See also the response to SDWA's comment III.A.

5. The proposed action includes releases from New Don Pedro. The alternative to re-operate Hetch Hetchy Reservoir is Alternative 6 of the SWRCB EIR, but it did not pass the initial screening process. Releases from Friant Dam were included in several of the alternatives

considered. However, these did not pass the screening process. Section 3406(c)(1) of the CVPIA provides that no releases are to be made from Friant Dam for the purpose of restoring flows between Gravelly Ford and Mendota Pool or as a measure to impement the CVPIA in the absence of an Act of Congress. See also response to SEWD comment 10.

6. Comment noted. The commenter is entitled to his opinion. There are legal roadblocks to nearly every alternative dealing with water allocation in California. The alternatives analysis in this EIS/EIR is adequate under CEQA and NEPA; and the format of the alternatives analysis is appropriate for the objectives of the proposed action which provides a specific amount of water at specific times at Vernalis. Projects in the Delta are subject to broad alternatives analysis, given the greater number of options geographically to obtain flow and water quality improvements.

7. Comment noted. Concerning flows, the commenter is referred to Tables 4.5-1(A) and 4.5-1(B) which show insignificant changes in flow in the months outside of April and May in most of the tributaries and the San Joaquin River. The average percent change in cfs for the San Joaquin River at Vernalis is generally positive (increased flows in most months) with reductions in flows ranging from one to 5 percent. Concerning water quality, see Section 4.2.2.3 and response to comment III.B by SDWA.

8. The SJRA and the associated VAMP component relies only on the flow control barrier at the Head of Old River. This barrier is covered by an existing biological opinion issued by the U. S. Fish and Wildlife Service (USFWS).

   The comment refers to testimony given by USFWS relative to the Interim South Delta Program (ISDP). This is a joint Bureau of Reclamation and California Department of Water Resources project for mitigating south Delta water circulation and water level impacts caused by operation of the south Delta pumping facilities. The ISDP consist of several components including a barrier of the Head of Old River and tidal barriers at Old River, Grant Line, and Middle River. A draft biological opinion from the FWS indicates that the ISDP recommended that the project be considered in a broader context such as the CALFED planning process. A final biological opinion in the ISDP has not been issued at this time.

9. Section ES.2 PROJECT PURPOSE AND NEED describes the purpose of the proposed project to acquire water identified in the San Joaquin River Agreement. The SJRA was negotiated as a solution to meeting flow objectives on the San Joaquin River at Vernalis consistent with the alternatives being analyzed by the SWRCB. Under SWRCB Alternative 2, the Vernalis flow objective is assumed to be met out of New Melones releases and to be the exclusive responsibility of the Central Valley Project. It is known that New Melones releases will be insufficient to meet the Vernalis flow objective. If Alternative 2 is selected

by the SWRCB the SJRA will still be operable in supporting Reclamation in meeting the flow objectives. The EIS/EIR analyzes the impacts associated with providing flows under the SJRA in comparison to providing similar flows under the No Action alternative (SWRCB Alternative 2).

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ P. O. Box 15830, Sacramento CA 95852-1830, (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

November 5, 1998
F&C 98-209

Mr. Michael Delamore
Bureau of Reclamation
2666 N. Grove Industrial Drive, Suite 106
Fresno, CA 93727

Draft Environmental Impact Statement/Draft Environmental Impact Report – Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010

Dear Michael:

The Sacramento Municipal Utility District (SMUD) has received and reviewed the Draft Environmental Impact Report - Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010.

SMUD is the largest Central Valley Project (CVP) power customer, providing not only payments into the Restoration Fund but repayment of the CVP plant-in-service and Operations and Maintenance costs allocated to power. We have significant financial interest in the prudent management of the CVP facilities. SMUD has concerns regarding the policies and programs under development that may modify the operations and management of the CVP.

SMUD supports the VAMP and the need to provide protective measures for fall-run Chinook in the San Joaquin River. SMUD recognizes the need for a long-term solution that will benefit all users and the environment in the San Joaquin River Basin.

1 The San Joaquin Agreement requires higher spring flows than have been historically required. If the Agreement is not coordinated in a well-planned, manner this may have an impact upon storage capacity of the hydro facilities. We do not believe that CVP facilities should burden the entire impact of the VAMP flow recommendation.

2 SMUD requests that hydropower generation is protected and continues to receive proper consideration in the planning and operational activities included in the San Joaquin River Agreement. Within the constraints of other power project purposes, the timing of water releases, CVP reservoir storage and afterbay operation should continue to be used to optimize the amount and timing of CVP hydropower generation so as to provide optimal power benefits where possible.

SMUD supports the preferred alternative, which minimizes generation losses to the existing hydropower facilities and allows for more carry-over storage in New Melones.

Thank you for the opportunity to comment.

Sincerely,

Paul Olmstead
Water and Power Resources Specialist

SACRAMENTO MUNICIPAL UTILITY DISTRICT (NOVEMBER 5, 1998)

1. Comment noted. See Appendix B, Mitigation Reporting Program, for a discussion of the Operations Group and the process for developing an annual operations plan. The SJRA provides for a coordinated, well-planned water release schedule along with related operational considerations for the SWP.

2. Comment noted.

SOUTH DELTA WATER AGENCY

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Gerald T. Orlob

November 9, 1998

HAND DELIVERED

Mr. Allen Short
San Joaquin River Group Authority
c/o Modesto Irrigation District
1231 11th Street
Modesto, CA 95354
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COMMENTS TO SAN JOAQUIN RIVER AGREEMENT

The following are SDWA's Comments to the Draft environmental Impact Statement and Draft Environmental Impact Report ("DEIR/S") for Meeting Flow Objectives for the San Joaquin River Agreement 1999 - 2010. SDWA concludes the environmental reviews are inadequate under CEQA and NEPA and thus the lead agencies have not identified the likely adverse impacts that will result from the project's implementation. In support of this opinion, SDWA submits the following:

I.
Incorrect Modeling Assumptions.

A. No Action Alternative. The DEIR/S compares the Preferred Alternative with a No Action Alternative or Base Case and it concludes the Preferred Alternative shows slight improvement to water quality as measured at Vernalis. However, the assumed Base Case is inappropriate and incorrect.

The DEIR/S at page 2-10 lists the assumptions for the Base Case which include:

Implementation of the SWRCB's 1995 Water Quality Control Plan;

Adherence to the March 6, 1995, Delta smelt and February 12, 1993, winter run Chinook Salmon Biological Opinions;

No San Joaquin Basin AFRP actions other than the 1995 Water Quality Control Plan; and

New Melones is operated pursuant to the Interim Plan of Operation dated May 1, 1997.

Implementation of the 1995 Water Quality Control Plan requires that the water quality objective for agricultural beneficial uses be met at Vernalis by meeting a .7 EC from April through August and a 1.0 EC from September through May (see Exhibit 1). The New Melones Interim Operation Plan under which the USBR currently operates New Melones Dam and Reservoir has been modeled by the Bureau. That modeling indicates that in approximately 40 percent of historic water year types, the Vernalis standard will be violated (see Exhibit 2). Hence, if one assumes the 1995 Plan is implemented, one cannot assume it is implemented solely by way of the New Melones Interim Operation Plan. If that were the case, the SWRCB would be adopting an Implementation Plan that assumed repeated water quality violations. This is not a reasonable assumption given that violations of water quality standards are assumed to be significant adverse environmental impacts under CEQA. It is illogical to conclude that in implementing water quality

standards the Board will do so in a way that has adverse environmental impacts to water quality standards. The drafters of the DEIR/S get around this by stating that the 1995 Water Quality Control Plan will be implemented "to the extent possible." The SWRCB is currently examining eight different alternatives to implementing the 1995 Plan. The drafters have chosen one possible method; one that will not fully implement the Plan. This allows the comparison with the project to show incremental benefit. A legally required comparison forces the drafters to compare full implementation of the 1995 Plan (and thus the meeting of the Vernalis water quality standard) with their Preferred Alternative. Since the Preferred Alternative results in little additional benefits to water quality over the New Melones Interim Operation Plan, a comparison of full implementation of the 1995 Plan would necessarily show that the project causes significant adverse impacts to water quality.

Page 4-17 of the DEIR/S contains Table 4.2-10. This table sets forth the number of exceedences of the water quality standard at Vernalis per month resulting form an implementation of the SJRA (with a pulse flow in either April or in May). This table shows that under the SJRA there will be 73 violations in the months November, February, June, July, August, and September when the pulse flow is modeled in April (or 59 violations if the pulse flow is in May). If we assume the Board fully implements the 1995 Plan, there would be zero expected water quality violations. Seventy-three (or 59) compared to zero shows significant adverse impacts caused by the project. There is no examination of violation in other months such as March which historically has water quality problems.

Similarly, on page 4-17, we see that the Project results in average water quality in July and August always above the standard (the .7 EC standard for this time frame corresponds to approximately 450 TDS). The TDS values given in the chart are all above 497 for this time period. Any violations of the water quality standard must be presumed to cause harm to agricultural interests. As TDS exceeds approximately 400, there is an increasing harm to crop yield (see Exhibit 4, SDWA's testimony in SWRCB hearings establishing the water quality standard for agricultural beneficial uses). The fact that high TDS or EC causes harm to agriculture is the reason for the standard.

As a further indication of the inappropriateness of the base case, it must be noted that the ongoing SWRCB proceedings are conducting a similar analysis. The SWRCB's DEIR also analysis the SJRA pursuant to the request of the SJRGA. However, the base case in the SWRCB analysis includes the existing standards of D-1485 and D-1422, neither of which includes the New Melones Interim Operation Plan. There cannot be two different base cases for the same analysis. Since the SWRCB has not yet decided how to implement the 1995 Water Quality Control Plan, it is incorrect to assume the New Melones Interim Operation Plan is the base case as has been done by the SJRA.

B. Stanislaus Watershed. The DEIR/S makes false assumptions with regard to the Stanislaus watershed which result in faulty modeling results.

(1) One of these false assumptions is that in the absence of the project, SSJID and OID will each take their contractual allotment of 300,000 acre-feet from the USBR. Although not explicitly stated, the DEIR/S assumes that the SSJID/OID portion of any SJRA flows each year is a result of a decrease in their 600,000 acre-foot allotment for that year. This is confirmed by the DEIR/S' statement that the additional 15,000 acre-feet from OID "will be reduced from OID's allotment and diversions" (page 7, Appendix A). (See also Exhibit 5.)

The true facts are that SSJID and OID do not need and do not divert 300,000 acre-feet per year. This is evidenced by documentation the Bureau has provided. This documentation shows total delivery amounts to the districts since the beginning of the New Melones Project (see Exhibit 4). One can see from this Exhibit the districts have generally not taken a total allotment of 600,000 acre-feet. (Note: Prior to 1988, the total allotment was 660,000 acre-feet.) As is typical with many districts, SSJID and OID have most likely run water through their system in excess of actual needs.

The second method of confirming that the districts do not use 300,000 acre-feet per year is evidenced by their irrigated acreage and crop use. Per page 3-4, SSJID irrigates 62,000 acres of mainly almonds and grapes. OID irrigates 72,000 acres of pasture, oats-corn, rice, fruits and nuts, and miscellaneous crops such as berries, melons, onions, and home gardens. Comparing these acreages and crops with the DWR publication showing water use for crops (see Exhibit 7), we see that the districts do not use or need 300,000 acre-feet each per year. Even assuming a margin of error, the districts do not need to apply 4.8 (300,000 acre-feet ÷ 62,000 acres) or 4.2 acre feet (300,000 ÷ 72,000 acres) to their crops.

(2) Another false assumption regarding water use by the districts is related to the first and suggests what the true effects of the project are. The water not historically diverted by SSJID and OID has been kept in a "conservation account" in New Melones pursuant to their contract with the USBR. This account is barely mentioned in the DEIR/S. That contract allows them to keep up to 200,000 acre-feet of unused allotment in storage for use in subsequent years as long as the use in any one year does not exceed 600,000 acre-feet [this storage is the first water spilled in the event of flood releases]. In times of drought, this storage would be available to the districts during their normal irrigation months. If used during these times, the conservation account water would generate return flow to the river in excess of the amounts of return flows if the conservation account water were not available. This return flow contributes substantially to Stanislaus River flows and towards meeting the Vernalis water quality standard because it is occurring in water deficient times when the standard is at risk.

SDWA is and has shown the above in the currently ongoing SWRCB hearings on the Implementation of the 1995 Water Quality Control Plan. In those hearings, SDWA has shown that this decrease in flow is substantial at times when the Vernalis standard is at risk (see Exhibit 8, 9 and 10).

One of the ways that SJRA is purported to benefit water quality is the purchase of at least 15 TAF per year from OID. Exhibit 11 is SDWA's analysis of putting 15 TAF "back into the pot." When this amount goes back into the Bureau's calculation for water quality, it results in an additional 600 AF of water. However, when it is applied for agricultural purposes by OID, it generates somewhere near 5,000 AF. This difference is tremendously significant when one realizes that the 5,000 AF would be in a time of shortage (because that is when the conservation account would be used).

The SJRA's consultant (Daniel Steiner) who modeled this data stated in oral testimony before the SWRCB that the additional water the Bureau purchases under SJRA from OID goes back into the pot and thus assists in providing more water for water quality (see Exhibit 12). Mr. Steiner in his recent testimony before the SWRCB stated that his modeling assumed all of the district's allotment was diverted and ignored the conservation account. Mr. Steiner admitted that if the districts did not divert all of their allotment, modeling results would be different (Exhibit 13.) Consequently, the lead agencies have not examined the true effects of the project.

(3) In a more general sense, we can also see that the modeling is based on faulty input. Exhibit 4 is Mr. Steiner's written testimony for part of the SWRCB hearings. Pages 18 - 21 set forth some of his modeling results. That modeling shows that as a result of the SJRA, more water flows out of the San Joaquin River Basin. The problem with this is that the SJRA includes no corresponding decrease in consumption of water by any party. It is impossible to have more outflow each year unless there is less water used (or lost) upstream. Absent such a decrease in consumption (or loss), one is simply reallocating existing supplies. Reallocation to create more outflow at one time necessarily requires less outflow at some other time since the system only has so much water each year (see Exhibit 8, 9 and 10). Thus we see that the modeling done for the project does not accurately describe the effects of the project. (See Exhibit 15.)

This same sort of analysis must be done with regard to the SJRA flows supplied by the other SJRGA entities. If the water supplied would have been used at some other times, it must be determined how much return flow was generated and when the return flows were assisting in meeting the Vernalis water quality standard. Depending on the results, shifting them to different times will either exacerbate or cause water quality violations. Further, SDWA has informed the SWRCB as well as the SJRGA that during some years the flow of the San Joaquin River is insufficient to meet channel depletion needs which include public trust uses as well as riparian needs (see Exhibit 2). The

DEIR/S includes no evaluation of how the reallocation of flows under the SJRA will affect those channel depletion needs. A project that causes or exacerbates insufficient channel depletion needs is necessarily causing significant adverse environmental affects.

(4) The DEIR/S makes another error in the modeling supporting the project. The document states that there is a net increase in New Melones storage over the No Project Alternative. This is caused, the document states, by a lessening of the burden on New Melones for downstream releases resulting from the additional flows from the other tributaries to the San Joaquin River. Again, the drafters misstate the facts. The New Melones Interim Operation Plan sets forth the amount of water that will be released in any year type for various downstream purposes. Those releases are a function of storage and inflow (see Exhibit 16) and are not dependent on other flows in the San Joaquin River. Therefore, if those other flows are the basis of "savings from New Melones," the DEIR/S is incorrect.

We have already seen that the "increase" in New Melones storage is a result of the modelers failure to recognize the district's conservation account. Without examining the effect of the use of the conservation account on water quality or downstream quality, and the corresponding effect on the amount of New Melones water needed for downstream purposes, there can be no conclusion as to whether there actually is any real increase.

II.
Examine Cumulative Effects

The DEIR/S is deficient for failing to examine other ongoing activities that are likely to occur and in combination with the project, result in significant adverse environmental effects.

A. At this time, USBR is conducting negotiations with Tuolumne Utilities District to provide water from New Melones. TUD seeks 9,000 acre-feet from New Melones under a permit, an agreement with the Bureau, various SWRCB water right decisions, as well as area of origin statutes. (See Exhibit 17.) Given TUD's clear priority, USBR will have to provide it with water sometime in the near future. The current project makes no analysis of the effects on downstream quality or quantity in the event TUD is supplied with water.

B. Currently SSJID is proposing to sell water to local communities including Manteca, Lathrop, Escalon, and Tracy (see Exhibit 18). This project seeks to transfer up to 50,000 acre-feet per year of water to these cities. The transfer will necessarily result in SSJID applying less water for agricultural purposes. (One will recall that the assumptions for the modeling of the project assume SSJID will divert and use all of its allocation each

year) resulting in less return flows and the corresponding downstream effects. These affects have not been analyzed by the DEIR/S.

C. SSJID and OID are similarly in negotiations with Stockton East Water District for another sale of water (see Exhibit 19). The effects of this additional transfer of up to 30 TAF of water are also unexamined as to how it will affect downstream water quality and quantity.

III.
Existing Law

A. The proposed project is in violation of CVPIA (a copy of which is attached hereto as Exhibit 20). Section 3406(b) of that Act requires the USBR to meet all of the obligations of its permits as established by the SWRCB. The Bureau's existing New Melones permits (see Exhibits 21) require to meet the Vernalis water quality standard as set forth in the current water quality control plan. Pursuant to the modeling of the effects of the project, the SJRA will result in Vernalis water quality violations in 40 percent of historic year types. The Bureau has made no provision for meeting the standard beyond permitting SJRA (See Exhibit 22.)

B. California Water Code § 12202 requires that the State and Federal Projects provide salinity control in the Delta as well as an adequate supply for in-Delta users. (See Exhibits 8 and 30.) There is sometimes an insufficient supply and quality of water in the Delta for South Delta riparian needs. When this is combined with the fact that the SJRA will result in Vernalis water quality violations in 40 percent of historic year types, we see that the signators to the SJRA will violate Section 12202. [The State and Federal Governments are also in violations of Sections 1216, 11460 et seq., and 12232 et seq.]

C. The proposed purchase of water by the USBR from certain SJRGA parties is also in violation of CVPIA § 3405(a)(1)(I). That subsection requires that any water transferred by the Bureau must be water that was either previously used consumptively or irretrievably lost. CVP water is defined under § 3403(f) as "water that is developed, diverted, stored, <u>or</u> delivered by the Secretary in accordance with the statutes authorizing the Central Valley Project" (emphasis added). Since the Exchange Contractors receive water from the CVP that it is developed, diverted, stored and delivered by the CVP, their water is subject to the limitations set forth in § 3405(a)(1)(I). Similarly, SSJID and OID receive water from the Bureau's New Melones project, and that water is at a minimum, stored and delivered by the USBR. Therefore, the water provided by SSJID, OID, and the Exchange Contractors for purposes of SJRA must be water that would have been consumptively used (or irretrievably lost). There is no indication that any of these districts or entities delivering water for the purposes of SJRA are decreasing their

consumption (or the amount of water previously irretrievably lost). Therefore, portions of the project are in violation of CVPIA.

IV.
Incorrect and Inconsistent Analyses of Alternatives

A. The DEIR/S is grossly deficient in its analysis of alternatives by not applying the screen criteria consistently.

1. The document analyzes whether or not any of the possible alternatives are different from VAMP flows but fails to note that SJRA is itself different from VAMP. Exhibit 23 hereto is a copy of the SJRA. The lowest flows for VAMP are 3,200 CFS in certain years while the lowest flows for the SJRA are 2,000 CFS. In addition, SJRA allows for relaxation of the obligation to provide additional water and can result in no additional flows being provided to existing flow. Existing flow could itself be less than the 2,000 CFS requirement of VAMP. The DEIR/S gives no explanation as to why or how this affects the project's goals and why this is ignored while other alternatives are said to not be incapable of providing VAMP flows.

2. The DEIR/S concludes the no-action, recirculation, Friant water, tributary responsibility, and outside basin alternatives don't provide for VAMP flows or reliable water supplies. There is no basis for concluding that long-term contracts under these alternatives could not be executed for certain amounts of water over a long term. However, with absolutely no explanation was to why this is not possible, the DEIR/S concludes those alternatives fail these criteria.

3. The application of the fall attraction flow criteria is incorrect. SJRA does not always meet the 1995 Water Quality Control Plan obligation for the fall attraction flow (Exhibit 24). Similarly, there is no explanation as to why some other method of providing flows could not be done during this fall attraction flow.

4. The analysis of the recirculation proposal is superficial and incorrect. There is no analysis of whether or not recirculation could provide the VAMP flow in a reliable manner, yet the document simply concludes it cannot. Exhibit 25 sets forth just such an analysis and shows that it can be provided. That analysis also shows that the recirculation can be done without third party impacts, and yet the DEIR/S concludes otherwise.

The DEIR/S concludes recirculation requires there be no decrease in export pumping during the 31-day pulse flow. There is no analysis that suggests this is the case, to the contrary Exhibit 10 shows otherwise.

The DEIR/S concludes recirculation would have major adverse impacts to fisheries despite no supporting evidence and the contrary testimony of SJRA fishery experts in the SWRCB hearings (Exhibit 27.)

The DEIR/S states recirculation is more costly. However, the true facts are that recirculation of water is much less expensive per acre-foot then SJRA's $48,000,000 for zero to 110,000 acre-feet of water each year.

The recirculation proposal can provide not only the VAMP flows but also the full 1995 Plan flows for fishery and water quality. The SJRA cannot do this yet this benefit is not taken into account.

The recirculation proposal also results in improved water quality on the San Joaquin River upstream of its confluence with the Stanislaus River. These benefits to fisheries and other beneficial users are ignored by the DEIR/S probably because they are not provided by the SJRA.

It is clear that the drafters of the DEIR/S have made no attempt to reasonably analyze a recirculation proposal as a method of providing either VAMP flows, SJRA flows, or flows to meet the 1995 Water Quality Control Plan. The conclusions stated in the DEIR/S regarding recirculation are apparently just that, conclusions and are obviously not supported by any data or investigation.

5. The DEIR/S fails to note that SJRA is not a "reliable source" for the subject flows in that the Agreement allows for parties to dispute and termiante yearly flows, export limits, and the entire Agreement. Those provisions are not even mentioned in the DEIR/S and yet clearly make SJRA the least reliable of any of the alternatives examined. In the absence of the SJRA, the State and Federal Governments are supposed to "back stop" the 1995 Water Quality Control Plan. However, we have seen that the USBR has made no provisions to provide such a back stop. Other alternatives could certainly provide necessary flows.

6. The DEIR/S does not examine the effects of the various alternatives on out-migrating salmon smolts occurring outside of the 31-day pulse period. Various other alternatives including the recirculation one can assist with this issue where as the SJRA will not. Failure to account for these other smolts can compromise VAMP data (Exhibit 26.)

7. The DEIR/s makes no attempt to analyze a separate effective alternative. There is no reason why a combination of water sources; from Friant users, other CVP contractors, and recirculation cannot result in reliable releases of water into the

San Joaquin River. Long-term contracts for the requisite water are discarded by the DEIR/s without reason or analysis.

8. The DEIR/S concludes the alternative of water from each tributary cannot provide VAMP flows, is not reliable, is not implementable in the near future, and is inconsistent with State law. However, the SWRCB may implement this very alternative within six months to provide the full 1995 Water Quality Control Plan flows. Again, the drafters have simply drawn conclusions not based on any data or analysis. As stated before, any one of the eight alternatives currently under consideration by the SWRCB may be implemented in the near future as a means of fully providing the 1995 Plan flows rather than the more limited SJRA flows.

9. The DEIR/S concludes that the water rights priority alternative has adverse impacts to third parties and costs too much. This can only be true if one assumes the SWRCB might implement a water right priority based order which is contrary to California law. Such an assumption is inappropriate as by definition following the water right priority system in order to provide necessary flows is in compliance with the law.

10. The DEIR/S incorrectly concludes recirculation has adverse impacts to third parties while the SJRA does not. The only recirculation studies to date (Exhibit 25) assumes no net loss to any party and thus no adverse impacts. SJRA however by incorrectly modeling its effects ignores how that program causes harm to third parties. Although the effects have not been quantified, they can certainly be deduced. By increasing flows at one certain time of the year without any decrease in consumption necessarily results in decreased flows at some other time. Given the ongoing water quality and quantity problem in the San Joaquin River and the South Delta, the decrease will most likely exacerbate these problem as well as violations of water quality objectives.

V.
ADVERSE EFFECTS OF SJRA

A. As stated above, the SJRA will necessarily have adverse impacts to downstream beneficial uses by changing the timing of downstream flows. Under the current situation, the SJRA parties (who are selling water thereunder) store, divert, and use certain amounts of water each year. Since they are generally irrigation districts, their uses occur mostly from April through September each year. Without decreasing any actual consumptive use of water by those parties, SJRA increases flows in the San Joaquin River during the 31-day pulse in spring as well as in October. By failing to specify where and how those flows will be provided, the DEIR/s cannot examine how the increase inflows will affect flows at other times. The actual result of this will be less water in the San Joaquin River in times of shortage which will cause or exacerbate water

quality violations and adversely impact amounts available to downstream riparians (see Exhibits 8, 9 and 10.)

B. The sources of water for the SJRA flows are generally specified in the Division Agreement associated with the SJRA. However, the Division Agreement allocations can be changed (see Exhibits 15 and 28). Since the various providers of water have varying qualities of water, any change in who provides how much water can have an affect on downstream quality. This contingency is ignored by the DEIR/S (see Exhibits 15 and 27. [Also enclosed herewith are Exhibits 29 and 30. Exhibit 29 is a 1980 Report coauthored by the USBR indicating the extreme adverse effects the CVP has upon the water quality and quantity of the San Joaquin River and Southern Delta. Exhibit 30 are further excerpts from the testimony of Daniel Steiner before the SWRCB indicating other examples of what was and was not modeled by him.]

VI.
CONCLUSION

The DEIR/S is insufficient under both CEQA and NEPA. Its analysis is faulty due to the incorrect assumptions in the modeling as well as its failure to examine actual conditions. The analysis of alternatives applies criteria in an inconsistent manner and makes unsupportable conclusions or ones contrary to existing facts. The project itself is simply a shift in the timing of water releases which results in harm to downstream beneficial uses. Finally, the project will institutionalize violations of Federal and State law, as well a permit conditions and water quality objectives. SDWA therefore opposes adoption of the DEIR/S as a final document.

Dated: November 9, 1998

JOHN HERRICK, Attorney for
SOUTH DELTA WATER AGENCY

C:\Comments\San Joaquin River Agreement

COMMENTS BY JOHN HERRICK FOR SOUTH DELTA WATER AGENCY
NOVEMBER 9, 1998
LIST OF ATTACHED EXHIBITS

Exhibit No.	Description
1	Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, 95-1WR, May 1995, SWRCB and California EPA, p.17.
2	New Melones Interim Operation Plan modeling, October 31, 1996, "INT_PLN.WK4", 2 pages of printout.
3	DEIR for Implementation of the 1995 Bay/Delta Water Quality Control Plan, November 1997, SWRCB, pp. II-13,14.
4	Testimony before the State Water Resources Control Board, State of California, in the matter of WATER QUALITY PLAN for the Protection of Beneficial Uses in the Sacramento-San Joaquin Delta and Suisun Marsh, and Permit 12720 (Application 5625) and other Permits of the U. S. BUREAU OF RECLAMATION for the Federal Central Valley Project and of CALIFORNIA DEPARTMENT OF WATER RESOURCES for the State Water Project: December 7, 1976, Volume XIV, pp. 2-47, 86-87, 98, 155-156; June 22, 1977, Volume XXVIII, pp. 122-123, 127-128, 132-140; Public Hearing, State Water Resources Control Board, State of California, in the matter of Draft Water Quality Control Plan for Sacramento-San Joaquin Delta and Suisun Marsh, and Draft Environmental Impact Report, May 30, 1978, pp. 114-119.
5	State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and p. 1426.
6	Annual Tri-Dam Storage Accounting in TAF, October 23, 1996.
7	California Water Plan Update, volume 1, Bulletin 160-93, October 1994, pp. 60, 166.
8	Testimony by Alex Hildebrand for SDWA in 7/98, Phase I and Phase II Hearings by SWRCB, June 1, 1998, pp. 1-6.
9	Testimony, Gerald T. Orlob for the South Delta Water Agency, State Water Resources Control Board Hearings Implementing 1995 Water Quality Control Plan, September 13, 1998.

EXHLIST.WPD

10	Testimony of Alex Hildebrand in support of South Delta Water Agency's Phase 2A Case in Chief, September 14, 1998.
10A	FONSI, Proposed Water Transfer between the Arvin-Edison Water Storage District and the Metropolitan Water District of Southern California, U.S. Bureau of Reclamation, March 12, 1997.
10B	Water Resources Plan for Diablo Grande, Western Hills Water District, Modesto, California, unpublished work, February 1997, Table of Contents, pp. 3-7 through 3-11.
11	Analysis of Adding 15 TAF Purchase from OID into New Melones Storage, undated.
12	State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and p. 1448.
13	State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and pp. 1428, 1430.
14	Testimony of Daniel B. Steiner Concerning the San Joaquin River Agreement, June 10, 1998.
15	State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, August 4, 1998, index and pp. 1953-1976.
16	Letter from Lowell F. Ploss, Operations Manager, Bureau of Reclamation, to John Herrick, Attorney for South Delta Water Agency, on Interim Water Acquisition Program, July 31, 1997.
17	Testimony of Timothy McCullough, General Manager, Tuolumne Utilities District, with regard to the San Joaquin River Agreement, before the State Water Resources Control Board, June 15, 1998.
18	Notice of Preparation of a Draft Environmental Impact Report, South County Surface Water Supply Project, SSJID, February 3, 1998, p. 1.
19	Draft Initial Study and Proposed Negative Declaration for the Oakdale Irrigation District/South San Joaquin Irrigation District Water Transfer Project, December 1997, pp. Negative Declaration.
20	Title 34 of Public Law 102-575, Central Valley Project Improvement Act, Sections 3401 - 3405(a)(1)(L), Section 3406(b)(1)(A).\

EXHLIST.WPD

21 Permit for Diversion and Use of Water, Application No. 14858A of U. S. Department of the Interior, Bureau of Reclamation, Region 2, Permit No. 16597 from the State Water Resources Control Board, July 25, 1983.

22 State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 30, 1998, index and pp. 1772-1773.

23 San Joaquin River Agreement, incorporated by reference.

24 State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and p. 1403.

25 Preliminary Staff Report of the State of California, California Department of Water Resources, San Joaquin District, SJRIO Studies of San Joaquin River Recirculation and Reoperation of Wetland Discharge and Tile Drainage, January 1998.

26 State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 22, 1998, pp. 1111-1148.

27 State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and pp. 1423-1424.

28 State Water Resources Control Board, Public Hearing, 1998 Bay-Delta Water Rights Hearing, July 28, 1998, index and pp. 1400, 1419, 1427, 1449-1450.

29 Effects of the CVP upon the Southern Delta Water Supply, Sacramento-San Joaquin River Delta, California, prepared jointly by the Water and Power Resources Service and the South Delta Water Agency, June 1980.

30 Letter from John Herrick, South Delta Water Agency to Stacey Gianoli, SWRCB, Bay-Delta Division, re South Delta Channel Depletion Requirements, Development of 1995 WQCP EIR, July 15, 1997.

EXHLIST.WPD

SOUTH DELTA WATER AGENCY (NOVEMBER 9, 1998)

I.A. Comment noted and materials reviewed and considered.

The "base case" or "no action alternative" describes existing and reasonably foreseeable conditions. (See CEQA Guidelines Section 15126(d)(4), 40 CFR 1502.14). The "No Action" alternative as described in Section 2.3 of the DEIS/DEIR accurately describes existing and reasonably foreseeable conditions.

The commenter states that the "No Action" alternative must include full implementation of the standards contained in the 1995 Water Quality Control Plan ("WQCP"). This assertion is incorrect. Under existing conditions, violations of the 1995 WQCP occur. In addition, under reasonably foreseeable conditions, some violations will continue to occur in the future. Implementation of the flow dependent objectives in the 1995 WQCP is the subject of the Bay-Delta Water Rights Hearing, which began July 1, 1998, and is on-going as of the date of publication of this document. Both the 1995 WQCP and the DEIR for that process state that flow measures alone will not achieve all the standards of the 1995 WQCP. (See, i.e., Page II-15 of the Bay-Delta DEIR; Chapter IV of the 1995 WQCP). As for the Vernalis Standard, the Bay-Delta DEIR shows that none of the alternatives considered meet the Vernalis Standards of the 1995 WQCP at all times and under all circumstances. (See Figure VI-14 of the Bay-Delta Supplemental DEIR; see also Figures VI-2 through VI-13, VI-15 through VI-17, and Page VI-16). Therefore, it is reasonably foreseeable that there will be some continued violations of the Vernalis Standard, and other standards of the 1995 WQCP, in the future.

In addition, the goals and purposes of the project are to implement the flows of the SJRA and VAMP, not to implement the 1995 WQCP. The 1995 WQCP implementation is the subject of the Bay-Delta Water Rights Hearing and the environmental documents associated with that process. The "No Action" alternative and analysis in the meeting flow objectives DEIS/DEIR was based in large part on the environmental documents for the Bay-Delta Water Rights Hearing, and thus properly describes and analyzes the "No Action" alternative.

I.B.1. Comment noted and materials reviewed and considered.

SDWA states that the DEIS/DEIR assumes OID/SSJID's SJRA contributions are made by a decrease in their 600 TAF allotment. The districts still receive their 600 TAF; to comply with SJRA, some of that water is released directly to the Stanislaus River or transferred to MID with a corresponding release from the Tuolumne River.

The comment states that the DEIS/DEIR assumes that OID and SSJID's contributions to the flows under the SJRA are assumed to be a decrease in the district's allotment. This

statement is inaccurate. Under the SJRA, OID and SSJID receive their full allotment of 600,000 acre-feet. When OID and SSJID need to supply water from the SJRA, that water is released directly into the Stanislaus River or conveyed to MID as a substitute for releases on the Tuolumne River.

The allotment of 600,000 acre-feet annually to OID and SSJID is made pursuant to an agreement with the Bureau of Reclamation. The Interim Operations Plan for New Melones Reservoir is predicated on the districts receiving their full allotment, and thus that was how the modeling for the EIS/EIR was conducted. This assumption was also the basis for the modeling performed for the Bay-Delta DEIR and the New Melones Interim Operations Plan.

In those years in which OID and SSJID receive their full allotment of 600,000 acre-feet, their use of that water is reasonable. The commenter's Exhibit 7 confirms this. This exhibit, which is Table 7 from Bulletin 160-93, does not show actual crop need, but rather gives ranges of applied water used by Department of Water Resources to estimate agricultural water demand by region. Even using the gross figures for the amount of water diverted by the districts and the irrigated acreage of the districts provided by the commenter, water use within OID and SSJID is consistent with Table 7.

Moreover, the new Water Plan for California, Bulletin 160-98, shows on Table 4-5 that applied water within OID and SSJID is within the ranges observed for crops grown in those districts. The Bulletin points out that applied water use varies considerably depending on irrigation practices, field conditions, and other variables. In addition, excess applied water is available for reuse by downstream water users either from return flows or groundwater accretions, and thus is not wasted.

I.B.2. Comment noted and materials reviewed and considered.

The comment states that return flows from OID and SSJID in dry years where the districts use their conservation account are substantial. However, the comment provides no information or data to substantiate this claim. It is also unclear what is the "decrease in flow" to which the comment refers. However, the comment is incorrect in its basic assertion that the conservation account of OID needs to be included in the modeling.

The conservation account of OID and SSJID does not need to be modeled, for several reasons. First, it is already considered under the existing modeling. Water in the district's conservation account is simply considered to be stored water for the purposes of modeling the Interim Operations Plan for New Melones Reservoir. Thus, water in the conservation account is simply included as incremental additions of storage for New Melones, and is budgeted according to the Interim Operations Plan.

Second, the decision by OID and SSJID to use, to add, or withdraw water from the conservation account is dependent of a wide variety of variable factors. These factors include the pattern and amount of precipitation, the form and location of that precipitation, operational factors, including flood control operations and downstream channel capacity, the amount of water already in the conservation account, and the water needs of the districts. Because of the extreme variability of these factors, the use of the conservation account cannot be modeled with any degree of accuracy.

Third, the districts are extremely limited in their ability to withdraw water from the conservation account. In no event can the districts take more than 600,000 acre-feet in any one year. In addition, when CVP contractors from the Stanislaus River are receiving only a percentage of their contract amounts, OID and SSJID cannot use the conservation account to receive a greater percentage of their normal allotment of 600,000 acre-feet down to a floor of 450,000 acre-feet. In addition, the first water spilled for flood control operations in New Melones is water from the district's conservation account.

The example in the comment and in Exhibit 11 that compares the benefits of the 15,000 acre-feet of water on water quality is based on assumptions and speculation. The example assumes a return flow of 5,000 acre-feet to the Stanislaus River, without any indicated basis for this assumption. The comparison assumes that the purchased water will be applied strictly according to the budgeting of the Interim Operations Plan, when in fact the Bureau may use this water for any of the authorized purposes of New Melones Reservoir, depending on real-time operational needs. The comparison states that the conservation account would be used during a time of "shortage," which is speculative at best.

Further, the contention in the comment that the SJRA will exacerbate low summer flows in the South Delta area, and therefore making it less likely that the Vernalis Standard will be meet, is incorrect. The DEIS/DEIR shows that the proposed project will provide slight improvements in the levels of TDS at Vernalis in June through September (See Table 4.2-11) and result in fewer violations in the Vernalis standard on an annual basis (See Table 4.2-10). The commenter's Exhibits 8, 9, and 10, offered in support the contentions in the comment, are unsupported opinion that merely reaffirms the contentions in the comment itself.

I.B.3. Comment noted and materials reviewed and considered.

This comment is based on the fundamental premise that all the water in the San Joaquin River system is being put to beneficial use at all times in all years. Based on this premise, any change in water use at one time of the year necessarily impacts water use at some other time in the year.

This premise is incorrect. Not all water in the San Joaquin Basin is put to beneficial use at all times. In addition, the timing of many of the existing beneficial uses, such as irrigation and power production, can vary widely based on a variety of factors, such as weather, market changes in foods and electricity, and other reasons. Thus, temporal shifts in water use can occur from the existing beneficial uses of the water.

The comment is also incorrect in the asserting that there will be no changes in consumptive use resulting from the SJRA. Section 2.1.4 describes generally how the members of the SJRGA will make what available for the flows in the SJRA and VAMP. That section indicates the sources of water include regulating surface water storage, increased use of groundwater, tailwater recovery and reuse, and conservation efforts. Subsumed within these possibilities is the temporal shifting of water use, such as hydropower production, that is permitted under the existing water rights of the SJRGA members. The remainder of the DEIS/DEIR explains the possible impacts of these actions, and therefore evaluates the effects of making flows available for the SJRA and VAMP.

The comment requests an analysis of return flows. Return flows are included in the hydrology analysis. The hydrology model used for the EIS/EIR already adjusts return flows based on diversions.

The comment asserts that there needs to be more accurate modeling of return flows. However, the SANJASM model used already accounts for changes in return flows based on the amount of diversions for irrigation, such that as diversions decrease, so do return flows. Thus, the effect of decreased irrigation diversions on river levels is already contained in the EIS/EIR.

Thus, the existing information in the EIS/EIR shows that there would be little or no impact on channel levels in the South Delta from the project. The comment provides no information beyond unsubstantiated opinion that the SJRA will cause or exacerbate channel depletion problems in the South Delta or that such depletion, were it occurring, would be a significant adverse environmental effect.

I.B.4. Comment noted and materials reviewed and considered.

The EIS/EIR accurately models the effects of the SJRA on storage in New Melones. To clarify this, the text of Section 4.2.2.2 has been revised to more accurately describe the effects of the SJRA on the storage levels of New Melones.

II.A. Comment noted and materials reviewed and considered.

While TUD does wish to have a contract for water from New Melones, at this time USBR is not conducting negotiations for a contact with TUD. USBR has been involved in informal discussions with TUD concerning their desire for a water contract of up to 9,000 acre-feet of water annually from New Melones. At this point in the discussions, there is no basis to determine what the form of that agreement will be and what environmental impacts an agreement, if any, will have. Those impacts will be studied and the appropriate environmental impacts considered if and when an agreement is reached.

II.B. Comment noted and materials reviewed and considered.

The discussion of cumulative impacts in the EIS/EIR has been revised to include the SSJID South County Surface Water Supply project as a potential future action (Section 4.12.1.6.).

II.C. Comment noted and materials reviewed and considered.

The discussion of cumulative impacts in the EIS/EIR has been revised to include the OID/SSJID Water Transfer Project to SEWD as a potential future action (Section 4.12.1.7.).

III.A. Comment noted and materials reviewed and considered.

The purpose of the project is to implement the flows of the SJRA and VAMP, not to meet the standards of the 1995 WQCP. Implementation of the flow dependent objectives of the 1995 WQCP is the subject of the on-going Bay-Delta Water Rights Hearing.

Violations of the 1995 WQCP plan standards, including the Vernalis standard, occur under existing conditions. Both the 1995 WQCP and the Bay-Delta DEIR state that flow alone will not ensure compliance with all the standards, including the Vernalis standard. Indeed, none of the alternatives considered in the Bay-Delta DEIR fully meet all the 1995 WQCP standards at all times under all conditions. Implementing the flows of the SJRA and VAMP will help to lower the numbers of these violations and help to meet the objectives of the 1995 WQCP. In addition, under the SJRA the Bureau of Reclamation has pledged to comply with the flow-dependent objectives of the 1995 WQCP that can reasonably be met.

The Bureau is in the process of developing an operations plan for New Melones through the Stanislaus Stakeholders process. Part of this process will be determining how to meet the 1995 WQCP standards applicable to the Bureau. The Bureau also has several tools available to it to meet water quality standards in addition to New Melones Reservoir, including operations of other components of the CVP, water purchases, and source control.

In addition, the comment misstates statistics concerning the number of violations of the Vernalis standard. While it may be true that the Vernalis standard is violated "in 40 percent of historic year types," this inaccurately portrays the extent of the violations by using years, rather than months, to determine the extent of violations. Based on Table 4.2-10 of the DEIS/DEIR, under existing conditions the Vernalis standard is violated 85 out of 852 months, or approximately 10 percent of the months considered. Under the proposed alternative, the Vernalis standard would be violated 9 percent of the months.

III.B. Comment noted and materials reviewed and considered.

Water Code Section 12202 applies only to the Federal Central Valley Project and the State Water Project. It places no obligation on any other entities, including the signatories of the SJRA who are not responsible for the operations of the state and federal projects.

Problems with both salinity and water supply in the South Delta are existing conditions. The evaluation in the DEIS/DEIR demonstrates that the proposed project would either improve or not impact the water quality or water levels in the South Delta. See Response to Comment I.B.3, above.

In addition, the comment exaggerates the number of violations of the Vernalis standard. While it may be true that the Vernalis standard is violated "in 40 percent of historic year types," this inaccurately portrays the extent of the violations by using years, rather than months, to determine the extent of violations. Based on Table 4.2-10 of the EIS/EIR, under existing conditions the Vernalis standard is violated 85 out of 852 months, or approximately 10 percent of the months considered. Under the proposed alternative, the Vernalis standard would be violated 9 percent of the months.

III.C. Comment noted and materials reviewed and considered.

The commenter fails to recognize that the nature of water provided for pulse flows under the San Joaquin River Agreement/Vernalis Adaptive Management Plan by the members of the Exchange Contractors is water right water, not CVP water.

The Exchange Contractors receive "substitute water" delivered by the Bureau of Reclamation to meet obligations imposed on the Bureau since 1939 by the terms of the Exchange Contract. A portion of this water is scheduled to be released to meet SJRA/VAMP pulse flow obligations by members of the Exchange Contractors. A Water Code Section 1707 permit application has been filed with the SWRCB to change the place and purpose of use of pulse flow water released.

The SJRA is an agreement proposed by the Exchange Contractors and others that, when and if implemented by SWRCB, will satisfy the obligations that the SWRCB could seek to impose on water right holders on the San Joaquin River and its tributaries in the Bay Delta water right proceeding. This pulse flow water is not a water transfer pursuant to CVPIA; consistently, the commenter's CVPIA analysis does not apply.

Even if CVPIA did apply to the provision by the Exchange Contractors' members of water to meet SJRA/VAMP pulse flow obligations, the manner in which water would be provided for pulse flows still meets the requirements of a CVPIA transfer. CVPIA's guidelines focus on whether water will be provided by means delineated therein: ground water substitution, recapture of water that would have otherwise flowed to a salt sink, and limited conservation projects as approved by the Bureau of Reclamation such as substituting recovered tailwater for other surface water supplies. Water released by the members of the Exchange Contractors to meet pulse flow obligations would be water relinquished from growers. (See Table 4.1-1, Surface Runoff and Return Flows.) It may then be made up by conjunctive use or other methods recognized by CVPIA water transfer guidelines.

The evidence and data which we have reviewed conclude that no injury occurs to any legal user of water as a result of this activity. If the commenter would like to provide evidence that the provision of water by the Exchange Contractors' members to meet SJRA/VAMP pulse flow obligations results in injury to a legal user of water that is caused by this action, we will be pleased to look at that evidence.

The water received by OID and SSJID is not "CVP water" under the Bureau of Reclamation's interpretation of that term. Therefore, the restrictions of Section 3405(a)(1)(I) do not apply to the water of OID and SSJID. (See Order of Judge Garland E. Burrell, Jr., dated May 20, 1998, in South Delta Water Agency et al. v. United States et al., Case Number Civ. S-97-1590 GEB GGH).

IV.A.1. Comment noted and materials reviewed and considered.

The evaluation criteria did not evaluate whether the alternatives are different from the VAMP flows. Rather, the evaluations, as indicated in Section 2.4.2.1, was whether under the alternative there was sufficient water available to meet the VAMP flow criteria. As indicated, several different alternatives would provide sufficient water for the VAMP flows. However, other aspects of those alternatives resulted in their removal from further consideration. In addition, the evaluation criteria included whether the alternative was a distinctly different approach in making water available for the SJRA and VAMP. Here again, however, several of the alternatives met this criteria as well, but were rejected for other reasons.

On Page 2-17, the criteria is given as "Different from SJRA," while in Table 2.4-1, the criteria is described as "Different from VAMP." These both have been labeled "Different from SJRA."

IV.A.2. Comment noted and materials reviewed and considered.

Whether or not long term contracts could be executed for certain amounts of water from the sources indicated in the alternatives was not the evaluation criteria used in determining whether the proposed alternative meet the "VAMP criteria" and "Reliable water supplies" criteria. Rather, these criteria, as explained in Section 2.4.2.1, examined whether the described alternative would (1) provide sufficient water for the 31-day pulse flow period in a hydrologic sense, and (2) whether there was a reliable water supply for the VAMP flows and the other flows in the SJRA in the long term, again in a hydrologic sense. The reference to long-term versus a series of short-term transfers was an explanation that a series of short term transfers would not provide a reliable supply of water.

In addition, the decision concerning a criteria was not based on "possible" or "impossible," as indicated in the comment, but rather "a potentially positive effect or is reasonable relative to the criterion" or "a potentially negative effect or is unreasonable relative to the criterion." Simply because an action may be possible does not change the type of effect it may have or the reasonableness of the action relative to the specified criterion. Therefore, the minus signs ("-") indicated in Table 2.4-1 for the "No Action," "Recirculation," and "Friant Releases" do not indicate that the action is not possible, but that there are potential negative effects or the action is unreasonable in light of the criterion.

The "No Action" alternative was not eliminated in the screen process described in Section 2.4, but rather was fully evaluated as the baseline for purposes of comparison with the Water Rights Priority and VAMP alternatives. "No Action" by definition cannot achieve the goals of the project, but instead reflects the current situation.

As indicated in Section 2.4.2.4, the "Recirculation" alternative was evaluated in the second round of the screening process. However, as stated in that section, this alternative was in direct conflict with the stated need and purpose of the project, and was not rejected because it did not meet the "VAMP Flow" or "Reliable Water Supply" criteria.

It is unclear what the commenter means by the "tributary responsibility" and "outside basin" alternatives. If "tributary responsibility" means the "Ecological Fair-Share," alternatives, this alternative shows plus signs ("+") in both the "VAMP criteria" and "Reliable Water Supplies" columns in Table 2.4-1. If the commenter meant the "Worst Case by Tributaries" alternative, as indicated in Section 2.4.2.4, this alternative was rejected during the secondary screening process because no one tributary has sufficient water to meet the purpose and need

for the project. If "outside basin" means the "Purchase outside the SJR Basin with Delta re-operations" alternative, the description in Section 2.4.1 indicates that this alternative may not result in any water available at Vernalis. In addition, it suffers from the same reliance on pumping from the Delta as the "Recirculation" alternative, and therefore does not meet the purpose and need of the project.

IV.A.3. Comment noted and materials reviewed and considered.

It is unclear what the commenter means by the statement that "The application of the fall attraction flow is incorrect." The purpose of the project is to acquire water for the VAMP and the SJRA. The purpose of the project is not to meet the 1995 WQCP standards. Thus, the comment is correct when it states that the water provided under the SJRA does not meet the 1995 WQCP standards in all year under all situations. Under the SJRA, the Bureau of Reclamation will purchase 12,500 acre-feet of water each year from the Merced Irrigation District as a part of the Bureau's efforts to meet the fall attraction flow requirements of the 1995 WQCP. However, since meeting the requirements of the 1995 WQCP is not the purpose of the proposed project, no changes to the DEIS/DEIR need to be made.

It is also unclear what the commenter means by the statement that "There is no explanation as to why some other method or providing flows could not be done during the fall attraction flows." As Section 2.4.1 indicated, some 26 different alternatives were considered, each which provided a different means for achieving the purposes and goals of the project. In the consideration of each of these alternatives, the issue of fall attraction flows was considered.

IV.A.4. Comment noted and materials reviewed and considered.

The "Recirculation" alternative was rejected during the secondary evaluation because it did not call for reduction in Delta export pumping during the spring pulse flow period, which are in direct conflict with the purposes and goals of the project.

The SJRIO Report cited in the comment uses a water quality model, rather than a hydrology model. For the modeling done in the SJRIO report, the hydrology was essentially assumed. That is, the SJRIO model accepts input from the DWRSIM hydrology model, and then estimates water quality based on those assume hydrological inputs. However, SJRIO does not evaluate the recirculation proposal for the purposes of determining its practicality or reasonability in light of the historical or anticipated hydrology. Therefore, any assertions concerning the hydrological impacts shown by the SJRIO model are speculative.

Thus, the assertions in the comment that the SJRIO Report demonstrates that the "Recirculation" alternative can provide the flows needed to achieve the goals and purposes of the proposed project are speculative, as are the assertions that the "Recirculation"

alternative can provide sufficient flows for full compliance with the 1995 WQCP. Also speculative are the comments assertions that the "Recirculation" alternative could be implemented without third party impacts or without reducing export pumping during the pulse flow period. The referenced exhibit for these assertions, the Testimony of Alex Hildebrand in support of South Delta Water Agency's Phase 2A Case in Chief, September 14, 1998, is internally contradictory. For example, page 5 of that document states that "if export pumping in combination with [other actions] results in unacceptable takes of [delta smelt, a threatened species], then export pumping would have to be decreased. . . . At any time that exports must be curtailed and thus recirculation opportunities decrease, other alternatives take over." Clearly both reduced export pumping and third party impacts resulting from reduced export pumping are a possible impact from the "Recirculation" alternative.

The DEIS/DEIR does not conclude that "recirculation would have major adverse impacts to fisheries." Rather, the DEIS/DEIR states in Section 2.4.2.4 that the "Recirculation" alternative "could cause major adverse impacts to fisheries and endangered species." Support for this conclusion can be found in USFWS 1994a, USFWS 1994b, and USFWS 1996b, among others. In contrast, the exhibit 27 reference in the comment is to testimony by a hydrologist and concerns return flows from agriculture, not impacts of the "Recirculation" alternative on fisheries and endangered species. In addition, the "Recirculation" alternative advocated by the commenter in exhibit 10 explicitly relies on tidal barriers to mitigate the effects of increased pumping in the South Delta. However, these barriers have been shown to have an adverse impact on fisheries and endangered species in USFWS 1996b.

For costs, the DEIS/DEIR states in Section 2.4.2.2 that "Cost alone cannot be used to exclude an alternative."

IV.A.5. Comment noted and materials reviewed and considered.

The reliability of water from the SJRA was judged relative to the reliability of any of the other alternatives. The purpose of the project is to acquire water for the spring pulse flows and fall attraction flows, as well as other needs identified in the CVPIA, for the term of the VAMP study, which is 1999 to 2010. No alternative considered could guarantee a completely reliable supply of water. Reliability was considered along with many other factors in the screening process, and weighed against potential environmental impacts in the evaluation process, in determining the preferred alternative. In addition, it is difficult to discern how the SJRA can be less reliable than the "Weather Modification and Re-operation" alternative, which relies on weather modification, a highly inexact and speculative process, to increase precipitation, or "Willing Sellers/Willing Buyers," which relies on a series of short term contracts to obtain the flows for the project.

The dispute resolution and termination provisions of the SJRA do not make it unreliable. The SJRA contains extensive provisions concerning dispute resolution, including mediation, and provides that all decisions must be made by consensus. These provisions are designed to prevent the use of the termination clauses in the agreement. The termination provisions are designed to clearly define the rights and responsibilities of the parties, not to encourage termination.

The so-called "backstop" provisions of the SJRA are concerned with the question of the responsibility for meeting the flow-dependent objectives of the 1995 WQCP. Under the SJRA, the Bureau of Reclamation pledges to ensure compliance with the Vernalis standard, and the Bureau and the Department of Water Resources pledge to fulfill the Delta outflow requirements of the 1995 WQCP. The comment is incorrect when it asserts that the Bureau has made no provision to meet its obligations under the SJRA and VAMP. The Bureau is in the process of developing an operations plan for New Melones through the Stanislaus Stakeholders process. Part of this process will be determining how to meet the 1995 WQCP standards applicable to the Bureau. The Bureau also has several tools available to it to meet water quality standards in addition to New Melones Reservoir, including operations of other components of the CVP, water purchases, and source control. These responsibilities are currently the subject of the on-going Bay-Delta Water Rights Hearings before the SWRCB. Meeting the 1995 WQCP requirements is not the goal of this project, and therefore the "backstop" provisions have no effect on the project under consideration.

IV.A.6. Comment noted and materials reviewed and considered.

The pulse flow period of April 15 to May 15 is designed to correspond to the peak of salmon smolt out-migration. The purpose of the VAMP experiment is to study, in as controlled a manner as possible, the relationship between out-migration of salmon smolts from the San Joaquin basin and the amount of flow at Vernalis, the use of the Head of Old River Barrier, and reductions in export pumping. This time period was selected both because it would provide the most benefit to salmon, and would provide the best data for the VAMP experiment.

The VAMP experiment does account for migration of fry and smolts outside the 31-day pulse flow period. Studies are currently being conducted both in the Delta and in the tributaries concerning the out-migration of fry and smolts. These studies will be used both to assist in estimating the total salmon production of the San Joaquin basin as well as determining the best time for the 31-day pulse flow period. These studies will also be considered when evaluating the effects of the VAMP experiment.

IV.A.7. Comment noted and materials reviewed and considered.

An EIR must analyze alternatives to the proposed project (Pub. Res. Code § 21000). However, an EIR need not consider all possible alternatives, but rather only a range of reasonable alternatives. (CEQA Guidelines § 15126.6). In addition, whether or not other alternatives would be "effective" in meeting the project requirements is not the sole issue. Rather, to merit consideration, an alternative must be not only effective, but also feasible. (Id.). The requirement for consideration of alternatives under NEPA is similar. (40 C.F.R. § 1502.14).

The comment states that a combination of actions, including water obtained from Friant users, other CVP contractors, and recirculation could result in reliable releases of water into the San Joaquin River. This contention, however, suffers from two flaws. First, the project under consideration consists of more than simple releases of water into the San Joaquin River. Second, the alternatives considered individually included "Friant Releases" (alternative FR) and "Recirculation" (alternative "REC"). The "Friant Releases" alternative was rejected, in part, because flows from Friant could not be obtained in 1999, and because both the Department of the Interior and the SWRCB have determined that releasing water from Friant to increase San Joaquin River Flows at Vernalis would be an unreasonable use of water. The "Recirculation" alternative was rejected because it did not achieve the fundamental purposes of the project, as indicated in Section 2.4.2.4 of the DEIS/DEIR. In addition, one of the alternatives considered and rejected is "Combined Federal Releases" (alternative "CRF"), which is similar to the combination of actions indicated in the comment. The "Combined Federal Releases" alternative, however, was rejected in the initial screening process, because in a practical sense water cannot be obtained from Friant Dam, because of unacceptable third party impacts, and because it did not meet the goals and purposes of the project.

IV.A.8. Comment noted and material reviewed and considered.

The goals and purposes of the project are to obtain the flows under the SJRA and the VAMP, not to implement the standards of the 1995 WQCP. In addition, the State Water Resources Control Board has different powers, purposes, and constraints as compared to the Bureau of Reclamation and the other agencies involved in this project. Therefore, alternatives that may be reasonable for the purposes of the SWRCB and the Bay-Delta Water Rights Hearing may not be reasonable, for a variety of reasons, for the purposes of implementing the SJRA and the VAMP flows.

In addition, the SWRCB has stated that it may adopt one of the alternatives in the DEIR, or it may implement a combination of the alternatives, or a variation on the alternatives. Several of the alternatives under consideration, including Alternative 1 (No Project) and

Alternative 7 both have lower flows than the SJRA and VAMP. In addition, while most of the alternatives studied by the SWRCB will move closer to the full implementation of the 1995 WQCP standards for flow, none of the alternatives considered fully meet the flow-dependent requirements at all times under all conditions.

IV.A.9. Comment noted and materials reviewed and considered.

The conclusion that the "Water Rights Priority" alternative (alternative "WRP") will have third party impacts and result in large costs is based on the SWRCB's Bay-Delta DEIR. Adopting either alternative 3 or alternative 4 as described in the Bay-Delta DEIR would result in significant third party impacts, including the SDWA, which would be impacted by reduced summer flows and poor summer water quality.

The assertion in the comment that third party impacts will result only if the SWRCB adopts a water rights decision that is contrary of California Law is incorrect. The legal basis for using the water rights priority system to implement the flows of the SJRA and VAMP is a separate issue from the impacts of such an action. Under a water rights priority approach, based on the "first in time, first in right" principle, junior water rights holders would be required to cease diversions to storage and direct diversions when water was needed to implement the SJRA and VAMP flows. Requiring cessation of diversion, no matter what the propriety of the legal basis for the action, will have impacts on the affected water rights holders. As indicated in Table 2.5-1, such an approach would impact up to 38 water rights holders, as compared to the 6 water rights holders under the proposed action. In addition, while cost alone is not a basis to reject an alternative, the costs to those water rights holders forced to completely forego diversions could be extremely high. These considerations, along with others indicated in the DEIS/DEIR, indicate that the water rights priority approach has greater impacts, and more significant impacts, than the proposed action.

IV.A.10. Comment noted and materials reviewed and considered.

See responses to Comment IV.A.4 and Comment I.B.3. As indicated in the comment, the SJRIO Study assumes no third party impacts; that study does not demonstrate that there will be no third party impacts. In contrast, the hydrologic modeling and evaluation in the DEIS/DEIR indicates that in general the proposed action would improve water quality at Vernalis and consequently in the South Delta. Rather than harming third parties in the Delta, the proposed action should provide a benefit.

V.A. Comment noted and materials reviewed and considered.

See response comments I.B.3 and IV.A.10.

V.B. Comment noted and exhibits reviewed and considered.

The Division Agreement was used in modeling the flows because that will be the means of determining the flow responsibilities of the parties to the SJRA. The Division Agreement will remain in force so long as the SJRA remains in force. While the Division Agreement provides that it may be changed, such a change must receive the unanimous agreement of all the SJRGA members, and must also be made in consultation with USFWS and CDFG.

In addition, there is little reason to believe that changes in the source of the water for the flows in the SJRA and VAMP would have much effect on water quality. The quality of the water of the Stanislaus, Tuolumne, and Merced Rivers is in general both very high and comparable between the tributaries. Thus, changes in the distribution of flows between the eastside tributaries should have little effect on water quality at Vernalis. The quality of the water that will be provided by the Exchange Contractors is comparable to that taken at the pumps in the Delta. Assuming that all the flows for the proposed action were provided by the Exchange Contractors, this would be similar to the recirculation proposal advocated by of the commenter and studied in the SJRIO study, and thus should not adversely impact water quality at Vernalis.

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November 5, 1998

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RE: Draft EIS/EIR for Meeting Flow Objectives for the San Joaquin River Agreement

Dear Mr. Delamore:

The Stanislaus County Environmental Review Committee (ERC) has reviewed the subject project. Stanislaus County submitted a comment letter, dated January 18, 1998, in response to the scoping sessions conducted for this EIR/EIS. That letter raised four issues which are repeated below:

First, there should be an analysis of the impact of VAMP on the long term operations of New Melones Reservoir, and particularly the impact of VAMP on the availability of Stanislaus River water for existing and reasonably foreseeable future Stanislaus River in-basin needs. In other words, does the reallocation of Stanislaus River/New Melones water adversely impact the ability of local agencies to develop future water supplies or impair the ability of local agencies to exercise their watershed, basin, or area of origin priorities?

Second, to the extent applicable, there should be an analysis of the impact of reductions of use of surface water from the Stanislaus and the Tuolumne Rivers in Stanislaus County on groundwater usage in Stanislaus County. In other words, will the water acquisitions for VAMP be offset by increasing groundwater pumping, and if so, what will be the impact on local groundwater resources?

Third, to the extent that VAMP water acquisitions result in reductions in surface water usage in Stanislaus County which are not offset by increased groundwater pumping, there should be an analysis of the "third party" impacts of such reductions in surface water use, particularly the impacts on public and social services demands, reduced tax revenues and related impacts.

Fourth, there should be an analysis of the cumulative impacts of VAMP together with other water acquisition and transfer projects on the San Joaquin system and particularly the Stanislaus River. The issue is what is the cumulative impact of the reallocation of surface water supplies

for environmental purposes in the Delta an local agricultural production, economic development, groundwater resources and the local environment.

While the draft EIR/EIS does address some of the groundwater issues raised by our letter, it does not appear to be completely responsive to the concerns of Stanislaus County. More specific comments are set out below.

1. **Groundwater impacts in Stanislaus County.** Section 4.3 discusses groundwater impacts associated with this project. On page 4-22, section 4.3.1 summarizes the issues and concerns identified during the scoping phase. These include the need to identify and analyze the impacts of the project on groundwater usage and groundwater resources in Stanislaus County, the extent to which the project will result in additional groundwater pumping, and the cumulative impacts of this project and other water supply/transfer projects being considered by project proponents.

   Section 4.3 then analyzes the impacts of the proposed project, the no action alternative and the alternative action in several groundwater related resources areas including overdraft impacts, water levels, water quality, subsidence, and drainage. The analysis covers three service districts within Stanislaus County: Oakdale Irrigation District (OID), Modesto Irrigation District (MID), and Turlock Irrigation District (TID). The analysis indicates that no additional groundwater pumping will be required within Modesto or Turlock Irrigation Districts in order to implement the project. Additional groundwater pumping may occur within OID in an amount not to exceed 15,000-acre feet. This additional pumping is presumed to be offset by additional depletion (recharge) from the Stanislaus River, and is therefore considered to be less than significant.

   It is not clear if this presumption is supported by modeling or technical data. Is it possible that a condition may occur wherein the additional groundwater pumping is not offset by additional depletion from the Stanislaus River, but rather the groundwater levels in the OID and surrounding areas decline? If so, would this be a significant impact. If so, how would such an impact be mitigated?

   Generally, the discussion of groundwater pumping does not appear to include any analysis of impacts to Stanislaus County groundwater resources as a whole. Thus, this section does not respond to the questions identified in Section 4.3.1.

2. **Affected Environment** - We note that the affected environment section 3.3. provides extensive descriptions of the groundwater resources associated with the various Irrigation Districts, but the discussion does not appear to include eastern Stanislaus County or areas outside the various Irrigation District Boundaries. Thus, it appears that any potential impacts in these areas arising from this project have not been identified. Transfers of groundwater and the associated potential impacts to existing groundwater users (regardless of District Boundaries) is a major issue in Stanislaus County. Discussions should not be limited only to the Irrigation Districts, but should also include analysis of impacts of the project on these areas outside of the district boundaries.

3. **Groundwater pumping and loss of accretion to rivers** - Based on studies conducted for the Diablo Grande Water Resources Plan Supplemental EIR (Stanislaus County 1998), it is our understanding that in dry & critically dry years pumping of groundwater could result in decreases in accretion to the San Joaquin River, thus reducing surface-flows within the river. Our studies indicated, for example, that pumping approximately 11,000 acre-feet of shallow groundwater from the TID basin could result in reductions of up to 4.2 to 5.7 percent of the total flow in the San Joaquin River between the Merced and Tuolumne Rivers. Will any of the proposed uses of groundwater (OID, Merced ID, and Exchange Contractors) result in significant losses of groundwater accretion later in the season to any of the adjacent rivers including the Stanislaus, Tuolumne, San Joaquin, and Merced Rivers during dry or critically dry years, and what mitigation measures are proposed to reduce these impacts (if any are identified)? (Mitigation Measure 6 from Diablo Grande SEIR provided as attachment A to this letter for your review)

4. **Project Description and Groundwater Pumping** - SSJID, MID, and TID all project that none of their contributions would come directly from groundwater, thus no impacts are identified and no proposed mitigation is provided. Is it a correct assumption that these "projections" now constitute part of the Project Description, and that area groundwater will never be used by these districts to supplement flows directly or indirectly associated with VAMP? If there are any scenarios where these districts might use groundwater sources to replace or supplement surface sources used for this program, it is imperative that potential impacts to overdraft, water levels, subsidence etc., be identified and mitigation measures defined.

5. **Mitigation Measures** - The mitigation measures described in the DEIR/DEIS seem written in such a way that they do not require specific actions to be taken in relation to specific impacts. For example, one mitigation measure described on page 4-47 uses language such as:

> *"mitigation could include implementing a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping ... etc. etc.*

Several other mitigation measures are described throughout the document in a similar fashion.
Although we fully understand the adaptive character of the project, and the need to provide as much flexibility in the mitigation programs as possible, Stanislaus County typically requires that substantially more explicit and distinctive measures be developed

to mitigate the impacts that they are related to. Stanislaus County would prefer to see substantially more detailed mitigation measures throughout the document including descriptions of the specific actions and specifications associated with each proposed measure, the agency responsible for implementing those actions, the proposed timing of implementation, and the method, goals, and agency responsible for monitoring implementation of each program or measure.

These details should be provided in a Mitigation Monitoring Program as required by CEQA.

6. **Cumulative Impacts** - The discussion in section 4.3 does not include any cumulative impact analysis on groundwater conditions within Stanislaus County. How does this project relate to other proposals and projects, such as the proposed OID to Stockton East water transfer and the proposed TID to Diablo Grande transfer? Section 4.12 provides a very general programmatic discussion of the relationship of this project to the State Board's Bay Delta process, the Central Valley Project Improvement Act, the Interim South Delta Program, the CALFED Bay Delta Program, and the USBR long term operations plan for New Melones. However, there is no analysis of the relationship of this project to other specific projects which may affect land uses or water resources in Stanislaus County.

The ERC appreciates the opportunity to comment on this project. Please feel free to call Kirk Ford (Planning) at (209)525-6330 or John Aud (Environmental Resources) at (209)525-6717 if you have any questions or comments.

Sincerely,

W. Richard Jantz
Deputy Executive Officer

RJ:mh

STANISLAUS COUNTY CHIEF EXECUTIVE OFFICE (NOVEMBER 5, 1998)

The comments are identical to those submitted by the County Planning and Community Development Department. See responses to those comments which follow this letter/response.

Stanislaus County

Department of Planning and Community Development

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November 9, 1998

Mr. Michael Delamore
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RE: Draft EIS/EIR for Meeting Flow Objectives for the San Joaquin River Agreement

Dear Mr. Delamore:

Stanislaus County submitted a comment letter, dated January 18, 1998, in response to the scoping sessions conducted for this EIR/EIS. That letter raised four issues which are repeated below:

1 First, there should be an analysis of the impact of VAMP on the long term operations of New Melones Reservoir, and particularly the impact of VAMP on the availability of Stanislaus River water for existing and reasonably forseeable future Stanislaus River in-basin needs. In other words, does the reallocation of Stanislaus River/New Melones water adversely impact the ability of local agencies to develop future water supplies or impair the ability of local agencies to exercise their watershed, basin, or area of origin priorities?

2 Second, to the extent applicable, there should be an analysis of the impact of reductions of use of surface water from the Stanislaus and the Tuolumne Rivers in Stanislaus County on groundwater usage in Stanislaus County. In other words, will the water acquisitions for VAMP be offset by increasing groundwater pumping, and if so, what will be the impact on local groundwater resources?

3 Third, to the extent that VAMP water acquisitions result in reductions in surface water usage in Stanislaus County which are not offset by increased groundwater pumping, there should be an analysis of the "third party" impacts of such reductions in surface water use, particularly the impacts on public and social services demands, reduced tax revenues and related impacts.

4 Fourth, there should be an analysis of the cumulative impacts of VAMP together with other water acquisition and transfer projects on the San Joaquin system and particularly the Stanislaus River. The issue is what is the cumulative impact of the reallocation of surface water supplies for environmental purposes in the Delta on local agricultural production, economic development, groundwater resources and the local environment.

While the draft EIR/EIS does address some of the groundwater issues raised by our letter, it does not appear to be completely responsive to the concerns of Stanislaus County. More specific comments are set out below.

1. **Groundwater impacts in Stanislaus County.** Section 4.3 discusses groundwater impacts associated with this project. On page 4-22, section 4.3.1 summarizes the issues and concerns identified during the scoping phase. These include the need to identify and analyze the impacts of the project on groundwater usage and groundwater resources in Stanislaus County, the extent to which the project will result in additional groundwater pumping, and the cumulative impacts of this project and other water supply/transfer projects being considered by project proponents.

Section 4.3 then analyzes the impacts of the proposed project, the no action alternative and the alternative action on several groundwater related resources areas including overdraft impacts, water levels, water quality, subsidence, and drainage. The analysis covers three service areas within Stanislaus County: Oakdale Irrigation District (OID), Modesto Irrigation District (MID), and Turlock Irrigation District (TID). The analysis indicates that no additional
5 groundwater pumping will be required within Modesto or Turlock Irrigation Districts in order to implement the project. Additional groundwater pumping may occur within OID in an amount not to exceed 15,000 acre feet. This additional pumping is presumed to be offset by additional depletion (recharge) from the Stanislaus River, and is therefore considered to be less than significant.

It is not clear if this presumption is supported by modeling or technical data. Is it possible that a condition may occur wherein the additional groundwater pumping is not offset by additional depletion from the Stanislaus River, but rather the groundwater levels in the OID and surrounding areas decline? If so, would this be a significant impact. If so, how would such an impact be mitigated?

Generally, the discussion of groundwater pumping does not appear to include any analysis of impacts to Stanislaus County groundwater resources as a whole. Thus, this section does not respond to the questions identified in Section 4.3.1.

2. **Affected Environment** - We note that in the discussion on affected environment, Section 3.3 provides extensive descriptions of the groundwater resources associated with the various irrigation districts, but the discussion does not appear to include eastern Stanislaus County or areas outside the various irrigation district boundaries. Thus, it appears that any potential
6 impacts in these areas arising from this project have not been identified. Transfers of groundwater and the associated potential impacts to existing groundwater users (regardless of district boundaries) is a major issue in Stanislaus County. Discussions should not be limited only to the Irrigation Districts, but should also include analysis of impacts of the project on these areas outside of the district boundaries.

3. 7 **Groundwater pumping and loss of accretion to rivers** - Based on studies conducted for the Diablo Grande Water Resources Plan Supplemental EIR (Stanislaus County 1998), it is our

7 understanding that in dry & critically dry years pumping of groundwater could result in decreases in accretion to the San Joaquin River, thus reducing surface flows within the river. Our studies indicated, for example, that pumping approximately 11,000 acre-feet of shallow groundwater from the TID basin could result in reductions of up to 4.2 to 5.7 percent of the total flow in the San Joaquin River between the Merced and Tuolumne Rivers. Will any of the proposed uses of groundwater (OID, Merced ID, and Exchange Contractors) result in significant losses of groundwater accretion later in the season to any of the adjacent rivers including the Stanislaus, Tuolumne, San Joaquin, and Merced Rivers during dry or critically dry years, and what mitigation measures are proposed to reduce these impacts (if any are identified)? (Mitigation Measure 6 from Diablo Grande SEIR provided as attachment A to this letter for your review)

4. **Project Description and Groundwater Pumping** - SSJID, MID, and TID all project that none of their contributions would come directly from groundwater, thus no impacts are identified and no proposed mitigation is provided. Is it a correct assumption that these
8 "projections" now constitute part of the Project Description, and that area groundwater will never be used by these districts to supplement flows directly or indirectly associated with VAMP? If there are any scenarios where these districts might use groundwater sources to replace or supplement surface sources used for this program, it is imperative that potential impacts to overdraft, water levels, subsidence etc., be identified and mitigation measures defined.

5. **Mitigation Measures** - The mitigation measures described in the DEIR/DEIS seem written in such a way that they do not require specific actions to be taken in relation to specific impacts. For example, one mitigation measure described on page 4-47 uses language such as:

> *"mitigation could include implementing a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping ... etc. etc."*

9 Several other mitigation measures are described throughout the document in a similar fashion.

Although we fully understand the adaptive character of the project, and the need to provide as much flexibility in the mitigation programs as possible, Stanislaus County typically requires that substantially more explicit and distinctive measures be developed to mitigate the impacts that they are related to. Stanislaus County would prefer to see substantially more detailed mitigation measures throughout the document including descriptions of the specific actions and specifications associated with each proposed measure, the agency responsible for implementing those actions, the proposed timing of implementation, and the method, goals, and agency responsible for monitoring implementation of each program or measure.

These details should be provided in a Mitigation Monitoring Program as required by CEQA.

6. **Cumulative Impacts** - The discussion in section 4.3 does not include any cumulative impact analysis on groundwater conditions within Stanislaus County. How does this project relate to other proposals and projects, such as the proposed OID to Stockton East water transfer and the proposed TID to Diablo Grande transfer? Section 4.12 provides a very general programmatic discussion of the relationship of this project to the State Board's Bay Delta process, the Central Valley Project Improvement Act, the Interim South Delta Program, the CALFED Bay Delta Program, and the USBR long term operations plan for New Melones. However, there is no analysis of the relationship of this project to other specific projects which may affect land uses or water resources in Stanislaus County. 10

7. **Clarification of OID option** - On page 4-25, OID projects that form zero to 15,000 acre-feet would come from groundwater. Is OID going to pump groundwater for direct discharge into the river, pump groundwater to send to MID to offset MID's surface water releases, reduce their surface water diversion and offset that by groundwater pumping into their distribution system, or some other scenario? Please clarify. 11

Please feel free to call Kirk Ford (Planning) at (209)525-6330 or John Aud (Environmental Resources) at (209)525-6717 if you have any questions or comments. Thank you.

Sincerely,

Kirk Ford
Senior Planner

cc: Michele Laverty, Stanislaus County Environmental Review Committee
Michael G. Heaton, Attorney
John Aud, Stanislaus County Department of Environmental Resources
Dan Fults, Friant Water Users Authority

Mitigation 6: Mitigation measures shall be implemented during water years classified as Dry or Critical by the DWR for the San Joaquin River basin, as indicated in DWR Bulletin 120. Bulletin 120-2 (March 1) and 120-3 (April 1) shall be referred to annually, starting on the first year of pumping of the project wells. If Dry or Critical conditions are forecast for that water year, the following measures shall be implemented:

a. An adaptive management program shall be implemented to offset the project impacts to San Joaquin River flow, as predicted by the hydrological model and verified by monitoring of appropriate measuring gauges, for a 30-day period between April 1 and May 15, and a 30-day period between October 1 and November 15. A qualified hydrologist shall be retained by the WHWD to monitor hydrologic conditions in the project area and implementation of the management program. The primary component of this management program will consist of release of water into the San Joaquin River on a continuous basis during the mitigation period in the affected reach of the river, in an amount sufficient to offset project impacts as projected by the hydrological model or determined by direct monitoring of San Joaquin River flow in the project area. The primary option to implement this discharge of water to the San Joaquin River will consist of:

1) Release of surface water. If during the mitigation period, TID or some other water district in the project vicinity has water available which could be released into the river, this water may be purchased and released in the affected area of the river to supplement the river and meet the mitigation requirement. Options could include the following:

a. The WHWD will obtain the amount of water necessary (based on modeling using a monthly average) to mitigate the impact and "bank" the water, and/or

b. Use Marshall-Davis water for mitigation during the critical water years.

In addition to option (1) above, the following secondary options may be implemented individually or in combination to insure that the river is supplemented as set forth in this mitigation measure:

2) Reduction in project groundwater pumping. Under this option, the groundwater pumping would be reduced in an amount to permit increased accretion based on the required discharge amounts. This option generally would be

implemented when groundwater levels in the area of the well field are low. This option implies that Diablo Grande would reduce water use across the board for all land uses to fully or partially offset the impact.

3) Release of groundwater from other areas of the TID. The TID has groundwater drainage wells in many other areas of the District. If, during the required mitigation period, the groundwater level in the well field area is low, but the groundwater remains substantially high in other areas of the TID, then TID could increase pumping in those areas to supply the appropriate amount of discharge to the river.

If reduced project pumping, or increased project or drainage pumping is to be included as a component of this mitigation measure, a hydrological analysis would be required prior to implementation of this measure to assess how much the proposed reduction or increase would affect project impacts to the river during the mitigation period; the quantity of supplemental water purchased and discharged to the river would then be adjusted accordingly. This hydrological analysis would also address the potential impacts to the groundwater levels throughout the TID. The timing of this mitigation shall be coordinated with projected increased Merced River flows resulting from the VAMP and other programs, to support migration of salmon through the affected reach of the river. Mitigation requirements shall be phased to match the phased increases in project pumping and offset resultant impacts to the river. For example, at 25 percent project build-out, the estimated loss in accretion would average approximately 2 cfs during a drought year, and the mitigation requirement would total approximately 240 AF for the 60-day mitigation period. At full project build-out, the estimated loss in accretion would average approximately 8 cfs during a drought year, and the mitigation requirement would total approximately 950 AF for the 60-day period. If scheduled Merced River pulse flow releases are implemented for a period of less than 30 days in either spring or fall, the mitigation period and quantity shall be reduced accordingly.

b. This mitigation program shall be reviewed each year that it is implemented to assess its feasibility and success of implementation, which will be determined by a qualified hydrologist as provided in measure 6(a) above. Pursuant to this review, specific alternatives may be recommended, in consultation with the CDFG, USFWS and/or regional water resource agencies, which may be implemented in lieu of or in addition to measure 6(a) above, to mitigate potential cumulative

impacts of the project on fisheries resources of the San Joaquin River. Such alternatives could include contributing funds to local or regionally-based programs for restoration of riparian and instream habitat, management of naturally spawning/native Chinook salmon populations, or improvement of water quality in the San Joaquin River basin.

Agency/Individual Responsible for Implementation:	WHWD
Implementation Timing:	During dry and critical water years
Mitigation Specifications:	The WHWD assigned staff shall contact the DWR Bulletin 120-2 on March 1 and DWR Bulletin 120-3 on April 1 to determine if a dry or critical water year is projected. Thereafter, if a dry or critical water year is forecasted, commence implementation of mitigation 6.a. In addition, the WHWD shall submit adaptive management program reports and hydrological reports to the CDFG and Department of Water Resources.
Agency/Individual Responsible for Monitoring:	County of Stanislaus Environmental Coordinator in conjunction with the CDFG
Action by Monitor:	The County of Stanislaus Environmental Coordinator shall review the adaptive management program and hydrological analysis in conjunction with CDFG and DWR to assure accuracy of the reports and implementation of the findings contained in the reports.
Mitigation 7:	Prior to construction, a qualified biologist shall survey the project site and surrounding areas in the floodplain to determine the extent of the riparian vegetation zone, and identify any other sensitive plant communities or habitats (e.g., wetlands) that may occur in this area. Based on this survey, the construction area shall be located at least 100 feet from the edge of the riparian vegetation zone. The limits of the construction zone shall be clearly marked with flags or temporary fencing, and construction activities shall be contained within this zone. If loss of sensitive plants or habitats can not be avoided, a habitat restoration plan shall be developed and approved by the

STANISLAUS COUNTY PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT (NOVEMBER 9, 1998)

1. The operation of New Melones is an integral part of the EIS/EIR modeling analysis. The Interim Operations Plan was used within the analysis since it is the best representation of current operations available. However, the proposed project does nothing to affect the development and establishment of a long-term operation plan for the New Melones Project, nor does the proposed project reallocate Stanislaus River/New Melones water except whereby the proposed action transfers water from Oakdale Irrigation District to Reclamation for any of its authorized purposes. The long-term operation and allocation of Stanislaus River/New Melones water is not an appropriate subject of the proposed project.

2. The only case in Stanislaus County where surface water provided for VAMP would potentially result in direct groundwater pumping to offset the amount is Oakdale Irrigation District. The impacts to groundwater resources are explained in Section 4.3.2. Also see response to comment 11 below.

3. The district that would potentially reduce deliveries to irrigation customers in Stanislaus County is OID (0-15,000 acre-feet), and there are 62,000 acres irrigated land in its service area. However, groundwater substitution by OID is anticipated. As discussed in Section 4.6.2.3, the most probable option for farmers is to purchase groundwater from the district or pump it directly. With no significant reductions in water use overall, there are no significant effects on third parties. An analysis of negligible impacts on social service demands, reduced tax revenues, and related impacts is unnecessary.

4. Section 4.2 describes impacts specifically on the Stanislaus River. The cumulative analysis in Section 4.12 does not single out the Stanislaus River, and the proposed action is a regional action affecting the San Joaquin River Region. The San Joaquin River Region is part of the larger CALFED Bay-Delta planning program and contains numerous water projects covered under the CVPIA. The CVPIA Draft PEIS's cumulative impact analysis estimated no change to CVP contracts on the Stanislaus (p. V-8). The issue of what is the impact of all of the reallocation of surface water supplies for environmental purposes in the Delta on Stanislaus County is contained in the Draft PEIS which is incorporated by reference in this Final EIS/EIR. Some specific local project information is available for the Stanislaus River; and this information has been added to the EIS/EIR in Section 4.12.1. See also responses to SDWA comment II.B and II.C.

5. Three of the willing sellers (TID, MID, and OID) are located partially within the boundaries of Stanislaus County. Of these, only OID has proposed the possibility of rarely using groundwater as a source for their water under the SJRA. OID has projected that up to 15,000 acre-feet of groundwater may be used. The three irrigation districts together pump an

estimated 153,000 acre-feet of groundwater per year (Table 3.1-1). An additional 15,000 acre-feet pumped by OID represents less than 10 percent of the total volume pumped. The potential additional groundwater pumping proposed by OID is not significant when the entire basin (and recharge from river inflow) is considered. A study conducted by DWR in March 1992, *Historical Unconfined Groundwater Trends in the San Joaquin Valley*, indicates that Stanislaus County has experienced the least decline in groundwater levels (-10 feet) and groundwater storage (-835,000 acre-feet) of all the counties within the San Joaquin and Tulare groundwater basins over the period 1970 to 1991.

The projected maximum volume of groundwater that would be pumped by OID (0 to 15,000 acre-feet) should be recharged from several sources including seepage from the Stanislaus River and surface water infiltration from precipitation and applied water. This presumption is not supported by modeling but by technical data which shows that groundwater levels and groundwater storage tend to recover in non-drought years. Groundwater overdrafting is a problem throughout the San Joaquin Valley. An additional 15,000 acre-feet on rare occasions is considered insignificant when compared to the total volume of water pumped in the Valley. It does contribute to a cumulative impact that is significant, however.

Data used to evaluate potential impacts to the groundwater basins within Stanislaus County as a result of the VAMP flows was obtained from Groundwater Management Plans (AB 3030) supplied by the SJRG water agencies. The AB 3030 plans are listed in Chapter 8 (References). Data presented in the AB 3030 Groundwater Management plans typically included an analysis of groundwater usage and water demands within the representative water agencies boundaries. The irrigation districts occupy approximately 60 percent of the total area within Stanislaus County and a significantly higher percentage of the total irrigated acreage within the county. Well locations are primarily within district boundaries. Data trends on groundwater management within the irrigation districts' boundaries can generally be extrapolated over the entire county.

6. Comment noted. As explained above, the three districts (OID, MID, and TID) together cover much of the land area in Stanislaus County, and OID is the only irrigation district within Stanislaus County that may rarely pump groundwater for project water. The effect of pumping up to 15,000 acre-feet should not significantly affect storage or water levels outside of OID's service area, so the rest of Stanislaus County would not be impacted. See response 5 above, last paragraph.

7. As stated in the Diablo Grande SEIR, the maximum impact on accretion to San Joaquin River flows between the Merced River and the Tuolumne River under the alternatives evaluated would be in the 4.8 to 10.4 cfs range, with distinct variations seasonally and annually. The greatest impacts in terms of percent river flow in this reach would be during the summer and fall months for a 3-month period of time, during the fall of one year out of

32 years studied. Under the worst case scenario, the extended drought would result in the greatest impact in terms of percent of San Joaquin River flow for this reach of up to 5.74 percent. As pointed out in the SEIR, this modeled peak loss of accretion to this reach of the San Joaquin River is the exception and most often the loss of accretion to this reach of the San Joaquin River would be less than 1 percent, with occasional peaks at 2 percent. The SEIR concluded (p. 2-75) that the project's impact on flow and water quality is too small a percentage of the total flow to conclude the impact to be significant.

The SEIR states that this reduction of accretion during dry and critical years is significant as it pertains to Chinook salmon, thus necessitating implementation of Mitigation Measure 6. This mitigation would offset San Joaquin River flows in the reach between the Merced River and the Tuolumne River in dry and critical years during the spring outmigration and fall upstream migration periods.

Because the SJRA proposed action for this EIS/EIR would increase flows during the spring salmon outmigration and fall upstream migration periods, no additional flow would be needed and no mitigation is required.

8. The projections by SSJID, MID and TID are that they do not need to utilize groundwater for the proposed action, and these assertions are part of the Project Description. Should this condition change over the 12-year period, additional NEPA/CEQA analysis would be required.

9. Appendix G contains the Mitigation Reporting Program required by CEQA. The commitment to mitigation is contained in that appendix, while mitigation described in the impact analysis uses less definitive language to identify the types of mitigation projects that could be implemented. Specific projects by district, where required to mitigate significant impacts, are described in the appendix.

10. The cumulative impacts analysis in the DEIS/DEIR did not use a listing of small projects approach similar to a list of development projects that could occur in a city. It uses a hybrid larger project or program (projection-type) approach that evaluates regional conditions and is qualitative rather than quantitative. It is reasonable to assume that the proposed action would be one component in the larger plans underway by the CALFED Bay-Delta Program and in the implementation of long-term water contracts under the CVPIA. This EIS/EIR would have officially "tiered-off" the PEIS for the CVPIA had the PEIS been finalized. The NEPA/CEQA documents prepared for these regional programs provide detailed analysis of collectively significant projects occuring over the 12-year time period of the proposed action. Therefore, relying on the results of these previous studies is appropriate and efficient.

11. OID anticipates using up to 15,000 acre-feet of groundwater as a substitute for surface water dedicated to VAMP that it would otherwise use for irrigation. OID plans to use its existing facilities, as described in section 3.2.5.3, to pump groundwater into its surface conveyance system, and thereby deliver that water to its irrigation customers.

    OID would not pump groundwater for direct discharge into the Stanislaus River. Pursuant to the SJRA, OID provides the water for the VAMP instream flow experiment at its last place of control, which for OID is Goodwin Dam. All additional water transferred by OID to the Bureau of Reclamation is delivered to the Bureau at New Melones Reservoir. Because of the location for the delivery of OID's water, that water must be surface water.

    OID also does not plan to pump groundwater to provide replacement water for MID. In some circumstances, because of the need for the Bureau of Reclamation to keep the Stanislaus River at certain flow levels in order to protect downstream landowners from flooding, OID's water contribution for the VAMP experiment would be provided by MID in the Tuloumne River. Under these circumstances, OID anticipates that it would replace MID's water through surface water deliveries through OID's conveyance system to the MID conveyance system. OID does not plan to pump groundwater for the specific purpose of supplying replacement water for MID.

Sheriff's Department

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STANISLAUS COUNTY

LES WEIDMAN
SHERIFF - CORONER
PUBLIC ADMINISTRATOR

October 2, 1998

United States Department of the Interior
Bureau of Reclamation, MP-150
Mid-Pacific Regional office
2800 Cottage Way
Sacramento, California 95825-1898

ATTENTION: Michael Delamore or Dan Fults

ENVIRONMENTAL COMMENTS

Re: ENVIRONMENTAL REFERRALS-DRAFT ENVIRONMENTAL IMPACT STATEMENT/DRAFT ENVIRONMENTAL IMPACT REPORT MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT, 1999-2010

Based on this agency's particular field of expertise, our position is neutral and we offer no comments at this time.

Response Prepared By John Hansell
John Hansell
Construction Projects

cc: Stanislaus County Planning and Community Development

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"KEEPING THE PEACE SINCE 1854"

C-096338

C-096338

STANISLAUS COUNTY SHERIFF'S DEPARTMENT (OCTOBER 2, 1998)

No comment was provided, and no response is necessary.

C-096339

C-096339

HERUM, CRABTREE, DYER, ZOLEZZI & TERPSTRA, LLP

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JEANNE M. ZOLEZZI

November 3, 1998

Mr. Michael Delamore
United States Bureau of Reclamation
South-Central California Area Office
2666 North Grove Industrial Drive, #106
Fresno, California 93727-1551

Mr. Dan Fults
Friant Water Users Authority
1521 I Street
Sacramento, California 95814

Re: San Joaquin River Agreement DRAFT EIR/EIS
Our File No. 1026-013

Dear Mike and Dan:

The following comments are made to the San Joaquin River Agreement DRAFT Environmental Impact Statement and Environmental Impact Report (EIS/EIR) dated September 25, 1998 on behalf of the Stockton East Water District (SEWD).

In preparing the EIS/EIR, the United States has apparently forgotten that this environmental document is prepared under the California Environmental Quality Act (CEQA) and not solely under the National Environmental Policy Act (NEPA). The U.S. has prepared another one of its pre-determined environmental documents, albeit this time an EIS/EIR rather than the usual EA/FONSI. The result, however, is the same.

CEQA requires something more. It requires a meaningful analysis of alternatives and impacts. This document provides neither.

GENERAL COMMENTS

1. Alternatives. The selection of alternatives is perplexing, without apparent rhyme or reason other than to select the predetermined alternative and a less desirable alternative with which to compare it.

2 The EIS/EIR attempts to describe the screening process. The initial screening is shown in Table 2.4-1. The first concern is there is no narrative description of how the screening criteria listed was applied to each alternative. Without such narrative, there is no way to confirm that the screening was completed in a fair and unbiased fashion.

3 Further, the text indicates that "the set of 26 potential alternatives was reduced to six for further evaluation using this matrix." There is no discussion of how the six were selected using the matrix. One would assume that the highest scoring alternatives would be selected. However, this is not the case. The preferred alternative scored 9 points, the alternative chosen scored 6. However, three additional alternatives with a score of 6 did not even make it to the Secondary Screening. The Secondary Screening process is highly suspect. It appears to be nothing more than a phone call to selected individuals.

4 It has been said that the most substantive aspect of CEQA is Public Resources Code Section 21001, which "requires public agencies to deny approval of a project with significant adverse effects when feasible alternatives or feasible mitigation measures can substantially lessen such effects." In general, EIRs "must produce information sufficient to permit a reasonable choice of alternatives so far as environmental aspects are concerned." [*San Bernardino Valley Audubon Society, Inc. v. County of San Bernardino* (4th Dist. 1984), 1455 Cal.App.3d 738, 750-751].

5 By its own screening mechanism, the EIS/EIR rejects potentially feasible alternatives that CEQA requires be included in order to provide a reasonable range of alternatives. The alternatives shown and the scoring mechanisms alone provide enough information to establish that one alternative is not enough for this EIS/EIR.

6 2. <u>Impacts</u>. There is no analysis of the potential impacts of either of the alternatives on the Stockton East Water District. The EIS/EIR assumes continuation for twelve years of the New Melones Interim Plan of Operation that expired by its terms on October 1, 1998. VAMP is based upon and assumes continuation of those flows – while other alternatives not evaluated may reduce the need for those flows. In fact the alternative chosen reduces the need for those flows, **but this potential impact is not discussed at all in the EIS/EIR.**

7 Implementation of the plan would lock the interim flows in place because of its reliance on those flows. Although the EIS/EIR states that the long-term plan will be negotiated, the reality must be recognized that there will be tremendous pressure by the United States, the water districts participating in VAMP and others to maintain those flows. In addition, there may be environmental consequences to reduction of flows from New Melones if provided in a long-term plan that would have to be evaluated. These issues place an added burden on the Stockton East Water District, **which again is not evaluated in the EIS/EIR.**

SPECIFIC COMMENTS

8 Page 1-4. It is important to note that there is no Final Anadromous Fish Restoration Plan. The "need" discussed is based upon a Draft plan.

9 Page 1-5. The statement is made that "The March 6, 1995 Biological Opinion. . .requires that Reclamation provide flows from the New Melones Reservoir . . . in order to provide San Joaquin River flows at Vernalis in excess of those exported by the CVP and SWP." This is not true. The Biological Opinion did not require specific operation, it simply approved the operations voluntarily proposed by the Bureau of Reclamation and others. In addition, the proposed actions that were approved in the Biological Opinion did not provide that flows would be provided from the New Melones Reservoir. Rather, the opinion incorporates the language of the Principles Agreement:

> "Not later than three years following the adoption of this plan, the SWRCB shall assign responsibility for the following flows, together with other measures in the watershed sufficient to meet all criteria in the San Joaquin River at Vernalis among the water right holders in the watershed. During this three-year period, Reclamation shall provide these flows."

Clearly, then, the Bureau has alternatives, but continues to voluntarily utilize New Melones Water for that purpose.

10 Page 1-6. It is questionable whether or not it is an appropriate use of CVPIA Restoration Funds for the purchase of water from the Authority. This issue should be fully evaluated.

11 Page 2-6, Lines 7-9. It is impossible to make a complete evaluation of the potential adverse impact to the Stockton East Water District unless the use of the acquired OID water is identified. (See comment for page 4-13 below.)

12 Page 2-6. Sources of Water. New Melones should be identified as a source of water under the San Joaquin River Agreement.

13 Page 2-10. There is no support for the assumption in the No-Action Alternative that the SWRCB's 1995 Water Quality Control Plan will be met through operation of the CVP and SWP. The SWRCB will implement its Water Quality Control Plan even if the SJRA is not adopted. The stated purpose of the Bay-Delta Water Rights Hearing process is to adopt implementation measures for meeting that plan which do not impose obligations solely upon the CVP and SWP. Consequently, this assumption is unsupported and leads to inaccurate environmental impact analysis.

14 Page 3-4. The second paragraph inaccurately reflects that the Goodwin Dam is owned by SSJID and OID. Stockton East Water District owns 1/3 of this facility.

15 Page 3-6. The Calaveras River is not fed by snowmelt.

16 Page 3-10. To say that the reach of the San Joaquin River from Salt Slough to Fremont Ford "typically has the poorest water quality of any reach of the river" is an understatement.

17 Page 3-11. The City of Stockton should be included in the list of the CVP's M&I customers.

18 Page 3-12. Decision 1616, not 1422, actually provided the most recent operational conditions on the project.

Page 3-14. The statement that one of the purposes of New Melones Reservoir was to "maintain water quality conditions in the Stanislaus River and in the San Joaquin River at Vernalis" is very misleading and not wholly accurate. In fact, Congress did not authorize New Melones for water quality purposes, but directed the Secretary of the Army to: "*give consideration during the preconstruction planning for the New Melones project to the advisability of including storage for the regulation of stream flow for the purpose of downstream water quality control.*"

19 Upon completion of a study, the Bureau of Reclamation Mid-Pacific Director made the recommendation that limited water quality objectives be incorporated into the New Melones Project, based upon the assumption that: "*In terms of water, incorporation of water quality will not effect the project's yield*" and "*With the stipulation that, during its 50-year repayment period, these objectives will not require releases exceeding 70,000 acre-feet in any one year.*"

The Corps of Engineers, based upon the Bureau's conclusions, made its own recommendation that: Releases from New Melones Dam for water quality control purposes be made as necessary to maintain the objectives listed above, but not in excess of 70,000 acre-feet in any one year.

20 Page 3-16. Any discussion of unanticipated operational factors influencing the drawdown on New Melones must include a discussion of the large flows allocated from New Melones for CVPIA (b)(2) purposes in 1993.

21 Page 3-23. Although the Eastern San Joaquin County Basin is listed, there is no discussion of the critical state of overdraft or other relevant information about the basin.

22 Page 3-68. There is no authorization for utilizing water from New Melones Reservoir for "positioning of the freshwater/saltwater interface in the Delta". In fact, such a use would violate the terms and conditions of the water rights held by the Bureau for the project.

23 Page 3-84. The statement that "Increased flows for the benefit of salmon have been negotiated on the Stanislaus River, as part of the New Melones Interim Operation Plan . . ." is wholly inaccurate. Increased flows for the benefit of salmon have been <u>imposed</u>, and the stakeholders have negotiated to allocate any remaining yield. Few of the stakeholders agreed with the flows allocated by the Bureau and Fish and Wildlife Service for fishery flows.

24 Page 4-4. Stockton East Water District is not considered as a water user potentially affected by the proposed project. This is a fatal flaw.

25 Page 4-5. The assumption is made for the No Action Alternative that "New Melones Reservoir is operated consistent with the 1997 Interim Plan of Operation." This is not a likely scenario, and should not be used as an assumption.

13 For the same reasons, the assumption that "Implementation of the SWRCB's 1995 WQCP is accomplished through operations of the SWP and CVP" is unwarranted (see discussion above).

26 Page 4-7. Because of the unwarranted assumptions, above, the analysis of water deliveries in 4.2.2.1 is inaccurate.

27 Page 4-13. What assumptions were made with regard to allocation of the 15,000 af of water purchased from OID? No determination can be made regarding benefit unless these assumptions are known.

28 Page 4-17. Table 4.2-10 needs additional explanation. There is no explanation for why the change in the number of exceedances of the 1995 Bay/Delta Water Quality objective at Vernalis.

29 Page 4-19. The statement is made that "The significant negative impacts would need to be mitigated by releases of water from New Melones Reservoir sufficient to achieve the standards." This is again untrue. First, this assumes that the SWRCB will allocate responsibility for the Vernalis standard upon New Melones at the conclusion of its water right hearings. In addition, it assumes that there would be sufficient water in New Melones to make the additional releases, which cannot be demonstrated unless each particular year is reviewed.

Page 4-21. Last paragraph – see comments to page 4-19 above.

30 Page 4-24. SSJID projects that none of its transferred water would come from groundwater, so there would be no impact to the overdraft problem within Eastern San Joaquin County. There is no discussion, however, about the potential for reduced recharge by reduced application of surface water within SSJID.

31 Page 4-24 – 4-25. The assumption is made that third parties would pump groundwater to supplement any reductions imposed by the SWRCB. How can this assumption be made without further analysis? The previous section indicates that SSJID can transfer water without supplementing with surface water, yet the same assumption is not made with regard to third parties.

32 Page 4-25. If the groundwater within OID is already overdrafted, how can the conclusion be reached that pumping an additional 15,000 acre-feet per year "should not result in a significant negative impact to the overdraft problem within OID's service area?"

33 Page 4-134. Order WR 95-6 does not implement the 1995 WQCP.

34 Page 4-138. The statement that "The long term operations of the Stanislaus River will be affected by several pending actions including the SJRA." This admission supports the requirement that adverse impacts on surface water deliveries to Stockton East Water District be considered as a part of this EIS/EIR analysis.

35 Page 4-142. The statement that "Implementation of the preferred alternative (SJRA) would positively impact the SWRCB Bay/Delta Process" because "A negotiated settlement would avoid potentially contentious and protracted proceedings to protect Delta beneficial uses" is without support. The potentially contentious and protracted proceedings are ongoing, and have not been abbreviated because of the SJRA. To the contrary, the SJRA has possibly made the process longer (the addition of Phase 2A, for example). In addition, the SJRA itself will likely result in contentious and protracted litigation because it attempts to avoid the water rights process.

36 Page 4-143. There is no analysis of cumulative impacts on Stockton East Water District individually. The analysis on the CVP as a whole talks about mitigation through transfers and the development of additional water storage facilities. The likelihood of implementation of such water storage facilities is not discussed, nor who would pay for such facilities. The infeasibilty of water transfers as to particular CVP contractors, such as Stockton East Water District, is also not addressed.

CONCLUSION

The DRAFT EIS/EIR for Meeting Flow Objectives for the San Joaquin River Agreement is an inadequate CEQA document. It does not evaluate all feasible alternatives, or any feasible alternatives for that matter besides one. It does not evaluate the adverse potential impacts to the Stockton East Water District as a water user from New Melones Reservoir, which is admittedly an integral part of the San Joaquin River Agreement.

Very Truly Yours,

Jeanne M. Zolezzi
Attorney-at-Law

JMZ:des

cc: Mr. Edward M. Steffani, Stockton East Water District

HERUM, CRABTREE, DYER, ZOLEZZI & TERPSTRA FOR SEWD (NOVEMBER 3, 1998)

1. The alternatives analysis presented in the EIS/EIR is a summary of many hours of effort by a steering committee of representatives of Reclamation, the SJRGA, and cooperating and responsible agencies to identify a broad range of alternatives, to develop screening criteria based on the purpose and need and project objectives to evaluate these alternatives for reasonableness, and to solicit additional input from four resource agencies. The combined knowledge and experience of approximately 15 people who attended these monthly meetings was used to identify and evaluate the 26 alternatives. A technical memorandum was prepared and served as the basis for the text in the EIS/EIR.

2. The text preceding Table 2.4-1 explains how the screening criteria listed across the top of the table were applied, primarily with a positive or negative indication. The steering committee felt that a numerical scoring and weighting of each criterion was overly technical and unnecessary based on the professional judgement and expertise of the participants involved. Note that some members of the committee have 25-30 years or more experience in water projects in the San Joaquin River area and Central Valley. The purpose of the initial screening was to come up with a reasonable range of alternatives for further investigation, not to exhaustively document unreasonable alternatives that could not be implemented consistent with the purpose and need statement. Alternatives that would clearly not meet the criteria based on the purpose and need were eliminated from further analysis.

   See also response to SDWA comments IV.A.1. and IV.A.2.

3. The five alternatives (in addition to No Action) that survived the initial screening were not re-evaluated using the matrix. Yes, included in the second round were some alternatives that were not scored highly initially, such as the Recirculation Alternative, because the committee did not want to overlook information from key resource agency representatives to ensure that the initial screening did not rule out the alternative prematurely. Rather, input was formally solicited from the following agencies: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Region 9, and the California Department of Fish and Game. Input from these agencies was discussed at the steering committee meeting, and the results are documented in the EIS/EIR in Section 2.4.2.4.

   Also, the commenter assumes that the criteria have equal weight, 1. It can be argued that some criteria are more important than others. For example, if the alternative could not be implemented in a practical sense in the near term (i.e., require more than 5 years to bring on line), then other positive effects (such as reliable supply of water) are less important.

See also response to SDWA comment IV.A.2.

4. Comment noted.

5. The matrix was a tool to help develop a reasonable range of alternatives, five, for further investigation from a broad range of 26. Only one alternative, the Water Right Priority System, survived additional scrutiny by water resource professionals; and is sufficient under NEPA and CEQA given the stated purpose and need. In fact, CEQA directs that the alternatives should be selected to minimize adverse impacts of the proposed project. Under CEQA, the alternatives analysis follows the impact analysis of the proposed project and is compared to the proposed project. However, NEPA requirements dictated that the alternative for analysis be selected prior to completing the analysis of the proposed action, and both alternatives were evaluated simultaneously. The Water Right Priority System was selected for in depth impact analysis along side the proposed action.

   The commenter fails to identify which other alternatives are feasible and should have been evaluated in depth in the EIS/EIR.

6. The Stockton East Water District's existing water supplies are not affected by the proposed action, and future negotiations for water transfers from willing sellers such as OID/SSJID are not the subject of this EIS/EIR. The Base Case or No Action assumes continuation of the New Melones Interim Plan of Operation (IOP) in the absence of a revised plan, and this is a reasonable assumption. To do otherwise would be speculative and imprudent given the stakeholder group involved with Reclamation to develop a long-term plan. Concerning the assertion that the proposed action may reduce the need for these flows, we do not expect this to occur. The modeling assumes the IOP flows would continue, as this is technically defensible. The NEPA analysis for a revised operations plan for New Melones Reservoir should consider the impact of all approved actions and reasonably foreseeable actions, including implementation of the SJRA flows.

7. The New Melones Long-Term Operation Plan will be subject to a separate NEPA analysis when it is proposed. In the meantime, the IOP will be extended and continue to operate.

8. Comment noted. This is correct.

9. Concerning Section 1.2.2, page 1-5 (Draft EIS/EIR), the Final EIS/EIR has been edited accordingly. The March 6, 1995 Biological for the Threatened Delta Smelt, etc. contains the statement that "...Reclamation shall provide these flows." No mention is made in the Biological Opinion concerning where these flows would come from. The Draft EIS/EIR incorrectly stated that "...Reclamation provide these flows from New Melones Reservoir..."; and the sentence has been modified.

10. Concerning Section 1.3, page 1-6 (Draft EIS/EIR), the use of CVPIA Restoration Fund monies for water acquisition to achieve flow objectives is both appropriate and contemplated by the CVPIA. Section 3402 of the Act provides in part that the purposes of the CVPIA include "...to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary." Section 3406 (b)(7) includes a mandate to the Secretary to "meet flow standards and objectives and diversion limits set forth in all laws and judicial decisions that apply to Central Valley Project facilities...." Thus, one of the overarching purposes of the CVPIA is to assist in meeting Bay-Delta standards and to satisfy flow objectives imposed on the CVP.

In order to assist the Secretary of the Interior in achieving the goals of the legislation, the CVPIA established a number of programs. Included in those programs at Section 3406(b)(3) is a water acquisition program to supplement the 800,000 acre feet of Central Valley Project yield dedicated to fish and wildlife purposes under the CVVPIA. Thus, the Secretary is given a directive to acquire water from willing sellers to help achieve the purposes and mandates of the CVPIA.

Section 3406(c)(1) of the CVPIA provides that no releases are to be made from Friant Dam for the purpose of restoring flows between Gravelly Ford and Mendota Pool or as a measure to implement the CVPIA in the absence of an Act of Congress. In lieu of that requirement, a surcharge (currently $7 per acre-foot) is imposed on water delivered from the Friant Division of the CVP. This in lieu "surcharge" was intended to be used as a substitute for flows from Friant Dam in order to help achieve the purposes of the CVPIA, including the achievement of the Bay-Delta standards and flow objectives.

All surcharge monies are deposited into the Restoration Fund established by Section 3407 of the CVPIA. Section 3407(a) requires that at least two-thirds of the monies deposited into the Restoration Fund are to be appropriated by the Secretary to carry out the "habitat restoration, improvement and acquisition provisions of the CVPIA. The water acquisition provisions of the CVPIA are part of the "acquisition (from willing sellers) provisions" of the law.

Section 3407(b) authorizes up to $50,000,000 per year to be appropriated from the Restoration Fund. Therefore, two-thirds of that amount (or more than $33,000,000) is to be used annually for programs like water acquisition. Accordingly, there is more than ample authorization to use Restoration Fund monies in general to satisfy the Federal government's obligation for water acquisition under the San Joaquin River Agreement.

11. The water provided by OID would be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-

VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The commenter should see responses to comments made by the USFWS. Text changes have been made to several places where the OID additional water is described.

12. The commenter is not correct. The sellers provide the water from the identified sources, in Table 2.1-2 such as surface water storage, not a particular facility. New Melones Reservoir is not a provider under the SJRA, only the specified districts and water authority.

13. Comment noted. However, the assumption states "to the extent possible... ." It does not state that the 1995 WQCP can be implemented solely by the CVP and SWP. The commenter's later comment following comment 25 is addressed by this response. Operations of the SWP and the CVP will affect how the 1995 WQCP is implemented.

14. Comment noted. The text on page 3-4 of the DEIS/DEIR has been revised to reflect that SEWD owns one third of Goodwin Dam.

15. Comment noted. The text on page 3-6 of the DEIS/DEIR has been revised to reflect that the Calaveras River is not fed by snowmelt.

16. Comment noted.

17. The City of Stockton is within and a part of SEWD. Reclamation does not have a contract with the City. Its contract is with SEWD.

18. This is correct. D-1616 contains the current operational rules for New Melones and the Stanislaus.

19. The Legislative history speaks for itself. The commenter needs to look to the Congressional intent to determine the direction or authority granted. A very narrow, legalistically-oriented, reading of the New Melones authorizing legislation could result in the interpretation that SEWD has employs. However, a broad and plain, reading of the same legislation would conclude that water quality is a purpose of the project. In any event, water quality is a requirement of our water rights for New Melones.

20. The comment is correct in that at any time unanticipated operational factors such as statutory, regulatory, or legal decisions may alter the anticipated operation of New Melones Reservoir. Examples of this are the enactment of the Central Valley Project Improvement

Act, the 1995 Water Quality Control Plan, and requirements under the Federal Endangered Species Act.

21. The groundwater overdrafting within the willing sellers' groundwater basins is described in Section 4.3.2 and in Appendix B. DWR has identified the groundwater basin underlying Eastern San Joaquin County as a critically overdrafted basin (Bulletin 118, 1996). However, the portions of the basin that are in critical overdraft are the urban areas of SSJID. Groundwater extraction in agricultural areas is significantly below the safe yield. As a result, the average extraction rate within the SSJID is less than the estimated safe yield; and, therefore, SSJID's portion of the groundwater basin is technically not overdrafted (SSJID 1994). Under the proposed action, SSJID projects that no additional groundwater will be pumped to achieve their contribution to the VAMP pulse flow. These actions will have no direct impact to groundwater conditions within the SSJID groundwater basin. The groundwater resources of the SSJID are discussed in Appendix B, Section B.4.

22. The place of use for the "water rights requirement" for New Melones is for the Stanislaus River and lower San Joaquin River. We agree it does not extend to the X2 standard given where the X2 standard is usually located. However, meeting a Vernalis standard that is intended to be part of an effort to contribute to Delta outflow can be interpreted as meeting the X2 standard because Delta outflow is how the X2 standard is met. In addition, Reclamation stated before the SWRCB that it agreed to operate the CVP in conformance with the Accord of which the 1995 WQCP reflects the Accord. Reclamation did caution that it may not be possible or prudent to meet all the standards under all conditions.

23. The salmon flows for the Stanislaus River are based in part on the information contained in the Draft Anadromous Fish Restoration Plan (AFRP) and discussions that took place at the Stanislaus stakeholders meetings. The AFRP was subject to public review and comments providing Stanislaus river stakeholders an opportunity to provide input. Similarly the Interim Operation Plan was the result of numerous meetings in which the stakeholders had opportunity to provide comments and to develop an agreed upon operations plan for New Melones Reservoir.

24. Any future transfer of water between SEWD and the willing sellers or Reclamation would be subject to NEPA/CEQA analysis. Existing agreements/contracts between SEWD and any of the willing sellers/Reclamation would not be affected by the proposed action.

25. Continuation of the IOP is the most logical assumption to make in the absence of any other proposed or approved operation plan.

26. The assumption is reasonable as stated above, so the analysis of water delivery impacts in Section 4.2.2.1 is sufficient.

27. As modeled for this EIS/EIR, all of the OID water, up to 26,000 acre-feet, would be made available to Reclamation in the New Melones Reservoir as a reduction in the amount of water that is diverted by OID. The current IOP would initially treat this water as additional carryover storage after the year has passed, and then enter that effect on storage into the next year's water allocation. Current rules for allocating additional storage (or inflow) at New Melones under the IOP will not allocate out every additional acre-foot of additional storage or inflow. Thus, as modeled, a substantial portion of the OID water remains in storage, carried froward into the next year, and at times accumulating several years in a row.

28. Modeling indicates that there are no instances when additional exceedences of the 1995 Water Quality Control Plan standard will occur due to the proposed action. However, according to the model results, the proposed action would eliminate several instances when the standard would otherwise not be met. Specifically in October the no action scenario indicates that the standard will be exceeded. With the proposed action, with additional flow being provided by Merced Irrigation District, these exceedences would be eliminated.

29. The statement means that the operations plan for New Melones would need to adjust the releases targeted for water quality purposes. This water could come from other water providers who rely on storage in New Melones or through some other water transfer/sale arrangement. The commenter is correct that there are no guarantees that the water would be available in New Melones in all years.

30. SSJID projects that none of their 11,000 acre-feet of water for the VAMP pulse flow would come from groundwater or otherwise have been used for groundwater recharge (see Table 4.1-1), so there would be no direct impact to the overdraft problem within Eastern San Joaquin County. SSJID has water available for other uses, including the pulse flow, due to reduced demand for irrigation water in recent years as a result of water conservation efforts. Although it is possible that some of this project water may otherwise come from irrigation uses, SSJID also expects that the water could come from carryover storage. The potential indirect impact on irrigation users is small/infrequent and, therefore, is not expected to result in reduced applications of surface water (or to encourage private pumping of groundwater) of any significance. The District's annual diversion of surface water is less than its full entitlement of 300,000 acre-feet in most years (see Table 3.1-1). SSJID has engaged in other water transfers as explained in Footnote 2 in Table 3.1-1. In short, the water is available without adversely impacting existing customers/water users.

31. It is a standard practice to pump groundwater when surface water supplies are inadequate. SSJID has stated that it would not pump groundwater for the Spring Pulse Flow, and its commitment is a known quantity of up to 11,000 acre-feet. Up to 38 water right holders are involved in the alternative action, and it is reasonable to assume that several would resort to groundwater pumping.

32. An additional 15,000 acre-feet per year would represent approximately 25 percent of the total volume pumped per year within the basin by OID, private irrigators and Reclamation wells (see Table 3.1.1). The two sentences preceding the conclusionary statement (Section 4.3.2.1, Proposed Action) present the basis for the conclusion of no significant impact: historically high levels of groundwater and the hydraulic connection of the groundwater surface to the Stanislaus River.

33. Comment noted. The text has been revised in Section 4.12.1.1 to omit SWRCB Order WR 95-6.

34. There is no impact on surface water deliveries to SEWD from the proposed action. The analysis does not speculate on future water sales or transfers between Reclamation and the six willing sellers and SEWD. Rather, it evaluates the change over the base condition and does not interfere with current contracts.

35. Comment noted. The potentially contentious and protracted litigation statement means that members of the SJRGA would not initiate litigation because they would have a negotiated settlement.

36. SEWD is one of many CVP contractors. It is not affected by the proposed action as noted above in response 34. The analysis in Section 4.12.2.4 is consistent with the CALFED Bay-Delta Program Draft Programmatic EIS/EIR. CALFED is evaluating options such as water transfers and new facilities, and a preferred alternative had not been determined as of the writing of this FEIS/FEIR.

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Mr. Mike Delamore
South Central California Area Office
U.S. Department of Interior
Bureau of Reclamation
2666 N. Grove Industrial Drive, Suite #106
Fresno, CA 95727-1551

Dear Mr. Delamore:

This letter is to provide comment on meeting objectives related to flooding for the San Joaquin River, in relationship to the San Joaquin River Agreement Draft EIS/EIR.

Having lived in the Central Valley of California for nearly thirty years, living in locations including Oroville, Sacramento, Fresno and Porterville, I having experienced many flooding situations. This combined with having first hand knowledge of such events as a key manager for several local government agencies, has provided me with a good perspective of these events.

The most recent flooding on the San Joaquin River, and other rivers flowing into the Central Valley from the Sierra Nevada, appeared to reinforce an observation that Bureau of Reclamation projects do not do as good a job as the California Department of Water Resources, and more significantly the Army Corp of Engineers, in preventing down stream flooding. It appeared to me that without exception, Corp of Engineer dams controlled flooding down steam during this event and Bureau of Reclamation dams did not.

The fact that a dam is built, places an obligation on the agency that constructed and operates the facility to prevent downstream flooding. Not only is this a moral obligation, but in my opinion a legal one. Although I am not an attorney, it seems logical that diversion of natural waterways, where the flooding event is greater than it would have been absent the diversion, places legal responsibility on the party making the diversion. There may overall, overtime, have been a substantial benefit gained from prevention of flooding in individual events, but in a given event, this general benefit can not be used to offset responsibility.

To me there is no question that the Bureau of Reclamation dams could have prevent flooding that has occurred down stream from project dams, if they had been managed to do this.

Although the economic value of the management plan to retain water for commercial use is extremely great, to the extent that it may make or break

Agriculture and related dependent industry, prevention of flooding should be the primary objective of all water projects in the Central Valley. This is because prevention of loss of life, and related human suffering is a higher objective. Other methods and means of retaining water for these purposes are available, although it will take political will, time, money and planning to develop such alternatives.

The plan for San Joaquin River flooding should, in the following order, have these objectives:

1. Prevent all flooding that the Bureau's facilities are capable of preventing.
2. Maximizing retention of water for commercial use.
3. Development of resources to increase the storage for commercial use.

The prevention of flooding includes not only the management of Bureau dams, but taking those steps to protect people and property at down stream locations. This can include purchase and relocation of potential victims of flooding and improvement of water courses to handle maximum flows, while protecting adjacent people and property.

The last item, development of storage resources, is the most important challenge to be tackled. Making up for any loss of storage capacity, by having flood control as the primary objective, should be the first effort toward adding storage capacity. Even construction of flood control dams on such tributaries as White River and other streams that repeatedly flood down stream farms and communities, would support this objective, and should generate community support in these areas.

Environmental Laws that place a higher priority on maintaining the "natural" state, should not have preemptive authority over health, safety and economic value of projects that support these objectives. Efforts to change the current order of valuing "environmental" objectives above all others, should be the major effort toward moving such an agenda forward.

Thank you for the opportunity of providing input to this process.

Sincerely,

Earl Eckert

Earl Eckert

C—096354

C-096354

EARL ECKERT (NOVEMBER 2, 1998)

Comments noted. The key issue addressed in the letter is concern over flooding of the San Joaquin River and management of reservoirs to control flooding event. It requests that a flood management plan be prepared. Reclamation will consider these comments in developing the long-term operations plan for New Melones Reservoir and operations plans for other CVP reservoirs.

The proposed action flows are not sufficient to create flooding impacts, so no further analysis is needed in the EIS/EIR.

B

ENVIRONMENTAL DEFENSE FUND

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November 7, 1998

Mr. Allen Short
San Joaquin River Group Authority
c/o Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95252

Re: **Comments Of The Environmental Defense Fund On The DEIS/DEIR For Meeting Flow Objectives For The San Joaquin River Agreement, 1999-2010**

Dear Mr. Short,

While the DEIS/DEIR on "Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010" is designed to meet both federal and state obligations under NEPA and CEQA, the following comments will be addressed primarily at the responsibilities of the state participants to the SJRA. It is EDF's understanding that VAMP itself is exempt from NEPA review since it is as an element of the Department of Interior's November 20, 1997 decision implementing section 3406(b)(2) of the Central Valley Project Improvement Act. *See* Westlands Water District v. Natural Resources Defense Council, 43 F.3d 457 (9th Cir. 1994) (holding implementation of section 3406(b)(2) not subject to NEPA). However, as is evidenced by the distribution of a joint DEIS/DEIR, parts of the SJRA obviously go beyond the scope of VAMP, and therefore requires the NEPA analysis that has been provided.

1 Our primary concerns with the DEIS/DEIR do not so much concern the quality of the NEPA analysis that has been conducted, but instead the significant issues that have been left unaddressed under CEQA. To our knowledge no part of the SJRA is exempt from CEQA review. Many of the actions and obligations set forth in the SJRA go well beyond the water purchase program analyzed in the DEIS/DEIR. The state parties to the SJRA have a duty under CEQA to analyze the environmental impacts of the entire host of actions and obligations outlined in the SJRA so that they may fully assess the environmental impacts of the proposed project before making a twelve year commitment under the agreement. An analysis of the entire SJRA will also permit the state parties to properly evaluate whether more environmentally sound means may be used to achieve the goals of the SJRA, as is required under CEQA.

The Unduly Limited Scope of the DEIS/DEIR

The title of the DEIS/DEIR is, "Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010." It is clear from the title of the document, as well as the analysis that follows the title, that the document does not purport to analyze the impact of, or alternatives to, the SJRA in its entirety.

Elements of the SJRA that must be analyzed under CEQA before any state agencies or subdivisions may enter the agreement include, but are not limited to:

11-9-98

2 - **The impact of releasing 350,000 hatchery reared fish per year into the Delta.** There should be little doubt about the potentially significant environmental impacts of the release of hatchery reared

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fish. The proposed listing of the central valley fall/late fall-run chinook salmon under the ESA stated that the "NMFS is extremely concerned about threats to genetic integrity posed by hatchery and harvest programs related to fall/late fall-run chinook salmon." 63 FR 11482, 11492. The release of hatchery reared stock into the Delta, as is proposed under the SJRA, can be particularly problematic. The proposed listing noted that "[a]dditionally, stray rates are high because many hatchery fish are released off-station . . . resulting in a much larger proportion of hatchery chinook salmon present in the natural spawning population." 62 FR 11482, 11492. According to the proposed listing, spring-run populations may even be threatened by strays from the Delta releases. 62 FR 11482, 11492.

2

It appears likely that the California Department of Fish & Game will seek to increase hatchery production in the San Joaquin River watershed in order to meet the increased demands for hatchery reared smolts caused by the proposed SJRA (see letter of May 22, 1998 from Matthew Campbell, Deputy Attorney General of California, to proponents of the SJRA suggesting an increase in Department of Fish & Game hatchery production of 200,000 smolts per year or more to meet the needs of the SJRA). Because such increased hatchery production is a reasonably foreseeable result of the SJRA, and because even the use of current hatchery production to meet the needs of the SJRA will shift releases to a more damaging location in or near the Delta, the environmental impacts of the hatchery reared fish component of the SJRA must be analyzed in the DEIR.

- **The impacts of the barrier at the head of Old River.** By switching the hydraulics of the Delta, the barrier at the head of Old River has the potential to adversely impact both the delta smelt as well as salmon runs on the Sacramento river. Even if the barrier is likely to be installed absent the SJRA (either as an action under the CVPIA section 3406(b)(2) decision or as an independent California Department of Water Resources action), the fact that the SJRA includes an independent mandate for the California Department of Water Resource to install and operate the barrier (SJRA, ¶ 6.8) necessitates that the barrier either be independently analyzed in the DEIR or that the results of other environmental analyses of the barrier be incorporated into the DEIR by reference. The results of such analyses must be analyzed as a direct impact of the SJRA; the brief analysis of the barrier as a cumulative impact -- as something that would occur independent of the SJRA -- is simply insufficient when the SJRA itself calls for the barrier to be installed.

3

- **The flow levels to be provided under the federal and state backstops.** The SJRA does not state that the flows outlined in VAMP will be provided for 12 straight years. The agreement outlines many circumstances under which the flows will not be required, in which event the federal and state governments have pledged to provide the flows necessary to comply with the 1995 Water Quality Control Plan. The hearings before the State Water Resources Control Board to evaluate the SJRA have made clear that the state and federal governments cannot guarantee compliance with the 1995 WQCP; consequently, the DEIR should evaluate how often the backstop might be needed, the amount of water that is likely to be provided, and the environmental impact of any resulting shortfall from the no-action alternative. The flows and water quality conditions analyzed under the no-action alternative should be those called for in the State Water Resources Control Board's 1995 WQCP.

4

- **The use of money from the CVPIA Restoration Fund.** Because the preferred alternative is likely to use money from the CVPIA Restoration Fund to purchase water supplies (DEIS/DEIR, pg. 1-6), an analysis of alternatives to the SJRA should also consider what uses would be made of those funds. The analysis of the no action alternative, in particular, should consider the environmental benefits that are likely to result from the expenditure of Restoration Fund dollars on restoration projects other than the SJRA.

5

6 • **Alternative means for achieving the research goals.** One of the primary purposes of the SJRA is to conduct a controlled experiment on smolt survival through the Delta. To achieve the given research objectives of the SJRA, there are both alternative flow levels that may be used to conduct such an experiment, such as those called for in the 1995 WQCP, as well as alternative means for determining the flows to be provided in a given year (see, e.g. EDF Exh. 15 submitted to the SWRCB outlining a mechanism for determining flow requirements based on the 60-20-20 index). The CEQA analysis of the SJRA must consider alternative means of meeting the scientific goals of the agreement that will have reduced environmental impacts.

Given that the defined scope of the DEIS/DEIR has been unduly restricted with respect to the state parties' obligations under CEQA – resulting in a complete failure to analyze many important environmental issues surrounding the SJRA – a revised DEIR must be produced that addresses the SJRA as a whole. We look forward to reviewing, and making substantive comments upon, such a document once it is released.

Sincerely yours,

Daniel Suyeyasu
Legal Assistant

ENVIRONMENTAL DEFENSE FUND (NOVEMBER 7, 1998)

1. Water projects in California are inherently complex and may involve a myriad of actions and responsible parties. The SJRA contains three components with a number of related actions: a water purchase and performance program, an experimental salmon survival study/fish sampling program called VAMP, and an operations planning program. The component evaluated fully in the EIS/EIR is the water for instream flows, because it is the principal project contained in the SJRA . The underlying activity in the SJRA is ensuring an adequate water supply to support an experimental study and to meet Vernalis flow objectives. CEQA does not require that every activity related to a proposed project be included in a single CEQA document. The other components involve actions that either have been (or will be) addressed in other CEQA documents or are exempt from CEQA analysis.

   The VAMP is categorically exempt under "Class 6". This applies to basic data collection, research, experimental management, and resource evaluation activities that do not result in a serious or major disturbance to an environmental resource. These actions may involve information gathering only or be part of a study that leads to an action not yet approved, adopted, or funded by a public agency (Guidelines Sec 15306). VAMP monitoring is subject to a scientific collection permit from the CDFG for the sampling activity.

   The operations planning program is explained in detail in Appendix G. The SJRA establishes a technical hydrology group including Reclamation and DWR to prepare an operations plan for the coordination of flows. Based on the operations plan forecast of releases, the CVP/SWP operations plans are prepared. Section 2.1.3.2 of the EIS/EIR says that the operations plan would be evaluated for NEPA/CEQA compliance, and actions, such as export limits, not covered in this EIS/EIR or other NEPA/CEQA documentation would be evaluated at that time for potential environmental impacts. VAMP target flows and export rates are explained in Section 2.1.5, but the actual flows and rates are established based on hydrological and biological conditions that are adjusted on a real time basis during the pulse flow period. The specific details of the export rates are not necessary in order to make a decision about whether to proceed with the project flows. The combined Central Valley Project/State Water Project exports for VAMP are not within the scope of this EIS/EIR. Depending on the specifics of the annual operations plan, DWR may conduct a CEQA review and determine whether any proposed actions would be subject to a "partial exemption under regulation of water resources management projects" or not.

   The export reductions associated with VAMP are exempt from analysis under NEPA. While the reduced exports comprise one element of the overall SJRA, Interior is modifying exports pursuant to its authority under Section 3406(b)(2) -- not 3406(b)(3) -- of the Central Valley Project Improvement Act (CVPIA). The Ninth Circuit Court of Appeals has held that the

Secretary of the Interior may take actions pursuant to CVPIA Section 3406(b)(2) without preparing an environmental impact statement.

2. The VAMP experimental study relies on fish produced at the Merced River Fish Facility, owned and operated by CDFG. CDFG will review the need for hatchery fish by VAMP and other studies. If additional fish are needed, a separate CEQA document would be completed. In other words, VAMP relies on fish produced at facilities that are themselves subject to CEQA. Issues such as the potential threat to genetic integrity from hatchery and harvest programs are collateral to this EIS/EIR.

3. The SJRA's reliance on operation of the barrier at the head of Old River does not require a re-analysis of the facility or the incorporation of the existing EIR by reference into this EIS/EIR. Operation of the barrier is covered sufficiently under the cumulative impacts analysis. It is also addressed in Section 4.5.2.3 under the discussion of impacts to delta smelt and longfin smelt.

4. The flow levels to be provided under the federal and state backstops for compliance with the SWRCB 1995 WQCP are not under the scope of this EIS/EIR. The change in flows called for in the Agreement are the focus, not the fallback position of No Action or other requirements that may be implemented by the SWRCB relative to the 1995 WQCP.

5. The evaluation of alternative uses of monies that will be utilized for a particular activity is not an appropriate analysis in a NEPA (or CEQA) context. One primary reason is that if this was done there would be no end to the various activities that could take place were the monies to be directed elsewhere. This would be a highly speculative exercise, and overly speculative exercises are discouraged in NEPA and CEQA documents. The major point, however, is that the appropriate NEPA analysis is directed at the effects of the proposed action, and alternatives to that action, as they relate to the purpose and need statement. Spending Restoration Fund monies on other activities has no relationship to the purpose and need, and thus these other activities would not receive consideration in the context of the NEPA analysis. In addition, and in specific relationship to CVPIA activities, the Restoration Fund is but one source of funds for CVPIA activities, and thus the expenditure of Restoration Funds for one specific activity may or may not affect the implementation of other CVPIA activities, again a speculative exercise. See also the response to SEWD comment 10.

6. Comment noted. The design of the experimental study of smolt survival was developed with the input of multiple fisheries biologists. The study itself is adaptive and allows for variation in flows to meet changing hydrological and biological conditions. It is not required to be evaluated in this EIS/EIR and neither are other alternative experiments.

Lorens M. Foard
5225 Pleasant Valley Rd
Oakdale, CA 95361

November 03, 1998

Michael Delamore
U. S. Department of the Interior
Bureau of Reclamation
South-Central California Area Office
2666 North Grove Industrial Drive
Suite 106
Fresno, CA 93727-1551

Dear Sir:

On Thursday, October 29, 1998, I attended a meeting in Modesto at the MID building to find out some of the provisions of the VAMP agreement.

In discussing my views before the meeting with the person in charge, I was told that many government programs don't make sense.

My problem understanding the financial arrangement with VAMP Program is this:

- I will use OID as an example for I am a land owner in the OID. The district is supposed to receive $398,600 per year for 11,000 acre feet of water for the VAMP program for a period of 12 years

- In order to deliver this water from the New Melones Dam to the San Joaquin river, a large expenditure of funds will be necessary on the part of OID to build and maintain a canal from the Dam to the Tuolumne river in the MID district, because the flow of the Stanislaus River has legal restrictions on how much water can be released from New Melones.

Now I am told that if only 5000 acre feet are used for the VAMP PROGRAM, OID would be able to resell the remaining 6000 acre feet of VAMP water to another party, although this water is water that has been paid for under the VAMP AGREEMENT.

To me it does not make sense that OID could resell water that has been paid for already. This is where I got the answer "Many government programs don't make sense".

If OID sold the water that the Bureau bought for its use, whether it was for VAMP or other conservation projects, it would be selling water that it does not own. Is there a clause in your agreement with the San Joaquin River group permitting such a sale?

I can see a clause in the contract that would permit the Bureau to store unused water or get a credit for unused water for the following years, but to just give it back for nothing, <u>just does not make sense</u>.

I can see years of lawsuits and litigation with various environmental groups and other interested parties in water conservation, challenging this rather <u>loose</u> handling of Federal moneys to protect our fragile water supply for use in the future.

My question is: Can OID resell, as OID lawyers claim, any or all of the unused balance of the 11,000 acre feet of water each year that has been paid for by the VAMP PROGRAM?

I hope you can enlighten me on the matter of payment for VAMP water.

Sincerely,

Lorens M Foard

Lorens M. Foard

CC: Dianne Feinstein, Senator
Gary A Condit, Representative
Dick Monteith, State Senator
Georg R. House, State Representative

LORENS M. FOARD (NOVEMBER 3, 1998)

As stated in Section 1.3, Project Objectives, the SJRA is a "performance agreement" for the VAMP flows in that Reclamation and DWR will make annual payments to the SJRGA so long as Authority members perform under the terms of the Agreement. If not all of the 11,000 acre-feet is needed for the pulse flow in a particular year, OID could resell the VAMP water that is not needed to Reclamation. It would complete its performance requirement without actually contributing all of the water. In addition to the VAMP water, OID agrees to sell to Reclamation 15,000 acre-feet in every year of the Agreement.

State Water Contractors

455 Capitol Mall, Suite 220 • Sacramento, CA 95814-4502
Steve Macaulay, *General Manager* (916) 447-7357 • FAX 447-2734

NOV 24 1998

Directors

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Solano County Water Agency
Wallace G. Spinarski
Antelope Valley-East Kern Water Agency

November 23, 1998

Mr. Dan Fults
Friant Water Users Authority
1521 I Street
Sacramento, CA 95814

Mr. Michael Dalamore
U.S. Bureau of Reclamation
South-Central California Area Office
2666 N. Grove Industrial Dr. #106
Fresno, CA 93727-1551

RE: Draft Environmental Impact Statement/Environmental Impact Report for Meeting Flow Objectives For The San Joaquin River Agreement, 1999-2010

Dear Messrs. Fults and Dalamore:

The State Water Contractors (SWC) has reviewed the draft Environmental Impact Statement/Environmental Impact Report (EIR/EIS) for the San Joaquin River Agreement (SJRA). We appreciate the informal extension of the comment deadline to November 23, 1998.

As you are aware, the SWC participated in the negotiations leading up to the San Joaquin River Agreement and have signed the letter of support for the SJRA, as have some of our individual member agencies. Our primary concern with the draft EIR/EIS is that it is silent with respect to the water supply impact protections afforded to the State Water Project contractors and other export interests in the SJRA. The draft EIR/EIS only discloses hydrologic variations upstream of the Delta. The Vernalis Adaptive Management Program (VAMP) contains targeted Central Valley Project/State Water Project Delta export limits during the April-May pulse period as well as other actions that could pose a substantial water supply risk to the SWC and other export interests unless an appropriate operations plan is implemented. The basis for our support of the VAMP and the SJRA is the assurance that mutually-agreeable actions will be taken in every year of the VAMP, to assure the export water interests that there will be no water supply impacts

from the implementation of any aspect of the SJRA or VAMP. The following assurance language taken from Section 6.7 of the SJRA needs to be explicitly disclosed in the EIR/EIS:

> 6.7 Export Reductions Caused By the VAMP. If, on April 10, or, 5 days before the Pulse Flow Period, the operations plan for that year is unacceptable to any Party, then the export limitations contained in Paragraph 6.4 shall not apply during that calendar year.

We support proactive, consensual approaches to solving difficult Bay-Delta issues, and we believe that implementation of the VAMP under the protections afforded by the SJRA is a good example of the kind of approach necessary to move us forward in today's complicated water policy environment.

If you have any questions about our comments, please call me at (916) 447-7357.

Sincerely,

for Steve Macaulay
General Manager

Cc: Roger Patterson, U. S. Bureau of Reclamation
Mike Spear, U. S. Fish and Wildlife Service
David N. Kennedy, Department of Water Resources
Lester Snow, CALFED Bay-Delta Program
Allen Short, Modesto Irrigation District
SWC Member Agencies

STATE WATER CONTRACTORS (NOVEMBER 23, 1998)

Comment noted. Concerning the absence of discussion of impacts related to the export targets, see the response to Environmental Defense Fund comment 1. The export limits are part of the annual operations plan and are not part of the proposed action to provide instream flows. Concerning the requested language insert, see Section 2.1.5. The language was contained in the DEIS/DEIR, and it indicates that there would be no impacts to the SWP or to export interests or the limits would not apply, i.e., no change in rates.

H.2. PUBLIC HEARING TRANSCRIPTS

Transcripts of the two public hearings are attached. There were no formal public comments made at either meeting.

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BUREAU OF RECLAMATION

PUBLIC HEARING

---o0o---

3310 El Camino Avenue

Sacramento, California

October 23, 1998

---o0o---

REPORTED BY: BALINDA DUNLAP, CSR NO. 10710, RPR

SACRAMENTO, CALIFORNIA, OCTOBER 23, 1998

---o0o---

HEARING OFFICER PLOSS: We're going to officially open these hearings. I have a little script here to read, but I am not going to do that because I don't think we had anyone sign in as a speaker today to provide comments.

So I think at that, we will remind everyone that if you have comments that you haven't given us already, through the earlier review processes, the official written comments are due November 6th. And, also, there is a second hearing on October 29th at 6:30 in the evening at the Modesto Irrigation District in Modesto. So that is just a reminder to everyone.

AUDIENCE MEMBER: Has that date changed?

HEARING OFFICER PLOSS: It was changed to the 9th, November 9th. And I believe with that, we can just close the hearing for the record. We will officially close this hearing. If you want to order a copy of this transcript, call directly to our court reporter. Thank you for coming today, and some of you drove a distance to get here.

(Whereupon the proceedings were concluded.)

---o0o---

REPORTER'S CERTIFICATE

---oOo---

STATE OF CALIFORNIA)
) ss.
COUNTY OF SACRAMENTO)

I, BALINDA DUNLAP, certify that I was the official court reporter and that I reported in shorthand writing the foregoing proceedings; that I thereafter caused my shorthand writing to be reduced to typewriting, and the pages numbered 1 through 3 inclusive, constitute a full, true, and correct record of said proceedings:

IN WITNESS WHEREOF, I have subscribed this certificate at Sacramento, California, on this 3rd day of December, 1998.

B. Dunlap

BALINDA DUNLAP, CSR NO. 10710, RPR

COPY

---o0o---

BUREAU OF RECLAMATION

---o0o---

PUBLIC HEARING

MODESTO IRRIGATION DISTRICT

THURSDAY, OCTOBER 29, 1998

6:30 P.M.

---o0o---

REPORTED BY: BALINDA DUNLAP, CSR NO. 10710, RPR

MODESTO, CALIFORNIA, OCTOBER 29, 1998

---o0o---

HEARING OFFICER MICHNY: I'm going to go ahead and do what I have to do legally to start the hearing. It will only take a minute, and then we'll be done and then we can sit around and chat.

We're supposed to start at 6:30. We were just waiting to give everybody a chance that may come in late, but we are already a half an hour past our starting time.

My name is Frank Michny. I am with the Regional Environmental Office of the Bureau of Reclamation for Sacramento and serving as a hearing officer this evening, October 29, 1998, on the draft IESR on meeting the flow objectives for the San Joaquin River salmon.

I thank all of you for coming. The main purpose of this hearing is to receive comments on the draft document. Nobody here has indicated the desire to provide any comments, so I have no comments to receive.

So, for the record, I would just like to say the hearing was here, the opportunity was provided, and this hearing is hereby closed.

Written comments will be accepted until November 9th. That's the 45-day review period on the environmental document. The hearing is closed.

(Whereupon the proceedings were concluded at 7:02 p.m.)

REPORTER'S CERTIFICATE

---oOo---

STATE OF CALIFORNIA)
) ss.
COUNTY OF SACRAMENTO)

I, BALINDA DUNLAP, certify that I was the official court reporter and that I reported in shorthand writing the foregoing proceedings; that I thereafter caused my shorthand writing to be reduced to typewriting, and the pages numbered 1 through 3 inclusive, constitute a full, true, and correct record of said proceedings:

IN WITNESS WHEREOF, I have subscribed this certificate at Sacramento, California, on this 8th day of December, 1998.

BALINDA DUNLAP, CSR NO. 10710, RPR