Final Programmatic Environmental Impact Statement
Implementation of the Central Valley Project Improvement Act of 1992

Prepared by the U.S. Bureau of Reclamation
for the Department of the Interior

This Programmatic Environmental Impact Statement (PEIS) is prepared in compliance with the National Environmental Policy Act (NEPA) and the U.S. Bureau of Reclamation (Reclamation) and U.S. Fish and Wildlife Service (Service) policy and procedures for implementing NEPA.

Reclamation and the Service are evaluating the impacts of implementing Title XXXIV of the Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law 102-575), the Central Valley Project Improvement Act (CVPIA). The general purposes of the CVPIA were identified in section 3402 as follows:

(a) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;
(b) to address impacts of the Central Valley Project (CVP) on fish, wildlife, and associated habitats;
(c) to improve the operational flexibility of the CVP;
(d) to increase water-related benefits provided by the CVP to the State of California through expanded use of voluntary water transfers and improved water conservation;
(e) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and
(f) to achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agriculture, municipal and industrial and power contractors.

The PEIS evaluated various alternatives against a No Action Alternative to identify the benefits and impacts of implementing the provisions of the CVPIA. These alternatives were developed through an extensive public scoping effort and screening process. The alternatives evaluate a range of actions or programs to meet CVPIA objectives. Multiple option programs provided the variability and flexibility needed to create such a range. The PEIS analyzed a No Action Alternative, 5 Main Alternatives, including a Preferred Alternative, and 15 Supplemental Analyses. The alternatives include implementation of the following programs: Anadromous Fish Restoration Program with flow and non-flow restoration methods and fish passage improvements; Reliable Water Supply Program for refuges and wetlands identified in the 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan; Protection and restoration program for native species and associated habitats; Land Retirement Program for willing sellers of land characterized by poor drainage; and CVP Water Contract Provisions for contract renewals, water pricing, water metering/monitoring, water conservation methods, and water transfers.

The purpose of the PEIS is to evaluate the impacts of implementing the CVPIA. The PEIS addresses the CVPIA's region-wide impacts on communities, industries, economies, and natural resources and provides a basis for selecting a decision among the alternatives. Because it is a programmatic document, the PEIS presents a system-wide analysis, rather than presenting detailed analyses of specific projects and sites.

The Federal action to be taken by the Department of the Interior (Interior) is to implement provisions of the CVPIA.

For further information regarding this PEIS, please contact

U.S. Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825-1898
www.mp.usbr.gov

U.S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825-1898
www.fws.gov

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CENTRAL VALLEY PROJECT IMPROVEMENT ACT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

FINAL
Programmatic Environmental Impact Statement

October 1999

TABLE OF CONTENTS

Items **Page**

Items	Page

Items **Page**

Items **Page**

Items **Page**

Items **Page**

Items **Page**

Items **Page**

VI. Consultation and Coordination

LIST OF ATTACHMENTS

LIST OF TABLES

Items		Page

Items		Page

Items		Page

Items		Page

Items **Page**

Items		Page

LIST OF FIGURES

Items		Page

Items		**Page**

Items		Page

Items		Page

List of Figures

Items		Page

List of Figures

LIST OF TECHNICAL APPENDICES

VOLUME ONE	Development of the No-Action Alternative Summary of Pre-CVPIA Conditions Evaluation of Preliminary Alternatives Public Involvement
VOLUME TWO	Surface Water Supplies and Facilities Operations Soils and Geology Groundwater CVP Power Resources
VOLUME THREE	Fisheries
VOLUME FOUR	Vegetation and Wildlife Recreation Fish, Wildlife and Recreation Economics
VOLUME FIVE	Agricultural Economics and Land Use Water Transfer Opportunities Municipal and Industrial Land Use and Demographics Municipal Water Costs Regional Economics Social Analysis
VOLUME SIX	Visual Resources Air Quality Cultural Resources Delta as a Source of Drinking Water *(superseded by Volume 10)*
VOLUME SEVEN	PROSIM M/M *(superseded by Volume 10)* SANJASM M/M CVGSM M/M
VOLUME EIGHT	CVPM M/M CVPTM M/M Municipal Water Costs M/M IMPLAN M/M
VOLUME NINE	Fish Habitat Water Quality M/M Vegetation and Wildlife M/M Recreation M/M Fish Wildlife and Recreation Economics M/M
VOLUME TEN	Delta as a Source of Drinking Water *(Revised)* PROSIM M/M *(Revised)*

LIST OF ATTACHED DOCUMENTS

Supplement to the Draft PEIS

Response to Comments

CHAPTER I

PURPOSE AND NEED

Chapter I

PURPOSE AND NEED

This document is a programmatic environmental impact statement (PEIS) that addresses the potential impacts of alternatives developed to implement provisions of the Central Valley Project Improvement Act (CVPIA). The PEIS was prepared under the National Environmental Policy Act (NEPA) by the U.S. Bureau of Reclamation (Reclamation) and U.S. Fish and Wildlife Service (Service). The Service became a co-lead agency in August 1999.

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 CVPIA. The CVPIA, provided in Attachment A, amends the 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 achieve a reasonable balance among competing demands for use of CVP water. Section 3409 directs the Secretary to complete a PEIS to analyze the direct and indirect impacts and benefits of implementing CVPIA. The CVPIA directs the Secretary to renew existing CVP water service and repayment contracts following completion of the PEIS and other environmental documentation, as may be needed.

PURPOSE AND NEED FOR THE ACTION

The Department of the Interior (Interior) is developing programs to improve environmental conditions and modify operations, management, and physical facilities, and thus the associated environmental conditions, of the CVP to comply with the purposes and goals of the CVPIA and the revised purposes of the CVP. These programs will define operational criteria, management, and structural priorities for the CVP through the next water contracting cycle.

The Federal action to be taken by the Interior is to implement provisions of the CVPIA. The general purposes of the CVPIA, and of the action proposed by Interior, were identified by Congress in Section 3402 as follows:

(a) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;

(b) to address impacts of the CVP on fish, wildlife, and associated habitats;

(c) to improve the operational flexibility of the CVP;

(d) to increase water-related benefits provided by the CVP to the State of California through expanded use of voluntary water transfers and improved water conservation;

(e) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and

(f) to achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agriculture, municipal and industrial and power contractors.

These purposes respond to a need to modify the existing water operations and physical facilities of the CVP. Over the past 150 years, competition for freshwater has escalated between fish and wildlife resources, agricultural users, municipal and industrial users, power generators, and flood control operations within the tributary area of the Sacramento-San Joaquin Delta (Delta). In addition, during this period, habitat that supports fish and wildlife resources in the Central Valley has been reduced as agricultural, municipal, and industrial development has occurred and California's economy has grown.

Prior to development of water resources in California, anadromous fish were attracted upstream during storm events from fall through the spring. The storm flows also provided flushing flows to move fish downstream from the upper reaches of the streams where spawning occurred. The rain and snow also repelled saltwater intrusion in the Delta from San Francisco Bay.

Water resource projects throughout the Central Valley and foothills modified the flow patterns by shifting peak river flows from fall through spring months to summer months, highly impacting anadromous fish species which evolved under more natural conditions. Delta flow patterns and salinity also changed due to use of export pumps that reversed the flow in the San Joaquin River and in the Delta. In addition to changing flow patterns, the reservoirs and diversions altered the temperature of some stream reaches, blocked fish passage to some colder water stream reaches that were needed for spawning and rearing, and entrained and entrapped juvenile fish in the diversions. Diversions also caused direct loss of fish through impingement and indirect loss through enhancement of conditions for predators. A portion of the reservoirs and diversions in the Central Valley were developed by the CVP.

Fish and wildlife resources also were impacted by construction of levees along many of the rivers and the Delta. The levees eliminated many wetland and shallow water zones where spawning and rearing occurred. The levee maintenance programs also eliminated riparian vegetation that provided shade for temperature control and protection from ultraviolet radiation. Insects that lived in the vegetation and fell into the water provided food for the fish. The vegetation also provided food and habitat for many different types of wildlife.

Municipal development of California also caused reduction in fish and wildlife resources. Communities grew throughout California and the United States, which resulted in increased demands for food and water. The increased demands for food resulted in increased need for agriculture, which also required additional water. The CVP, State Water Project (SWP), local water projects, and groundwater users provided water. The communities produced wastewater discharges and increased sediment loadings. These factors also have contributed to the decline of fishery resources in California over the past 150 years.

Wildlife resources also were affected by development of California. Changing flows, storage, and diversion of water and construction of levees reduced wetlands that provided resting and nesting areas and food sources for waterfowl. Since 1850, wetlands in the Central Valley have decreased from 4 million acres to about 300,000 acres in average water years. These wetlands are used year round by many species including wintering habitat for over 12,000,000 migrating birds in the Pacific Flyway. The wetlands and associated habitat are also important to many threatened and endangered species. Loss of wetlands seriously impacted these species.

Many riparian and upland woodlands were destroyed as communities converted land for agricultural and municipal purposes, and used the trees for lumber and fuel. Many threatened and endangered species' habitat had been provided by the woodlands.

Impacts to fishery and wildlife resources in California have been ongoing for over 150 years. A portion of the reduction in resources has occurred due to the construction and operation of the CVP. However, a portion of the reduction in habitat also has occurred due to the construction and operation of other water resource systems such as the SWP, water rights holders projects, and levee systems. The implementation of these water resource projects allowed expansion of irrigated agriculture and municipalities. Because of the vast array of actions over the last century, it is impossible to determine the specific causes and effects of the declining resources with respect to any one factor, such as the CVP. Through the CVPIA, Interior is developing policies and programs to improve environmental conditions that were affected by operations, management, and physical facilities of the CVP. The CVPIA also includes tools to facilitate larger efforts in California to improve environmental conditions in the Central Valley and the San Francisco Bay-Delta system.

CVPIA PROVISIONS COVERED IN THE PEIS

The PEIS alternatives were developed to implement at the programmatic level provisions of the CVPIA, including:

- CVP water contract renewals
- Water transfers
- Tiered water pricing
- CVP operational changes
- Fish and wildlife water dedication and management
- Fish and wildlife water acquisition
- Fish and wildlife habitat improvements
- Refuge water supplies
- Land retirement
- Some facility modifications

Provisions of CVPIA included in the Preferred Alternative are further detailed in Chapter II. As explained below in "Preparation of the Programmatic Environmental Impact Statement," programmatic analysis is focused on the "system-wide" impacts of implementing a program, and does not necessarily present site-specific analysis or provide for final, on-the-ground action.

The PEIS alternatives do not include implementation of increased instream fish flow releases in Trinity River. That program is being analyzed in a separate and concurrent EIR/EIS. This PEIS includes assumptions about Trinity River flows solely for the purpose of programmatic analysis of the PEIS.

OTHER CVPIA PROVISIONS NOT COVERED IN THE PEIS

The following other CVPIA provisions were not covered in the PEIS because the actions were not appropriate for programmatic analysis; the actions involved the preparation of studies where the outcome was speculative; or there is insufficient information at this time to proceed with analysis. Additional NEPA analyses may be required to implement these CVPIA provisions.

- New Contracts—Section 3404(a): Further NEPA analysis would consider CVP-wide water supply impacts information from the Needs Analysis and examine the impacts resulting from land use changes on lands not currently served by CVP water or in the CVP service area.

- Restoration of Striped Bass Fishery—Section 3406(b)(18): Actions taken to restore the striped bass fishery, including improvements to streambeds and channels and the development of a flow improvement program, would require additional NEPA documentation to evaluate possible impacts on surface water and groundwater supplies, water quality, fish and wildlife, vegetation, soils, and cultural resources. It may also be necessary to examine potential impacts on the interaction between the CVP and SWP operations.

- Use of CVP carryover storage for AFRP—Section 3406(b)(19): Future NEPA analyses would examine the use of carryover storage at Shasta and Trinity reservoirs to improve flows for anadromous fish. The impacts of this action would be considered only if reoperation differs significantly from what was examined in the PEIS alternatives, specifically differences in water supplies and stream flows as compared to the "bookends" evaluated in the PEIS.

- San Joaquin and Stanislaus Rivers Studies—Section 3406(c)(1 and 2): These are studies and depending on the findings and recommendations with regards to actions which may be taken to improve streamflow, channel, riparian habitat, and water quality, future NEPA analyses may be required.

- Construct conveyance facilities for refuges—Section 3406(d)(5): This action involves construction of conveyance facilities for levels 2 and 4 water supplies.

Separate NEPA documentation is currently being prepared to evaluate impacts on fisheries, vegetation, wildlife, water supply, land use and the local economy.

- ♦ Investigate means to improve water supplies to privately-owned wetlands—Section 3406(d)(6): This refers to investigations and depending on the outcome, further NEPA studies may be required to evaluate the recommended actions in the reports.

- ♦ Supporting Investigations—Section 3406(e): This action addresses a number of studies to be initiated to address various methods for improving anadromous fish survival. Depending on the findings, additional NEPA analyses may be required.

- ♦ Use of electrical energy for fish and wildlife purposes, such as energy for pumping on refuges—Section 3408(b): Future NEPA analyses would evaluate impacts to available energy for sale to preference power customers and the need to acquire additional energy for CVP operations and preference power customers.

- ♦ Contracts for additional storage and delivery water and use of project facilities for water banking—Section 3408(c-d): These provisions address the delivery of CVP water and non-project water for beneficial purposes, including fish and wildlife and use of CVP facilities for water banking. Future NEPA analyses would evaluate impacts on such things as water supplies and CVP and SWP water users; and changes to CVP power generation, reservoir recreation, fisheries, water quality, and economics.

- ♦ Project yield increase—Section 3408(j): This provision requires the development of a plan to increase the yield of the CVP to replace the amount dedicated to fish and wildlife purposes under the Act. The plan is to address various options stipulated in the Act. NEPA analyses would be conducted on recommended actions coming out of the plan.

- ♦ Extension of the Tehama-Colusa Canal—Section 3412. This provision addresses the extension of the Tehama-Colusa Canal and the change in the service area to be served by the canal. Future NEPA analysis would address the site-specific impacts of construction of the canal extension and impacts of water use.

CENTRAL VALLEY PROJECT AND STATE WATER PROJECT FACILITIES IN THE CENTRAL VALLEY

Major water resource facilities in the Central Valley are shown in Figure I-1. The CVP facilities include reservoirs on the Trinity, Sacramento, American, Stanislaus, and San Joaquin rivers. Water from the Trinity River is stored and re-regulated in Clair Engle Lake, Lewiston Lake, and Whiskeytown Reservoir, and diverted through a system of tunnels and powerplants into the Sacramento River for use by the CVP in the Central Valley.

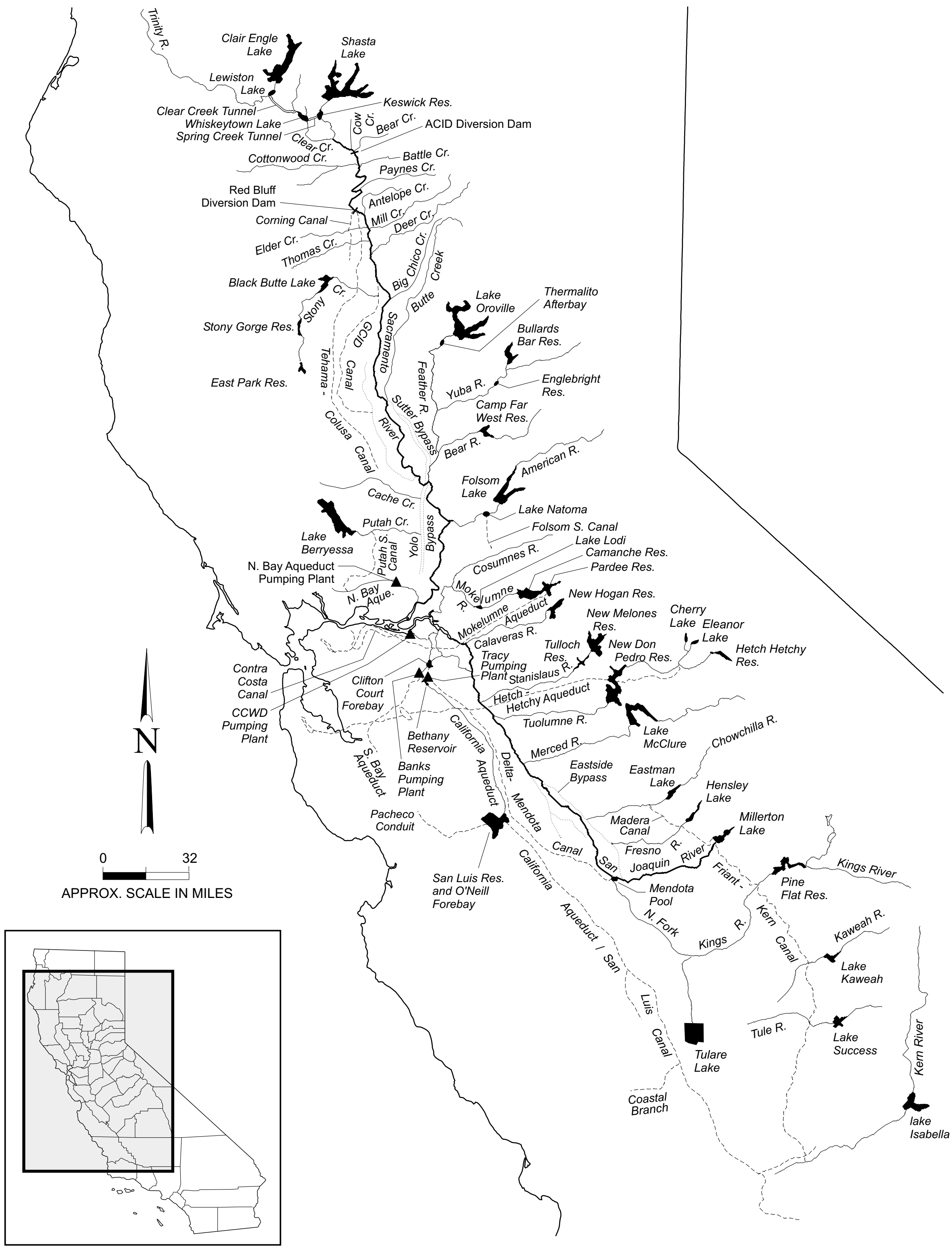


FIGURE I-1

MAJOR WATER FACILITIES IN THE CENTRAL VALLEY

Water also is stored and re-regulated in Shasta Lake and Folsom Lake for use by the CVP. Waters from all of these reservoirs, and other reservoirs owned and/or operated by the SWP and local water rights holders, flow into the Sacramento River. Some of the CVP contractors divert water directly from or immediately below the dam outlet works. Other CVP contractors, Sacramento River Water Rights contractors, and water rights holders divert water directly from the Sacramento and American rivers.

Water is conveyed in the Sacramento River to the Delta. The CVP water is exported at the Tracy Pumping Plant in the southern end of the Delta. The Tracy Pumping Plant lifts the water into the Delta Mendota Canal, which delivers water to CVP contractors and exchange contractors on the San Joaquin River and water rights contractors on the Mendota Pool. The CVP water also can be conveyed to the San Luis Reservoir for deliveries to CVP contractors that divert from the San Luis Canal. Water from San Luis Reservoir also can be conveyed through the Pacheco Tunnel to CVP contractors in Santa Clara and San Benito counties.

The CVP also delivers water from the Friant Dam on the San Joaquin River to CVP contractors located near the Madera and Friant-Kern canals. Water from New Melones Reservoir is used by water rights holders in the Stanislaus River watershed and CVP contractors located in the northern San Joaquin Valley.

The SWP water is stored and re-regulated in Lake Oroville. The SWP contractors and SWP water rights settlement contractors divert water from the Feather River. The SWP water flows in the Sacramento River to the Delta. The SWP water is exported from the Delta at the Banks Pumping Plant. The Banks Pumping Plant lifts the water into the California Aqueduct, which delivers water to SWP contractors. The SWP water also can be conveyed to the San Luis Reservoir for deliveries to SWP contractors that divert from the California Aqueduct. These contractors are located in the southern San Joaquin Valley, Central Coastal area, and Southern California. The SWP also delivers water to the Cross-Valley Canal, when capacity is available in the conveyance systems, for CVP water service contractors.

Because both the CVP and the SWP convey water in the Sacramento River and the Delta, operations of the facilities are coordinated based on the Coordinated Operating Agreement (COA), the Bay-Delta Plan, and other agreements.

In recent years, operations of the CVP and SWP have become more constrained. The CVP and SWP are allowed to export water from the Delta when the upstream water demands are met and the Delta is in a balanced or excess condition with respect to flow and water quality under water rights orders from the State Water Resources Control Board (SWRCB). With the increasing upstream water demands due to municipal growth and recent instream fish flow release requirements, the capability of the CVP and SWP to export water from the Delta has been reduced. The reductions in CVP and SWP deliveries north and south of the Delta due to increased municipal demands and environmental requirements are discussed in more detail in the Pre-CVPIA Conditions Technical Appendix of the PEIS.

AUTHORITIES AND INSTITUTIONAL CONSTRAINTS

Federal statutes establish a number of responsibilities for the Secretary. These legislative authorities relate to management of numerous agencies and projects that affect water resource facilities in California. Many responsibilities are specifically mandated. Discretionary authority is provided for other responsibilities. The authorities for the CVP and other actions that affect implementation of CVPIA are presented in Table I-1.

TABLE I-1
INVENTORY OF MAJOR FEDERAL AUTHORITIES AND STATE WATER RESOURCES CONTROL BOARD DECISIONS THAT AFFECT THE CENTRAL VALLEY PROJECT

Law or Agreement	Year	Action on CVP
Reclamation Act	1902	Formed legal basis for subsequent authorization of the CVP.
Central Valley Project Authorization	1937	Authorized construction of the initial project features for navigation, flood-control, waste storage, construction of distribution systems, and hydropower generation.
Reclamation Project Act	1939	Provided for repayment of construction charges and authorized sale of CVP water to municipalities and other public corporations and agencies, plant investment, and certain irrigation water deliveries to leased lands. Required the Secretary to comply with laws of the State relating to the control, appropriation, use, or distribution of water used in irrigation or vested rights acquired thereunder.
Rivers and Harbors Act	1940	Authorized of CVP for construction and mandated that dams and reservoirs be used first for river regulation, improvement of navigation, and flood control; second for irrigation and domestic users; and third for power.
Water Service Contracts	1944	Provided for delivery of specific quantities of irrigation and municipal and industrial water to contractors.
American River Division Authorization Act	1949	Provided for Folsom Dam and Sly Park Dam and associated facilities.
Grasslands Development Act	1954	Provided for wells and drainage recovery facilities. Added authority for use of CVP water for fish and wildlife purposes. Also authorized development of facilities in cooperation with the State for furnishing water to the Grasslands area for waterfowl conservation.
SWRCB Decision 893	1958	Established minimum fish flows on lower American River.
Trinity River Act	1955	Provided for operation of the Trinity River Division to be integrated and coordinated with other CVP features. Included provisions for the preservation and propagation of fish and wildlife.
Reclamation Project Act	1956	Provided a right of renewal of long-term contracts for agricultural contractors for a term not to exceed 40 years.
Fish and Wildlife Coordination Act	1958	Provided for integration of Fish and Wildlife Conservation programs with Federal water resources developments; authorized the Secretary to include facilities to mitigate CVP-induced damages to fish and wildlife resources. Required consultation with the Service.
San Luis Unit Authorization Act	1960	Provided for San Luis Dam and associated facilities.

TABLE I-1. CONTINUED

Law or Agreement	Year	Action on CVP
Rivers and Harbors Act	1962	Provided for New Melones, Hidden, and Buchannan Dams.
Reclamation Project Act	1963	Provided a right of renewal of long-term contracts for municipal and industrial contractors.
Water Rights Contracts	1964	Provided diverters holding riparian and appropriative rights on the Sacramento and American Rivers with CVP water to supplement water which historically would have been diverted from natural flows.
Auburn-Folsom South Unit Authorization Act	1965	Provided for Auburn Dam and associated facilities including Folsom-South Canal.
San Felipe Division Authorization Act	1967	Provided for Pacheco Tunnel and associated facilities.
National Environmental Policy Act	1969	Established policy, set goals, and provided means for ensuring scientific analysis, expert agency participation, and public scrutiny and input are incorporated into the decision making process regarding the actions of the Federal agencies.
Council on Environmental Quality Regulations	1970	Provided directives for compliance with NEPA.
State Water Resources Control Board (SWRCB) Decision 1379	1971	Established Delta water quality standards to be met by both the CVP and the State Water Resources Project (SWP).
Clean Water Act	1972 Amended 1987	Provided protection for all surface waters to achieve “fishable and swimmable” goals.
SWRCB Decision 1422	1972	Required CVP to meet water rights and water quality protection of the Stanislaus and San Joaquin rivers.
SWRCB Decision 1400	1972	Established minimum fish flows on the lower American River to be met subsequent to construction of Auburn Dam.
Endangered Species Act	1973	Provided protection for animal and plant species that are currently in danger of extinction (endangered) and those that may become so in the foreseeable future (threatened).
SWRCB Decision 1485	1978	Required CVP and SWP to provide water quality protection in the Delta.
Trinity River Stream Rectification	1980	Provide for participation in stream rectification.
Energy and Water Development Appropriation Act	1980	Provided for energy and water development at New Melones Reservoir and archaeological recovery at the reservoir site.
Suisun Marsh Preservation and Restoration Act	1980	Established a cooperative agreement with State of California to improve and manage Suisun Marsh.
Secretarial Decision on Trinity River Release	1981	Allocated CVP yield so that releases can be maintained at 340,000 acre-feet in normal water years, 220,000 acre-feet in dry years, and 140,000 acre-feet in critically dry years.
	Amended 1991	Release 340,000 acre-feet annually for all water year types.
Reclamation Reform Act	1982	Provided for full-cost pricing, including interest on the unpaid pumping plant investment, for certain irrigation water deliveries to leased lands.

TABLE I-1. CONTINUED

Law or Agreement	Year	Action on CVP
Coordinated Operating Agreement (COA)	1986	Agreement between the U.S. Government and the State of California. Determined the respective water supplies and methods to share conveyance facilities of the CVP and the SWP while allowing for a negotiated sharing of Delta excess outflows and the satisfaction of in-basin obligations between the two projects.
Public Law 99-546	1986	Interior and Reclamation directed to include total costs of water and distributing and servicing it in CVP contracts (both capital and operation and maintenance costs).
SWRCB Orders WR 90-05 and WR 91-01	1990 1991	Water Rights Orders that modified Reclamation water rights to incorporate temperature control objectives in Upper Sacramento River.
National Marine Fisheries Service Biological Opinion	1992 1993 1995	Established criteria for operations to protect winter-run chinook salmon.
Public Law 102-575, Title 34	1992	Mandates changes in management of the CVP, particularly for the protection, restoration, and enhancement of fish and wildlife.
Draft Water Rights Decision 1630	1992	SWRCB circulated a draft water rights order to modify Decision 1485 to protect Bay-Delta water quality.
U.S. Fish and Wildlife Service Biological Opinion	1993 1994 1995	Established operational criteria to protect delta smelt.
Bay-Delta Plan Accord and SWRCB Order WR 95-06	1994 1995	Agreement and associated SWRCB order to provide for operations of the CVP and SWP to protect Bay-Delta water quality. Also provided for further evaluation and development of a new Bay-Delta operating agreement, which is being pursued under the CALFED process.

The constraints of the CVPIA also were recognized as the alternatives were developed in the PEIS. The CVPIA was considered very specifically with respect to the Purpose and Need for the Action to define the reasonable range of alternatives. Actions that extend outside of the CVPIA Purpose and Need and other portions of the law will need to be evaluated under separate environmental documentation.

PREPARATION OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

PURPOSE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This document has been prepared in compliance with section 102(2)(c) of NEPA of 1969 as amended (Public Law 91-190), Council on Environmental Quality Regulations dated November 1978, and the current guidelines of Interior for implementation of NEPA.

A PEIS is designed to analyze the effects of a program or series of actions that are part of a larger project. Accordingly, the analysis in a PEIS is focused on the "system-wide" impacts of a program or series of actions and frequently will require additional NEPA analysis prior to implementation of site-specific actions. A PEIS must address the probable environmental impacts and benefits that can be identified without undue speculation.

As directed by Section 3409 of CVPIA, this PEIS analyzes the direct and indirect impacts and benefits of implementing the provisions of CVPIA. The analysis in the PEIS is intended to disclose the probable region-wide effects of implementing the CVPIA and provide a basis for selecting a decision among the alternatives. Because implementation of CVPIA is required by statute, selection of the No-Action Alternative would require legislative change. There is a limited role for decision-making based on this PEIS, as discussed below. Therefore, the emphasis in this PEIS is more on informing the public of the environmental impacts of CVPIA than on providing a basis for selecting among alternatives.

The coverage of most of the CVPIA provisions in the PEIS is programmatic in nature. For many provisions, additional environmental documentation will be necessary to determine site-specific impacts. The PEIS is designed to allow subsequent environmental documents to incorporate PEIS analysis by reference and to limit the need to re-evaluate the region-wide and cumulative impacts of CVPIA. Where qualitative but not quantitative data is utilized as the basis of analysis, the PEIS describes what further actions may be taken to improve environmental assessments at the site-specific level, including monitoring and development of an adaptive management program. In many cases in the PEIS analysis, worst-case assumptions were used, which will maximize the utility of the analysis for tiering by subsequent NEPA analysis. By using worst-case assumptions, the PEIS increases the likelihood that subsequent implementation of CVPIA will have effects that are within the scope of the impacts analyzed in the PEIS.

This PEIS is not intended to disclose site-specific impacts of implementing the CVPIA. Because of the necessary level of generality of assumptions used to perform a programmatic, region-wide analysis, many of the conclusions of the PEIS analysis cannot be directly applied to specific sites within the region or to a specific action. While some of the analyses in this PEIS are based on a specific scenario resulting from specific assumptions, alternative scenarios are possible or likely. Other analyses in this PEIS present averages over the entire region and study period which cannot necessarily be broken down to provide reliable conclusions for specific sites or actions. Consistent with the programmatic nature of this document, analyses that are more specific and definite may not be possible or appropriate and therefore are not intended at the programmatic, region-wide level, but may be presented in subsequent, site-specific environmental documentation.

As the project-specific actions are considered, the lead agencies must determine if the specific impacts were adequately analyzed in the PEIS. If the actions under consideration were previously evaluated and the impacts of such actions would not be greater than those analyzed in the PEIS or would not require additional mitigation measures, the actions could be considered part of the overall program previously approved in a Record of Decision. In such a case, an administrative decision could be made that no further environmental documentation would be necessary. If the lead agency cannot determine the level of significant impacts associated with a site-specific action, an Environmental Assessment (EA) could be prepared to determine if the action would require additional evaluation.

If a tiered document is appropriate, the tiered document may be an EIS or an EA. The tiered documents can use the PEIS by reference to avoid duplication and focus more narrowly on the new site-specific effects and decision-making issues. Tiered documents would also need to revisit factors that are changed. For example, the analysis of systemwide impacts related to water management could be incorporated by reference on tiered activities to avoid a rediscussion of these issues. Therefore, if specific actions are discussed in the tiered documents, only changes from the alternatives considered in the PEIS would be addressed in detail.

There have been interim implementation programs for some actions addressed in the CVPIA. The interim implementation programs have been developed through a process which has involved public review and changes in response to the public review. Review of implementation actions under the interim programs has been used in the development of the impact assessment portion of the PEIS. The interim process has addressed implementation programs for the following issues:

- Section 3404(c) Interim Contract Renewals
- Section 3405(a) Interim Water Transfers under CVPIA
- Section 3405(b) Water Measurement
- Section 3405(e) Water Conservation
- Section 3406(b)(1) Development of the Anadromous Fish Restoration Program
- Section 3406(b)(1)(B) Reoperation of the CVP without Affecting Deliveries
- Section 3406(b)(2) Water Management ("Dedication of 800,000 acre-feet")
- Section 3406(b)(3) Water Acquisition
- Section 3406(b)(6) Funding for Shasta Temperature Control Device
- Section 3406(b)(11) Modification to Coleman National Fish Hatchery
- Section 3406(b)(12) Clear Creek Restoration
- Section 3406(b)(20) Modification to Glenn-Colusa Irrigation District Diversion Facility
- Section 3406(b)(21) Avoidance of juvenile anadromous fish loss at diversions including construction of screens, bypasses, fish ladders, and modification of diversions
- Section 3406(d)(1-4) Provide Firm Level 2 and Acquire Level 4 Refuge Water Supply Studies
- Section 3408(h) Land Retirement

The PEIS alternatives include many separate actions that could be combined into hundreds of permutations. For the PEIS, these actions were combined into alternatives to provide the decision maker with information of how different factors would be affected by changes in fish and wildlife habitat actions, water facilities operations, and water pricing and contract provisions. In many cases in the PEIS analysis, worst-case assumptions were used, which will maximize the utility of the analysis for tiering by subsequent NEPA analysis. By using worst-case assumptions, the PEIS increases the likelihood that subsequent implementation of CVPIA will have effects that are within the scope of the impacts analyzed in the PEIS. Another reason that the PEIS alternatives were developed as bookends is because many of the programs addressed in CVPIA require partners. If the partners do not willingly participate, the action would not be implemented.

HOW THE PEIS WILL BE USED FOR DECISION-MAKING

This section describes briefly the analysis and decision-making process for the major provisions of CVPIA. The PEIS is intended to provide the basis for a decision on whether to implement most of the provisions discussed below. However, the decision-maker may determine that additional analysis is needed to reach a decision on how to implement any or all of these provisions. This section is not a complete list of CVPIA provisions or of the provisions analyzed in the PEIS, but highlights how the major provisions of CVPIA will be considered in the analysis and decision-making process.

Water Contract Renewals 3404(c)

A ROD based on this PEIS would likely include a decision about whether to implement at the programmatic level the renewal of long-term CVP water contracts. A decision to execute such contracts would require tiered, site-specific NEPA analyses for long-term contract renewals. These tiered NEPA documents would provide a more geographically-specific analysis of the effects of implementation of several CVPIA provisions, including:

- Contract renewals
- Measurement of water use
- Determination of contract amount for tiered water pricing
- Reporting procedures for water conservation
- Friant Division surcharge
- Collection of restoration fund

Water Transfers 3405(a)

A ROD based on this PEIS would likely include a decision about whether to proceed at the programmatic level with water transfers that include additional fees to transfer agricultural CVP water to non-CVP municipal users. In addition, specific water transfers would require tiered, site-specific NEPA documentation.

Tiered Water Pricing 3405(d)

The PEIS considers several tiered water pricing schemes. A ROD based on this PEIS would likely include a decision about whether to implement at the programmatic level one of the tiered water pricing schemes considered in the PEIS. However, the PEIS does not analyze alternative definitions of the contract amount to which a tiered pricing scheme would be applied. Because of potential differences among CVP divisions in defining the contract amount, a single, programmatic approach may have to be supplemented by division-specific analysis. Regardless, the total effect of using different definitions of contract amount can reasonably be expected to fall within the range of effects analyzed in the PEIS. Therefore, the determination of which contract amount to be used in a tiered water pricing scheme would not be implemented at the programmatic level, but would be addressed in contract renewal negotiations and analyzed as appropriate in site-specific contract renewal NEPA documentation.

CVP Operations 3406(b)(1)(B)

Some provisions of CVPIA related to CVP operations are fully analyzed in the PEIS, and further NEPA analysis may be unnecessary if operations are within the historic operational range of CVP. These provisions include:

- ♦ Reoperation of the CVP 3406(b)(1)(B);
- ♦ Pulse flow releases 3406(b)(8);
- ♦ Minimize flow fluctuations 3406(b)(9).

A ROD based on this PEIS would likely include a decision about whether to implement at the programmatic level these CVP operational provisions.

Fish and Wildlife Water Dedication 3406(b)(2)

The CVPIA directs that, upon its enactment, the Secretary of the Interior dedicate and manage annually 800,000 acre-feet of CVP yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by the Act. A ROD based on this PEIS would not include a decision about whether to implement (b)(2) water dedication and management because the nature of the (b)(2) mandate does not require compliance with NEPA before implementation, as confirmed by the Ninth Circuit Court of Appeals. Westlands Water District v. Natural Resources Defense Council, 43 F.3d 457 (9th Cir. 1994). However, impacts of implementing the (b)(2) mandate are analyzed at a programmatic level and are disclosed in the PEIS.

In November 1997, Interior adopted an Administrative Proposal for accounting and managing water dedicated under (b)(2). As a result of litigation, the accounting method used to analyze the impact of implementing the November 20, 1997 Administrative Proposal has been replaced by a final decision on implementation of (b)(2), which was released on October 5, 1999. In addition to describing the final accounting method, the October 1999 decision sets out a policy for use of the water that differs in some respects from the November 20, 1997 proposal. While the November 1997 proposal described with particularity the fish measures to be implemented, the October 1999 decision sets forth a range of actions and acknowledges the discretion granted by the statute to the FWS to manage the (b)(2) water annually. This feature of the October 1999 decision makes it extremely difficult to construct a typical scenario for (b)(2) dedication and management that spans the study period of the PEIS. The October 1999 decision also establishes a comprehensive process for the Department of the Interior to coordinate (b)(2) water management with the CALFED Bay-Delta Program and to engage stakeholders. This coordination is important for wise resource management, yet adds additional uncertainty to the planning level evaluation of (b)(2) dedication and management.

The PEIS (b)(2) analysis is purposely limited to a planning level evaluation, because of the many uncertainties associated with the prioritization, allocation, and accounting of (b)(2) water, as well as variables such as hydrological conditions. Given the uncertainties and variability of (b)(2) water dedication and management, it would be impractical for the PEIS to model the effects of (b)(2) under all plausible scenarios over 30 years. Furthermore, it is likely that amounts of (b)(2) water dedication and management in a specific river reach would vary from year-to-year, making quantitative, programmatic analysis of limited utility.

Therefore, to reflect the impact of (b)(2) most usefully and in a manner that is not misleading, given the range of uncertainties in (b)(2) water management, the PEIS displays the impact of using 800,000 acre feet of project yield under section 3406(b)(2) of the Act in a combination of quantitative and qualitative analyses. As a first step, the PEIS (b)(2) analysis consists of development of preliminary prescriptions designed to attempt to meet the AFRP target flows on CVP-controlled streams and in the Delta. By modeling those preliminary prescriptions supplied by the FWS, the PEIS displays data based on assumptions and scenarios that are fairly likely to occur and hence reflect a fairly reliable set of results at a programmatic level. To that first set of data, the PEIS then adds a qualitative analysis of the general effects of a variety of plausible scenarios of (b)(2) water dedication and management above the preliminary AFRP targets.

As noted above, the October 1999 (b)(2) policy permits the FWS discretion in deciding, based on year to year hydrological conditions and changing biological needs, where, how, and when to use the (b)(2) water. Thus, no year can be viewed as a typical year, representative of any other year. Given the programmatic nature of this PEIS and the speculative nature of attempting to model future (b)(2) measures beyond those set out in the AFRP and November 20, 1997 paper, the PEIS presents qualitative analysis of (b)(2) based on the October 1999 decision. Furthermore, the change in accounting method does not alter the comparative relationship of the effects of the programmatic alternatives.

Fish and Wildlife Water Acquisition 3406(b)(3)

A ROD based on this PEIS would likely include a decision about whether to implement at the programmatic level the acquisition of water for fish and wildlife management needs. Based on the analysis of the PEIS action alternatives, such a decision might include approximate water acquisition targets and might consider a programmatic limit on exports of acquired water. In addition, specific water acquisition actions would be analyzed in site-specific NEPA documentation as appropriate.

Trinity River 3406(b)(23)

This PEIS alone will not provide the basis for a decision to implement the increased instream fish flow releases in Trinity River. That program is being analyzed in the Trinity River Mainstem Fishery Restoration EIS/EIR, a separate and concurrent NEPA document. The analysis of increasing instream flows in the Trinity River is summarized in the PEIS and considered in the analysis of environmental consequences and the cumulative effects analysis (see pp. I-12, II-20, IV-11, and V-8).

If implemented, the increased flows in Trinity River would be a related action that would have a cumulative effect together with the Federal action proposed in this PEIS. Therefore, this PEIS makes assumptions about increased flows in Trinity River solely for the purposes of programmatic analysis. These assumed increased flows are analyzed in this PEIS only to the extent that they would have a cumulative effect with the provisions actually proposed in this action. However, the assumed increased flows in Trinity River are closely related to the action proposed here and would have wide-ranging interactive effects with the action proposed here. Accordingly, the environmental analysis in the PEIS considers increased flows in Trinity River in the analysis of direct effects, indirect effects, and cumulative effects. Indeed, it would not be possible to provide a meaningful and complete analysis of the direct and indirect effects of the action proposed here without incorporating the cumulative effect of increased flows in Trinity River. Effects in the Trinity River Basin are addressed in the Trinity River Mainstem Fishery Restoration EIS/EIR, a separate and concurrent NEPA document.

Refuge Water Supplies 3406(d)(1-2)

A ROD based on this PEIS would not include a decision about whether to provide CVP water supplies to refuges as described in 3406(d)(1), because the nature of the 3406(d)(1) mandate does not require compliance with NEPA before implementation, as confirmed by the Ninth Circuit Court of Appeals. Westlands Water District v. Natural Resources Defense Council, 43 F.3d 457 (9^{th} Cir. 1994). However, a ROD based on this PEIS would likely include a decision about how to describe hydrologic shortages to which refuge water supplies would be subject.

A ROD based on this PEIS would likely include a decision about whether to proceed at the programmatic level with water acquisition to provide increased refuge water supplies, as described in 3406(d)(2). NEPA analysis has begun on use and management of refuge water supplies; that NEPA documentation will be tiered to the PEIS. Separate NEPA documentation has already been completed on conveyance of refuge water; that NEPA documentation is not tiered to the PEIS. In addition, specific water acquisition actions would require tiered, site-specific NEPA documentation.

Land Retirement 3408(h)

The PEIS considers a land retirement program of selective purchase from willing sellers of up to 30,000 acres of lands characterized by drainage problems, in addition to the 45,000 acres assumed to be retired in the No-Action Alternative. A ROD based on this PEIS would likely include a decision about whether to implement at the programmatic level a land retirement program of selective purchase. Tiered, site-specific NEPA documentation would be needed for specific land purchases. A separate and concurrent NEPA analysis is currently in preparation for a limited demonstration land retirement program in the Central Valley.

Facility Modifications

Several provisions of the CVPIA address modifications to operations and structures at specific CVP facilities, including:

- ♦ Upgrade Tracy and Contra Costa pumping plant fish protection facilities
- ♦ Construct Shasta Temperature Control Device
- ♦ Red Bluff Diversion Dam Actions
- ♦ Complete improvements to Coleman National Fish Hatchery
- ♦ Delta Fish Barrier Actions
- ♦ Modifications to Anderson-Cottonwood Irrigation District and Glenn-Colusa Irrigation District diversion facilities

The PEIS did not define specific actions related to these facilities, but analyzed the general effects of facility modifications. A ROD based on this PEIS would likely include a decision about whether to proceed at the programmatic level with these facility modifications. Separate NEPA documentation has already been completed for the Shasta Temperature Control Device, and separate NEPA documentation is being prepared for improvements to the Coleman National Fish Hatchery. Prior to implementation, other facility modifications would require site-specific environmental documentation.

STUDY AREA

The Study Area for the PEIS is presented in Figure I-2. The criteria for defining the Study Area were developed through a public scoping process and included three criteria. The first criterion was to include areas with CVP facilities, CVP water users, or water rights holders affected by CVP operations. This criterion resulted in the incorporation of many counties in California. The CVP facilities and users are located throughout the Central Valley, and in Trinity, Contra Costa, Alameda, Santa Clara, and San Benito counties.

The second criterion was to include areas that could be directly impacted by changes in CVP operations or actions implemented under the CVPIA, including the Anadromous Fish Restoration Program (AFRP). This criterion resulted in incorporation of watersheds in the Sacramento and San Joaquin basins and coastal communities affected by commercial fishing of anadromous fish. The eastern boundary of the Study Area was limited to the areas within the watersheds that could be affected by provisions of the CVPIA, which was defined as extending from the valley floor to the western boundaries of national forests in the Sierra Nevada Mountains. Lake County was excluded from the Study Area because the area is hydrologically isolated except in extremely wet years when flood waters flow from Clear Lake into the Central Valley. Due to the hydrologic isolation of this basin in all but extremely wet years, this basin was not included in this CVPIA analysis.

The third criterion was to include areas that could be directly impacted by water transfer programs which involve CVP water users or CVP facilities, as allowed by the CVPIA. This criterion resulted in the inclusion of counties in the San Francisco Bay Region, Central Coast Region, and South Coast Region where potential users of transferred water are located. It was

FIGURE I-2
STUDY AREA

assumed for the purposes of this PEIS that no new facilities would be constructed under the actions considered. Therefore, the potential for water transfers was limited by the physical capacity and operation rules. However, these areas were not addressed in the PEIS because adequate information was not available to define the actions or related impacts.

Not all of the technical evaluations include analyses in the full Study Area. For example, analysis of factors related to increased instream fish flow releases in the Trinity River were only summarized in the PEIS. A separate technical and environmental document is being prepared that evaluates impacts and benefits within the Trinity River watershed of such actions.

STUDY PERIOD

The analysis for the PEIS was conducted for projected conditions in the Year 2025. The PEIS evaluation is a comparison of projected conditions at the end of the 30-year study period both without and with the implementation of CVPIA. The 30-year study period was based upon the period assumed necessary for completion of the implementation of CVPIA including the first period of renewal for the 25-year long-term water service contracts. This meets one of the primary purposes of the PEIS which is to evaluate the system-wide impacts of renewing these contracts under CVPIA. No interim time period conditions were considered or evaluated with respect to build-out conditions with or without implementation of CVPIA.

It should be noted that due to the time required to complete the Final PEIS, the study period has been extended from the year 2022 (described in the Draft PEIS) to the year 2025. The input data used for the PEIS analytical tools were reviewed during preparation of the PEIS. It was determined that the data were adequate for the analysis at the year 2025 as well as for the year 2022.

PARTICIPANTS IN THE PREPARATION OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Reclamation and the Service will jointly implement the CVPIA. The Secretary designated Reclamation as the lead agency in preparing the PEIS. The Service became a co-lead in August 1999. Cooperating agencies were involved in substantial research, data collection, participation in development and evaluation of alternatives, and preparation of the PEIS. The following Cooperating Agencies participated in the process:

- California Department of Fish and Game
- California Department of Water Resources
- California State Water Resources Control Board
- Hoopa Valley Tribe
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- National Marine Fisheries Service
- Western Area Power Administration

Consulting Agencies were involved in the development of analytical tools and background information. The following Consulting Agencies participated in the process:

- ♦ U.S. Geological Survey
- ♦ Natural Resource Conservation Service
- ♦ Bureau of Indian Affairs

PUBLIC INVOLVEMENT PROCESS

Reclamation started the preparation of the PEIS during the Scoping phase. Scoping served as a fact-finding process that helped identify public concerns and recommendations about the PEIS process, issues that would be addressed in the PEIS, and the scope and level of detail for analyses. Scoping activities began in January 1993 after a Notice of Intent to prepare the PEIS. Throughout the preparation of the PEIS, meetings were held with the Cooperating and Consulting Agencies, other agencies, interest groups, and the public. Issues raised during the public involvement process included geographic scope of the PEIS, level of detail, analytical tools used in impact assessments, definition of the No-Action Alternative and other alternatives, and redefinition of the alternatives in an iterative manner. A more detailed discussion of the public involvement process is provided in Chapter VI of this PEIS.

ORGANIZATION OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The Final PEIS consists of the revised PEIS, the Draft PEIS, the Supplement to the Draft PEIS, revised PROSIM Methodology and Modeling Technical Appendix, revised Delta as a Source of Drinking Water Technical Appendix, Response to Comments on the Draft PEIS, and Response to comments on the Supplement to the Draft PEIS.

The CVPIA contains over 60 individual provisions for which multiple implementation methods were developed during the preparation of the PEIS. The development and evaluation of the options were based upon an analysis of many issues which ranged from biological, physical, economic, and social considerations. Many of these evaluations utilized mathematical models, and incorporated extensive information from field observations and literature reviews. The PEIS summarizes the technical information and evaluations. Detailed information concerning the technical analyses is presented in technical appendices.

Three types of technical appendices were prepared as part of the PEIS. One type of technical appendix describes the assumptions that led to development of the No-Action Alternative and other alternatives. A second type of technical appendix was prepared for most of the issue areas considered in the PEIS to present the detailed descriptions of the affected environment and impact analyses. The third type of technical appendix presents the assumptions and analytical approaches of the computer models and spreadsheets used in the analyses. The models or spreadsheets and the input and output data are available electronically.

To further assist the reader in utilizing the technical information, the PEIS also includes a glossary of terms, list of acronyms and abbreviations, and metric conversion factors in Attachment D. Attachment D also includes a Reader's Guide for interpreting frequency curves that are used in the surface water analyses.

A summary of the organizational structure for the PEIS and technical appendices is presented in Figure I-3.

RELATED ACTIVITIES

Due to the extent of the PEIS study area, there are many activities and studies that are currently on-going or planned for the near future that could be affected by the findings of the PEIS or are related actions of the CVPIA. Related studies and projects that have been conducted recently or are currently being completed are summarized in Table I-2.

Preliminary information from these studies has been used to assess cumulative effects of implementing CVPIA and other potential projects in California.

Executive Summary/Final PEIS
Hardcopy or Electronic Files

- **Purpose and Need**
- **Description of Alternatives**
- **Impact Assessment**
- **Future "Next Steps"**
- **Glossary and Other Attachments**

Technical Appendices
Hardcopy or Electronic Files

- **Basis for Development of Alternatives**
- **Detailed Descriptions of Affected Environments and Impact Assessment**
- **Methodologies Used for Models and Other Analytical Tools**

Models Presented on CD-ROM
Electronic Files only

- **Models and Spreadsheets Used in Impact Assessment**
- **Data Input Files**
- **Data Output Files**

Note: PEIS documentation is contained in both hardcopy and electronic files.

FIGURE I-3

READER'S GUIDE FOR THE FINAL PEIS

TABLE I-2

RELATED ACTIVITIES

Project or Study and Lead Agency	Summary
Water Rights Process for CVP and SWP - State Water Resources Control Board (SWRCB)	In response to Bay-Delta Plan Accord, SWRCB is evaluating alternatives to Decision 1485 and the Bay-Delta Plan Accord to meet water rights and water quality issues in the Delta by parties that affect the Delta. This process may increase the amount of water provided by other water rights holders to meet Bay-Delta Water Quality Standards, and/or it may change Delta export criteria. Therefore, CVP operations to meet CVPIA actions to protect fish in the streams and the Delta may change. Because the outcome of this study was not known, a conservative assumption was used in the PEIS. It was assumed in the PEIS, that the Bay-Delta Plan Accord criteria would be the long-term plan for the Delta. The SWRCB is completing an Environmental Impact Report (EIR) as part of this process.
CALFED Bay-Delta Program - CALFED	Established in May 1995, the consortium of federal and state agencies is charged with the development of a long-term solution to the Delta water concerns. This process could change the Bay-Delta operations criteria, provide additional conveyance and storage facilities that would affect Delta exports, and identify actions that may need to be met by the CVP and other water rights holders. Because the outcome of this study was not known, a conservative assumption was used in the PEIS. It was assumed in the PEIS, that the Bay-Delta Plan Accord criteria would be the long-term plan for the Delta. CALFED is completing an EIR/EIS as part of this process.
Place of Use EIR for CVP water supplies - Reclamation/SWRCB	Some areas within the existing CVP service area but out of the SWRCB place of use have been served with CVP water. This process considered the impacts of expanding the SWRCB designated Place of Use for CVP water to include these areas. SWRCB and Reclamation are preparing the EIR as part of the approval process. The PEIS assumes that this process will be completed by the Year 2025 to include lands currently receiving CVP water.
Vernalis Adaptive Management Plan	The Vernalis Adaptive Management Plan (VAMP) provides protective measures for fall-run chinook salmon and gathers scientific information on survival of salmon smolts through the Delta. The VAMP will be implemented through experimental flows on the San Joaquin River and export pumping rates with a temporary fish barrier on Old River during the 1-month period each year, from approximately April 15 to May 15. Additional attraction flows are targeted for October. The VAMP includes water acquisition for a pulse flow at Vernalis during the April and May period, and other flows identified to meet anadromous fish flow objectives. The San Joaquin River Group Authority, Reclamation, and the Service have prepared a Final EIS/EIR for the water acquisition component of VAMP, in January 1999. This document is incorporated by reference into this PEIS.

TABLE I-2. CONTINUED

Project or Study and Lead Agency	Summary
Refuge Water Conveyance Study - Reclamation	This study identified the need to improve or construct water conveyance facilities to deliver existing water supplies and Level 2 and Level 4 water supplies in accordance with the 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan. Environmental documentation is being prepared for the facilities. The PEIS assumes that the conveyance facilities will be approved and completed by the Year 2025.
Sacramento River Toxic Pollutant Control Program - SWRCB and Central Valley Regional Water Quality Control Board	Program to reduce pollutants into the Sacramento River, especially metals. This program could improve fishery conditions in the Sacramento River. The PEIS assumes that this program is ongoing in the Year 2025.
Iron Mountain Mine Superfund Site - U.S. Environmental Protection Agency (EPA)	Iron Mountain Mine was operated periodically for copper, zinc, gold, and other metals for about 100 years. Acid mine drainage with high metal concentrations flows from the mine into Spring Creek, a tributary to the Sacramento River. In recognition of the threat to water quality, EPA listed the site on the National Priority List in 1983. Remediation of the site is being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act. To date, EPA has issued three Records of Decision for the site and many remedial activities have been undertaken. At this time, Interior has not considered if activities for remediation of Iron Mountain Mine may be addressed through CVPIA activities. The PEIS assumes that remediation will continue and that water quality will improve.
Trinity River Studies - U.S. Fish and Wildlife Service (Service)	In October 1984, the Service began a 12-year study to describe the effectiveness of increased flows and other habitat restoration activities to restore fishery populations in the Trinity River. An EIS/EIR is being prepared under a concurrent program to evaluate alternatives to restore and maintain natural production of anadromous fish in the Trinity River mainstem downstream of Lewiston Dam. Information from this program was used in the PEIS.
2004 Power Marketing Plan - Western Area Power Administration (Western)	Western markets surplus power generated by the CVP to Preference Power Customers. This plan evaluated the availability of surplus CVP power and alternatives to meet customer demands starting in the Year 2004, when new contracts will be executed. An EIS was prepared as part of this process. The PEIS evaluated programmatic changes in CVP power generation.
State Water Project Supplemental Water Program	This program is to allow the transfer of unused water rights, CVP water contracts, or SWP water entitlements to water users that have an unmet water demand.
Delta Wetlands	This water storage/wetlands restoration project will be developed by a private party. Water would be diverted from the Delta and stored within several Delta islands. The project also will include restoration of several other islands to provide mitigation for lost habitat on flooded islands. This project would require a change in water rights and, therefore, approval by the SWRCB. The SWRCB is preparing an EIR as part of the approval process. This program is not included in the PEIS alternatives.

CHAPTER II

DESCRIPTION OF ALTERNATIVES

Chapter II

DESCRIPTION OF ALTERNATIVES

This chapter presents a description of the alternatives considered in the PEIS, a summary of the Supplement to the Draft PEIS, and a summary of the impact assessment.

ISSUES CONSIDERED IN THE PEIS ALTERNATIVES

Alternatives considered in the PEIS were developed by Reclamation, the Service, and cooperating agencies through an extensive scoping effort and a three-phase screening process. The process is described in more detail in the Evaluation of Preliminary Alternatives Technical Appendix.

Section 3402 identifies six general purposes for the CVPIA, as described in Chapter I under the Purpose and Need for the Action. In the remaining sections of the CVPIA, Congress identified actions that taken together would achieve these purposes. Individually, specific actions may not achieve all the overall objectives of the CVPIA. Therefore, the alternatives considered in the PEIS include varying groups of implementation actions.

Issues

Based on internal and external scoping, the primary issues related to the PEIS alternatives are:

- What are the environmental benefits of implementing CVPIA?
- How will implementing CVPIA affect water deliveries?
- Is implementing CVPIA technically feasible?
- Is implementing CVPIA affordable within the existing funding mechanisms?

These issues were used in the PEIS to help guide the analysis and to develop the preferred alternative.

DEVELOPMENT OF PEIS ALTERNATIVES

The PEIS considered a No-Action Alternative, 5 Main Alternatives, including a Preferred Alternative, and 15 supplemental Analyses. The PEIS alternatives were developed with Core Programs and Multiple Options. The Core Programs included the actions addressed by separate concurrent programs, such as the Shasta Temperature Control Device, and CVPIA programs, such as non-flow actions under the Anadromous Fish Restoration Program. The Multiple Options included actions with several implementation methods, such as water acquisitions under Section 3406(b)(3) and vary among action alternatives. Some of the Multiple Options were evaluated as full alternatives (Alternatives 1 through 4). Other Multiple Options were evaluated in a manner that represents sensitivity analyses only (Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a). The Preferred Alternative includes the Core Programs and recommendations for implementation of actions evaluated as Multiple Options.

SELECTION OF THE PREFERRED ALTERNATIVE

The Preferred Alternative was defined in response to the results of the Draft PEIS analysis, public comments received on the Draft PEIS and the Supplement to the Draft PEIS, public comments received on related Administrative Proposals, and the results of early implementation of several CVPIA provisions. The Preferred Alternative was constructed to implement CVPIA in a manner that best balances environmental benefits, affordability, and technical feasibility. By increasing water-related benefits provided by CVP and by addressing impacts of CVP, the provisions of CVPIA will contribute to the overall economic and environmental sustainability of California. Implementation of CVPIA results in a variety of impacts to the regional economy and social conditions. As such, it did not include provisions that would clearly exceed the funding mechanisms of CVPIA and require additional congressional authorization.

The Preferred Alternative most closely resembles Alternative 2 in the Draft PEIS. The Preferred Alternative differs from Alternative 2 primarily in Water Acquisition for Fish and Wildlife (b)(3): the Preferred Alternative has different river-specific targets for water acquisition and would allow only up to 50 percent of acquired water to be available for export. The Preferred Alternative also assumes the use of (b)(2) water for Delta flows, which Alternative 2 did not.

The Preferred Alternative includes all of the Core Programs and the following options of Multiple Option Program Actions. The following section does not address all provisions of the Preferred Alternative, but describes the major provisions which distinguish the Preferred Alternative from the action alternatives analyzed in the Draft PEIS.

- **Water Pricing:** The Preferred Alternative includes a water pricing scheme based on the 80/10/10 Tiered Water Pricing up to Full Cost Approach" and the use of the Ability-to-Pay policies, similar to Alternative 2. The Preferred Alternative did not include a higher-cost pricing scheme considered in some Draft PEIS alternatives, because the Draft PEIS analysis indicated it would have a high level of adverse effects on agricultural productivity.

- **Water Acquisition for Fish and Wildlife (b)(3):** The Preferred Alternative includes water acquisition targets of approximately 110,000 acre-feet/year on the San Joaquin River tributaries and approximately 30,000 acre-feet/year on the Sacramento River tributaries. The Preferred Alternative did not include the higher acquisition targets considered in some Draft PEIS alternatives, because the Draft PEIS analysis indicated that the CVPIA funding mechanisms would be insufficient to meet the higher targets.

  The Preferred Alternative would also require approximately 50 percent of acquired water be managed to improve Delta flows and approximately 50 percent could be available for export if Bay-Delta plan conditions were met. Some Draft PEIS alternatives made all acquired water available for export, and other Draft PEIS alternatives made no acquired water available for export. The Preferred Alternative adopted this partial limit on exports as a reasonable balance between fishery resources and water deliveries.

For several of the Multiple Option Program Actions, only one approach complies with the statutory requirements of CVPIA, but other approaches were examined in the PEIS either for the purposes of analysis (e.g., Water Transfers and Refuge Water Supply Actions) or because the courts had not yet clarified the statutory requirements of CVPIA (the (b)(2) Water Management).

- ♦ **Water Transfers:** The Preferred Alternative provides for water transfer actions and includes a $25/acre-foot fee on transfers of CVP agricultural water to non-CVP-municipal users. The Preferred Alternative did not include a higher fee considered in some Draft PEIS alternatives, because CVPIA 3407(d)(2)(A) mandated a $25/acre-foot fee and because Draft PEIS analysis indicated that the higher fee would discourage water transfers.

- ♦ **Refuge Water Supply Actions:** The Preferred Alternative would provide CVP water supplies to refuges to meet average historic refuge "Level 2 Supplies," which would be subject to hydrologic shortages described by the 40-30-30 Index with a maximum shortage of 25 percent of the total amount. All Draft PEIS alternatives described hydrologic shortages with the Shasta Index criteria. Several public comments on the Draft PEIS urged the use of the 40-30-30 Index, which responds to hydrologic conditions differently from the Shasta Index criteria. In response to these comments, the Preferred Alternative and Revised No-Action Alternative used the 40-30-30 Index to provide a greater range to the PEIS analysis. By analyzing both criteria, the PEIS preserves for the decision-maker the option of choosing either criteria in an eventual ROD based on this PEIS. One Draft PEIS alternative would have made water supplies not subject to hydrologic shortages, but CVPIA mandated that refuge water supplies be subject to hydrologic shortages 3406(d)(4).

  The Preferred Alternative includes water acquisition to increase refuge water supply levels over time from Level 2 to Level 4. Some Draft PEIS alternatives did not include water acquisition for refuge water supplies, but CVPIA mandates such acquisitions 3406(d)(2).

- ♦ **Reoperation and (b)(2) Water Management:** Reoperation of CVP (3406(b)(1)(B)) is generally linked with (b)(2) Water Management because of their close interrelationship. However, reoperation itself does not have multiple implementation methods, and thus does not vary among action alternatives.

  As a result of litigation, a final (b)(2) accounting method was released on October 5, 1999. Alternative accounting methods were not sufficient to determine if Interior would meet the statutory requirements of CVPIA, as explained in Chapter I.

EVALUATION OF PEIS ALTERNATIVES IN THE DRAFT PEIS

The PEIS alternatives were compared to the No-Action Alternative. The supplemental analyses were compared to the alternatives for which they provided sensitivity analyses. The alternatives and supplemental analyses were evaluated using over 20 analytical tools and qualitative comparisons.

EVALUATION OF PEIS ALTERNATIVES IN THE SUPPLEMENT TO THE DRAFT PEIS

One of the analytical tools used in the PEIS was Reclamation's PROSIM model that simulated operations of the CVP and the SWP. Immediately prior to release of the Draft PEIS, an inconsistency in the PROSIM input hydrology was discovered. Initial qualitative analyses of the inconsistency indicated that correction of the input hydrology would not affect the comparison of the alternatives, the supplemental analyses, nor the final selection of the Preferred Alternative. During the review of the Draft PEIS, Reclamation revised PROSIM and released PROSIM 99 at a PROSIM Workshop on November 20, 1998.

Reclamation received many comments requesting a re-evaluation of the PEIS alternatives using the revised PROSIM 99 model to determine the effects on the PEIS impact assessment. In response to these comments, a revised PROSIM analysis was conducted of the Draft PEIS No-Action Alternative and Draft PEIS Alternative 1. The purpose of the analysis was to identify and evaluate potential changes to the Draft PEIS impact assessment due to the modifications to the PROSIM model through a presentation of a "Revised No-Action Alternative" and "Revised Alternative 1" that were based only on revisions of the PROSIM model. The changes in the PROSIM model and the results of this comparison were presented in the Supplement to the Draft PEIS. Those results are summarized below.

With the exception of revisions to hydrology and CVP/SWP operational criteria described in this supplement, there were no changes to the definitions of the No-Action Alternative or Alternative 1 from those presented in the Draft PEIS. The evaluation of effects took place in two steps:

♦ First, results of the Revised No-Action Alternative were compared to the Draft PEIS No-Action Alternative to determine effects to the baseline PROSIM simulation. The results indicated reduced reliability of CVP water supplies and an increase in non-compliance with temperature requirements for winter-run chinook salmon in the Sacramento River. For example, the Revised No-Action Alternative conditions include reductions in municipal CVP water service contract deliveries to 50 percent of contract amount and in agricultural CVP water service contract deliveries to zero deliveries in drier water years.

♦ Second, the impacts of the Revised Alternative 1 were compared to the Revised No-Action Alternative to identify the incremental effects of the Revised Alternative 1. These increments were compared to the differences between the No-Action Alternative and Alternative 1 presented in the Draft PEIS. The results indicated that the impacts of Revised Alternative 1 were either equal to or less than the impacts of Draft PEIS Alternative 1. The impacts are reflected in changes in deliveries to CVP water service contractors. Because CVP water supply reliability is severely restricted in the Revised No-Action Alternative, water is not readily available for CVP water service contractors under Revised Alternative 1. Therefore, the impact of CVPIA implementation under Revised Alternative 1 is equal to or less than that reported under Draft PEIS Alternative 1.

It was determined that the modifications to the PROSIM model would result in similar comparisons between revised Alternatives 2, 3, and 4 and the Revised No-Action Alternative because the primary differences between Alternatives 2, 3, and 4 are related to non-CVP operations including the acquisition of water for Level 4 refuge water supplies and for increased Delta outflow and instream flows on the San Joaquin River tributaries and Sacramento River tributaries. The changes for refuge water supplies and the tributaries under the Revised simulation would be identical to those discussed in the Draft PEIS for Alternatives 2, 3, and 4. Under Alternatives 2, 3, and 4, the acquired water operations under the Revised simulations would be similar to those between Alternative 1 and Alternatives 2, 3, and 4 in the Draft PEIS.

The primary differences between Alternative 1 and the supplemental analyses were related to changes in non-CVP operations. These operations would result in impacts similar to those shown in the Draft PEIS when compared to Revised Alternatives, as described in the Supplement to the Draft PEIS. Therefore, the results of the impact assessments in the Draft PEIS with respect to overall comparison of alternatives are not affected by the modifications in the PROSIM model that accommodated the input hydrology and CVP operational changes considered in the Supplement to the Draft PEIS.

The Preferred Alternative was compared to the Revised No-Action Alternative in the PEIS.

DESCRIPTION OF PEIS ALTERNATIVES

The following sections of this chapter present the definition of the No-Action Alternative, PEIS alternatives and supplemental analyses, and the Preferred Alternative. This chapter also includes a summary of the environmental consequences presented in Chapter IV and a comparison of the PEIS alternatives with the objectives of CVPIA. Finally, this chapter describes potential environmental commitments and unavoidable adverse impacts.

DEFINITION OF THE NO-ACTION ALTERNATIVE

The No-Action Alternative is used as a basis for comparison of other alternatives. The No-Action Alternative includes projects and policies that would either be impacted by the CVPIA or that would impact implementation of the CVPIA.

The No-Action Alternative reflects conditions in the Year 2025 if CVPIA had not been adopted. The No-Action Alternative includes projections concerning future growth and land use changes based upon projections from DWR Bulletin 160-93, including lands projected to be retired in accordance with San Joaquin Valley Drainage Plan. The No-Action Alternative includes existing CVP facilities and changes in CVP operational policies which are being evaluated concurrently. The No-Action Alternative also included assumptions concerning concurrent but separate issues, such as the assumption that ocean harvest limitations for sport and commercial salmon fishing would be consistent with 1992 policies and will be evaluated in a separate process by NMFS and other groups. Another assumption included in the No-Action Alternative being addressed under a separate program is the U.S. Department of Agriculture farm commodities program. The No-Action Alternative assumed that the program would not vary from 1992 policies.

The No-Action Alternative included assumptions for:

- Physical features
- Operations
- Water contracts
- Central Valley Project Conservation Program

ASSUMPTIONS FOR PHYSICAL FEATURES UNDER THE NO-ACTION ALTERNATIVE

Existing physical features of the CVP constitute the starting point for defining the No-Action Alternative. The No-Action Alternative also includes projects that would have been implemented without adoption of the CVPIA. The criteria for inclusion of the future facilities in the No-Action Alternative were: 1) authorization and funding for design; 2) final environmental documents, permits, and approvals; and 3) initial authorization and funding for construction without CVPIA.

ASSUMPTIONS FOR OPERATIONS UNDER THE NO-ACTION ALTERNATIVE

The operational and regulatory policies and assumptions included in the No-Action Alternative are presented in Table II-1. Some of the policies were being developed prior to the adoption of CVPIA. The No-Action Alternative includes assumptions of the results of the ongoing evaluation processes for these polices. For example, the No-Action Alternative includes assumptions for implementation of the Bay-Delta Plan Accord. Policies in the No-Action Alternative that are different from what was considered as “existing conditions” are noted in Table II-1. The policies and facilities included in the No-Action Alternative are described in more detail in the Development of the No-Action Alternative Technical Appendix and the Pre-CVPIA Conditions Technical Appendix.

The CVP facilities operations in the No-Action Alternative are in accordance with the Long-Term CVP Operations Criteria and Plan (CVP-OCAP), Reclamation's Mid-Pacific Region guidelines, the National Marine Fisheries Service (NMFS) biological opinion for winter-run chinook salmon, the Service’s biological opinion for Delta smelt, and the Bay-Delta Plan Accord. Due to the coordinated nature of operations of the CVP and the SWP, some policies apply to both the CVP and SWP, such as implementation of the Bay-Delta Plan Accord.

TABLE II-1

OPERATIONS, POLICIES, AND REGULATORY REQUIREMENTS ASSUMED IN THE NO-ACTION ALTERNATIVE

Issue or Policy	Description	Change from pre-CVPIA Conditions
Acreage Limitations in Contracts	Existing acreage limitation regulations adopted to implement Reclamation Reform Act of 1982.	No Change
Central Valley Project Operations	Continued operations as presented in CVP-OCAP 1992 and other operational procedures for CVP, adjusted for biological opinions and water quality standards. (Biological opinions (May 1995) for winter-run chinook salmon and delta smelt. Bay-Delta Plan Accord and SWRCB Order 95-06.)	The process that led to biological opinions and the Bay-Delta Planning process had started before passage of CVPIA.
Contract Amounts for CVP (including shortage criteria)	Contracts would be renewed, per 1956 and 1963 acts, prior to Year 2022, including contracts with CVP and DWR associated with the Cross-Valley Canal. *Maximum contract amount:* Not to exceed existing contract amounts. Water deliveries not to exceed capacity of existing conveyance facilities. *Agricultural Water Service Contracts, Water Rights Contracts, and Exchange Contracts:* CVP water deliveries limited by maximum use between 1980 and 1993, projected use as addressed in environmental documentation, or maximum contract amount, whichever is less. Shortage criteria per OCAP. *Municipal and Industrial Water Service Contracts:* Total demand based upon 2020 demands in DWR Bulletin 160-93. CVP water deliveries limited by: a) maximum use between 1980 and 1993, b) projected use as addressed in environmental documentation, or c) maximum contract amount, whichever is less. Shortage criteria with maximum shortage of 25 percent. *Refuges:* Delivery of Level 1 and Level 2 water supplies by existing suppliers. Shortage criteria for CVP supplies per Shasta Index.	No Change Consistent with recent policies for refuge water deliveries
CVP Conservation Program	A long-term adaptive management program to address biological needs of special-status species, with an emphasis on habitat in areas affected by the CVP.	Discussions were started independent of CVPIA
Coordinated Operations of CVP and SWP	Based upon Coordinated Operating Agreement framework with additional assumptions to implement new provisions of Bay-Delta Plan.	Changes due to implementation of Bay-Delta Plan.
Delta Factors	Continued use of seasonal barriers at Old River and continued operation of Delta Cross Channel gates.	No Change
Land Retirement	Retirement of 45,000 acres between 1992 and 2022 under existing State of California land retirement programs, per DWR Bulletin 160-93.	No Change, program had started in 1992

TABLE II-1. CONTINUED

Issue or Policy	Description	Change from pre-CVPIA Conditions
Minimum Instream Flow Requirements for CVP Facilities	Sacramento River: Per SWRCB Order 91-01 and the Winter-Run Chinook Salmon Biological Opinion. American River: Per Modified SWRCB D-1400 strategy of CVP operations with a fixed amount of flood control storage under the Corps of Engineers interim requirements. Stanislaus River: Per SWRCB D-1422, including water quality standards on the San Joaquin River at Vernalis and dissolved oxygen requirements at Ripon; and 155,700 af/yr in all years but Critical Dry Years, then 98,300 af/yr per initial studies conducted under the 1987 agreements with DFG and the Service. Trinity River: Per Secretary's 1991 Decision (340,000 af/yr in all years).	Sacramento and American Rivers: Process that led to biological opinions and flood control criteria had started before passage of CVPIA Stanislaus River: No Change; however, annual operations in the late 1980s different due to drought No Change
Shortage Criteria for State Water Project	Monterey Agreement provisions for SWP.	Completed during preparation of PEIS
Non-CVP Water Users	Use water demands in DWR Bulletin 160-93.	No Change
Power Marketing	Existing Agreement between United States and PG&E would not be renewed. Project Use load met at all times.	Discussions were started independent of CVPIA
Red Bluff Diversion Dam Gate Closure	Mid-May through mid-September per winter-run chinook salmon biological opinion	Discussions were started independent of CVPIA
Tracy Direct Loss Mitigation Agreement	Reduces and offsets direct loss of fish associated with operations of the Tracy Pumping Plant and Fish Facility	No Change
Water Conservation	Water conservation levels based on assumptions presented in DWR Bulletin 160-93 for all water users, plus requirements by 1982 Reclamation Reform Act for CVP contractors.	No Change
CVP Ratesetting and Water Pricing	Existing ratesetting and cost-allocation policies, and ability-to-pay policies per Reclamation Mid-Pacific Region Policies, including 1988 policies, and Reclamation Reform Act draft rules and regulations.	No Change
Water Transfers	CVP water can be transferred within CVP water service contractors, SWP water can be transferred per the Monterey Agreement, and water rights holders can transfer water under SWRCB guidelines.	No Change
Water Rights	Total water rights would be delivered in all water year types without shortages even if water rights had not been fully utilized under pre-CVPIA conditions. CVP is operated in accordance with all water rights requirements as defined and implemented by the SWRCB, including Area of Origin and Delta Protection Act provisions.	No Change

Non-CVP facilities operations in the No-Action Alternative are in accordance with existing operational policies as defined by the SWP, Corps of Engineers, State Water Resources Control Board (SWRCB), and the Federal Energy Regulatory Commission (FERC).

Some of the operational policies included in the No-Action Alternative were developed prior to more recent policies; therefore, potential conflicts occur. For example, the Coordinated Operation Agreement (COA) was adopted in 1986. The COA includes formulas to define how much water the CVP and the SWP can export from the Delta. As the Bay-Delta Planning process proceeds, portions of the COA will incorporate new standards. However, for the purposes of the PEIS, it is assumed that the agreements established by the COA would be similar to future agreements with changes incorporated to reflect Delta export operations. Additional information concerning how operational policies were interpreted for the No-Action Alternative are included in Attachment G of the PEIS.

WATER CONTRACT AMOUNT ASSUMPTIONS UNDER THE NO-ACTION ALTERNATIVE

The long-term contract renewal process was initiated in 1989 due to the expiration of Friant Unit water service contracts. Pursuant to the 1956 and 1963 Reclamation Acts, the CVP water service contractors had the right to renew existing contracts. A total of 67 contracts expired between 1993 and 1997. These contracts have been reduced to 54 contracts as a result of various district consolidations and elections not to renew. However, due to the passage of CVPIA, only short-term interim contract renewals can occur until all appropriate NEPA documentation is completed. In addition to the 54 original interim renewal contracts, 14 interim renewals were signed with the "Friant 14" contractors to provide for uninterrupted water service to these entities. This resulted from the United States Supreme Court decision denying further consideration of a lower court's decision invalidating the "Friant 14"'s existing long-term renewal contracts.

During the contract renewal process, a needs analysis to determine beneficial use of the CVP water will be completed. The proposed contract amounts will reflect historic beneficial use, project demand, and potential for water conveyance. All contract renewal amounts will be subject to review under the NEPA process. During the NEPA review process, the public will have the opportunity to evaluate and provide input with respect to the beneficial use of CVP water. This type of review is also provided for municipalities through the review of environmental documentation for general plans, specific community plans, and water supply master plans.

For the purposes of the PEIS, it was assumed that the contract amounts in the No-Action Alternative and PEIS Alternatives would not be greater than existing contract amounts. To increase the contract amounts will require additional site-specific environmental and technical documentation. However, it was necessary to estimate potential need without completing contract-specific needs analyses. The maximum amount of CVP water delivered for each long-term CVP water service contractor was compared to the contract amount. Historic use during the period of 1980 through 1993 was used for this analysis because delivery amounts were consistently available for all contractors and other water users served by the CVP during this period.

If the maximum amount delivered during this period was equal to the maximum contract amount, the maximum contract amount was assumed for the PEIS analysis. If the maximum amount delivered was less than the contract amount, then the following criteria were used to determine the contract amounts to be used in the PEIS:

- **Criterion 1:** If an environmental document had been completed that evaluated the impacts of using CVP water, and conveyance capacity was available to deliver the CVP water to the agency boundary, then the contract amount assumed in the environmental documentation or the conveyance capacity, whichever was less, was used in the PEIS analysis. The maximum historic use was not considered in the analysis. This type of analysis was only available for municipalities that had environmental documentation for land use plans, as shown in the following examples. The assumed contract amount did not exceed existing contract amounts.

Example 1:

Maximum Contract Amount	= 10,000 acre-feet
Maximum Historic Use	= 7,000 acre-feet
Maximum Conveyance Capacity from CVP Supplies	= 10,000 acre-feet
Amount Assumed in General Plan Environmental Documents	= 10,000 acre-feet
AMOUNT ASSUMED IN PEIS	= 10,000 ACRE-FEET

Example 2:

Maximum Contract Amount	= 10,000 acre-feet
Maximum Historic Use	= 2,000 acre-feet
Maximum Conveyance Capacity from CVP Supplies	= 5,000 acre-feet
Amount Assumed in General Plan Environmental Documents	= 5,000 acre-feet
AMOUNT ASSUMED IN PEIS	= 5,000 ACRE-FEET

Example 3:

Maximum Contract Amount	= 10,000 acre-feet
Maximum Historic Use	= 10,000 acre-feet
Maximum Conveyance Capacity from CVP Supplies	= 15,000 acre-feet
Amount Assumed in General Plan Environmental Documents	= 15,000 acre-feet
AMOUNT ASSUMED IN PEIS	= 10,000 ACRE-FEET

- **Criterion 2:** If the maximum historical amount was less than the contract amount, and if an environmental document had not been completed that evaluated the impacts of using CVP water, then the contract amount was assumed to be the maximum historical amount, as shown in the following example. This criterion was used primarily for agricultural areas because they did not have environmental documentation and agricultural water supplies were not addressed in the county general plans. This criterion also was used for municipalities that had not completed environmental documentation, including documentation for conveyance facilities.

  Example:

Maximum Contract Amount	= 10,000 acre-feet
Maximum Historic Use	= 7,000 acre-feet
Maximum Conveyance Capacity from CVP Supplies	= 7,000 acre-feet
Amount Assumed in General Plan Environmental Documents	= No Document
AMOUNT ASSUMED IN PEIS	= 7,000 ACRE-FEET

The contract amounts assumed in the No-Action Alternative and all PEIS alternatives are presented in Table II-2.

The CVP contract amount assumptions were developed only for use in the PEIS. Reclamation intends to deliver the full CVP water contract amount consistent with hydrologic conditions and regulatory and environmental requirements. The specific allocations under a CVP water service contract in the PEIS would not inhibit or contribute in any way to the contractors' ability to develop projects to take delivery of full contract amounts prior to contract renewal.

The PEIS provides an indication of the amount of water available to deliver for contract under different operational and hydrological assumptions. Final decisions concerning CVP contract renewal amounts would not be based upon the findings of the PEIS, but rather upon project-specific contract renewal environmental documentation that would provide site-specific NEPA compliance as a tiered document from the PEIS.

The PEIS analysis also assumes the normal monthly operations of the Central Valley water resources facilities over the historic hydrological period of 1922 through 1991 for use in the hydrologic model simulations. Emergency operations of individual facilities, such as might occur after a major contaminant spill in the Delta or a levee failure, or the incidents of peak hourly flow conditions were not considered in the PEIS. Therefore, actual annual contract deliveries may vary from patterns evaluated in the PEIS.

The No-Action Alternative assumes a continuation of pricing policies and acreage limitation policies in accordance with Reclamation Law and Mid-Pacific Region policies. These policies include the Ability-to-Pay policy for agricultural water service contractors. Under the Ability-to-Pay policy, agricultural water service contractors can apply for partial to full relief from the repayment of capital costs for construction of the CVP. The application is reviewed by

TABLE II-2

CVP CONTRACT AMOUNT AND DIVERSION OBLIGATION ASSUMPTIONS USED IN THE NO-ACTION ALTERNATIVE AND PEIS ALTERNATIVES

Water Users	Existing Contract Amounts (1,000 acre-feet)	Amounts in PEIS Alternatives (1,000 acre-feet)
North of the Delta		
CVP Agricultural Water Service Contractors	570	480
Sacramento River Water Rights Contractors	1,940	1,870
CVP Municipal/Industrial Water Service Contractors	540	260
Municipal/Industrial Water Rights Holders	530	530
Water Service Contractors and Water Rights Holders that use Stoney Creek	4	4
Water Service Contractors that use Sly Park and Sugar Pine Units	26	26
South of the Delta		
CVP Agricultural Water Service Contractors	1,980	1,980
San Joaquin River Exchange Contractors	880	880
CVP Municipal/Industrial Water Service Contractors	160	160
Water served from the Stanislaus River		
CVP Water Service Contractors with firm water supply	49	49
CVP Water Service Contractors with interim water supply	106	106
CVP Water Rights Holders served at Goodwin Dam	600	600
Other Riparian Water Rights Holders	48	48
Friant Division		
Madera Canal Water Service Contractors	490	490
Buchanan and Hidden Unit Water Service Contractors	50	50
CVP Friant-Kern Canal Agricultural Water Service Contractors (includes Class I and Class II waters)	1,720	1,720
CVP Friant-Kern Canal Municipal/Industrial Water Service Contractors	65	65
NOTE: Refuge water supply contracts are presented in Tables II-3, II-6, and II-7		

Reclamation to determine the economic impacts of repaying the capital costs. If there is economic justification, the capital portion of the water costs will not be charged. However, operation and maintenance costs must be paid by the water user. The amount of repayment costs not paid for by the agricultural water service contractors is paid by preference power customers who purchase available energy generated by CVP hydroelectric generation facilities.

The No-Action Alternative assumptions also address water deliveries to the refuges. The water is supplied from historical water suppliers, which include the CVP, SWP, tailwater return flows from upstream water users, and water rights holders. The delivery amounts assumed in the No-Action Alternative for the refuges and wetlands considered in the PEIS are shown in Table II-3. The refuges and wetlands considered in the PEIS are limited to those identified in the CVPIA as the refuges addressed in the 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan.

TABLE II-3

REFUGE WATER SUPPLIES IN THE NO-ACTION ALTERNATIVE

Refuge	Refuge Water Deliveries at Refuge Boundary Plus Conveyance Losses (in 1,000 acre-feet)
SACRAMENTO VALLEY REFUGES	
Sacramento National Wildlife Refuge	46.4
Delevan National Wildlife Refuge	20.9
Colusa National Wildlife Refuge	25.0
Sutter National Wildlife Refuge (1)	23.5
Gray Lodge Wildlife Management Area (1)	35.4
Total for Sacramento Valley Refuges	**151.2**
SAN JOAQUIN VALLEY REFUGES	
San Luis National Wildlife Refuge	25.3
Kesterson National Wildlife Refuge	10.0
Volta Wildlife Management Area	13.0
Los Banos Wildlife Management Area	16.7
San Joaquin Basin Action Lands	
Freitas	5.3
West Gallo	10.8
Salt Slough	6.0
China Island	0.0
East Gallo	0.0
Grasslands Resource Conservation District	47.8
Mendota National Wildlife Refuge	18.5
Merced National Wildlife Refuge (1)	20.0
Kern National Wildlife Refuge	10.0
Pixley National Wildlife Refuge	0.0
Total for San Joaquin Valley Refuges	**183.4**
TOTAL FOR ALL REFUGES	**334.6**

NOTE:
Values based upon the 1989 Refuge Water Supply Study and San Joaquin Basin Action Plan. Values have been subsequently modified to reflect more recent data.
(1) Water provided by non-CVP sources.

Implementation of the CVP Conservation Program

The concept for a CVP Conservation Program was developed in 1991 during the Section 7 consultation between Reclamation and the FWS for the renewal of the Friant Division water contracts. As part of this consultation and a subsequent consultation on interim renewal contracts, Reclamation agreed to address endangered species issues throughout the area affected by the CVP.

The Conservation Program is a joint Reclamation/Service Program developed and being implemented by both agencies and CDFG. The primary goal of the Conservation Program is to meet the needs, including habitat needs, of threatened, endangered and species of concern in the areas affected by the CVP. The species of concern whose needs will be addressed by the Conservation Program include primarily Federally-listed species. In addition, species that are candidates or are proposed species for Federal listing, as well as other species of concern, will benefit from the Program if they have high-priority biological needs. The Conservation Program will proactively enhance populations of listed species and their habitats, while the CVPIA (b)(1) "other" Program (described later in this chapter) will focus on mitigating the past CVP impacts to a broader range of native species and their habitats that are not otherwise mitigated by other provisions of CVPIA.

The Conservation Program, along with other initiatives such as Habitat Conservation Plans, would help ensure that the existing operation of the CVP would not jeopardize listed or proposed species or adversely affect designated or proposed critical habitat.

The implementation process for the Conservation Program is guided by the following principles:

- Implementing actions will respond directly to biological needs,
- Highest priority needs will generally be addressed first, and
- Priorities and needs, and thus the implementation plan, will change over time.

The Conservation Program will identify actions for implementation mainly by synthesizing existing information about needs and specific actions rather than duplicating other efforts or developing its own information. However, there may be some issues where existing information is not available and the Conservation Program will develop new information. Actions will be implemented through other ongoing programs and with partners when possible.

The Conservation Program is a cornerstone for actions aimed at recovering natural production of threatened and endangered species and sensitive-species populations and habitats upon which these populations depend. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of the Conservation Program is the maintenance of secure, self-sustaining wild populations of species over the long-term with the minimum necessary investment of resources.

The actions and evaluations implemented under the Conservation Program have included restoring riparian habitat along the Sacramento, San Joaquin, and Cosumnes rivers for species such as the giant garter snake, valley elderberry beetle, riparian woodrat, and riparian brushrabbit. Comprehensive surveys were undertaken to determine priority sites for purchase, easements, or restoration for giant garter snake, California red-legged frog, riparian woodrat, riparian brushrabbit, vernal pools, and kangaroo rats. Additionally, tracts of land have been purchased and managed for giant garter snake, California red-legged frogs, vernal pools, and several threatened plant species.

Reclamation and the Service will fund the Conservation Program commensurate with the biological needs of the species for recovery and prevention of listing. Species closest to extinction and with the greatest and most urgent recovery needs will be the focus of the Conservation Program. These species will be identified during the yearly critical needs analysis.

The Conservation Program will be implemented through regularly scheduled meetings, close coordination with CDFG and other stakeholders/interested entities, and yearly critical needs analysis. The critical needs analysis will be a collaborative effort between Reclamation and the Service and will include close coordination with the CDFG and EPA. For any species that continues to decline, the Service and Reclamation will immediately assess the critical needs for the species and determine what actions are required to maintain and enhance the species.

DEFINITION OF PEIS ALTERNATIVES

The alternatives were developed to evaluate a range of actions, or programs, to meet the objectives of CVPIA and implement provisions of CVPIA. Different actions were added to the PEIS alternatives to represent a matrix of proposed actions. Table II-4 summarizes the alternatives and what follows is a description of the actions.

For some programs, several implementation methods were identified which resulted in different benefits and impacts at a programmatic level. For other actions, differences in implementation methods could not be discerned at a programmatic level. However, differences could occur at a site-specific level. For example, fish protection facilities at a specific diversion would result in a reduction in mortality at a programmatic level. However, the design and siting criteria would need to be examined at a site-specific level to determine specific benefits and impacts. For this type of program, a single implementation method was considered in the PEIS to be a “Core Program,” described in the next section of this chapter. Additional engineering, economic, and environmental analyses would be considered before site-specific projects are implemented. The following Core Programs are included in the alternatives with only one programmatic implementation method identified:

TABLE II-4

SUMMARY OF ASSUMPTIONS FOR CVPIA PROVISIONS IN THE NO-ACTION ALTERNATIVE AND PEIS ALTERNATIVES

	Contract Renewals (3404(c)) Core Program	Water Transfer Actions (3405(a)) Core Program	Water Measurement (3405(b)) Core Program	Water Pricing Actions (3405(d)) Core Program	Water Conservation (3405(e)) Core Program	Reoperation and (b)(2) Water (3406(b)(1 & 2)) Multiple Option Program	Water Acquisition for Streams (3406(b)(3)) Multiple Option Program	"(b)(1) Other" Program (3406(b)(1)) Core Program	Delta Actions(3406(b)(4-5 & 14-15)) Multiple Option Program	Shasta Temperature Control Device (3406(b)(6)) Core Program	Red Bluff Diversion Dam Operations (3406(b)(10)) Multiple Option Program	Non-flow Stream Restoration Actions (3406(b)(1, 11-13, 17, 20, & 21)) Core Program	Seasonal Field Flooding (3406(b)(22)) Core Program	Refuge Water Supplies (3406(d)(1-2)) Multiple Option Program	Land Retirement (3408(h)) Core Program
No-Action Alternative	All Contracts Renewed	Only non-CVPIA transfers occur (see text for description)	Per Reclamation Reform Act	Per Reclamation Reform Act	Per Reclamation Reform Act with Phased Implementation of Best Management Practices	Not Included (Bay-Delta Plan Accord included)	Not Included	Not Included	Not Included	Funded by Non-CVP Funds	Gates opened mid-September through mid-May	Not Included	Not Included	Level 2 provided by historical supplies with frequent shortages	No Land Retirement Program funded with CVP funds
Preferred Alternative	Same as No-Action Alternative	Water transfers without additional fees	Evaluate Measurement at Point of Diversion and at Point of Use	Tiered Pricing: 80% @ Contract Rate, 10% @ Full Cost, 10% @ Blended Rate with Ability-to-Pay (see text)	Per Reclamation Reform Act and Implementation of All Best Management Practices	Bay-Delta Plan Component, Instream Component, and Delta Component (see text)	Acquire 110,000 af on San Joaquin River tributaries and 30,000 on Sacramento River tributaries.	Implement Habitat Improvements (see text)	Further studies will be conducted prior to Implementation	Funded by Restoration Funds and Non-CVP Funds	Further studies will be conducted prior to Implementation	Habitat Restoration on many Central Valley Streams	Encourage Program Payments to Seasonally Flood up to 80,000 acres/year	CVP provides Level 2 with shortage criteria equal per 40-30-30 with maximum shortage of 25% and acquires Level 4 supplies with shortages per water supply	Retire up to 30,000 acres of lands with drainage problems with Revegetation Plan
Alternative 1	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Bay-Delta Plan Component and Instream Component	Same as No-Action Alternative	Same as Preferred Alternative	Non-structural Barriers for the Old River Barrier and Georgiana Slough	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Incentive Payments to Seasonally Flood up to 80,000 acres/year	CVP provides Level 2 with shortage criteria equal per Shasta Index with maximum shortage of 25%	Retire up to 30,000 acres of lands wtih drainage problems with no formal Revegetation Plan

TABLE II-4. CONTINUED

	Contract Renewals (3404(c)) Core Program	Water Transfer Actions (3405(a)) Core Program	Water Measurement (3405(b)) Core Program	Water Pricing Actions (3405(d)) Core Program	Water Conservation (3405(e)) Core Program	Reoperation and (b)(2) Water (3406(b)(1 & 2)) Multiple Option Program	Water Acquisition for Streams (3406(b)(3)) Multiple Option Program	"(b)(1) Other" Program (3406(b)(1)) Core Program	Delta Actions(3406(b) (4-5 & 14-15)) Multiple Option Program	Shasta Temperature Control Device (3406(b)(6)) Core Program	Red Bluff Diversion Dam Operations (3406(b)(10)) Multiple Option Program	Non-flow Stream Restoration Actions (3406(b)(1, 11-13, 17, 20, & 21)) Core Program	Seasonal Field Flooding (3406(b)(22)) Core Program	Refuge Water Supplies (3406(d)(1-2)) Multiple Option Program	Land Retirement (3408(h)) Core Program
Supplemental Analysis 1a	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Bay-Delta Plan Component, Instream Component, and Delta Component	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1b	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Structural Barriers for the Old River Barrier and Georgiana Slough	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1c	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Tiered Pricing: 80% @ Full Cost, 10% @ 110% Full Cost, 10% @ 120% Full Cost with Ability-to-Pay	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1d	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	CVP provides Level 2 all years without shortages	Same as Alternative 1
Supplemental Analysis 1e	Same as No-Action Alternative	Water Transfers without Additional Transfer Fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1f	Same as No-Action Alternative	Water Transfers with $50/af Additional Transfer Fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

TABLE II-4. CONTINUED

	Contract Renewals (3404(c)) Core Program	Water Transfer Actions (3405(a)) Core Program	Water Measurement (3405(b)) Core Program	Water Pricing Actions (3405(d)) Core Program	Water Conservation (3405(e)) Core Program	Reoperation and (b)(2) Water (3406(b)(1 & 2)) Multiple Option Program	Water Acquisition for Streams (3406(b)(3)) Multiple Option Program	"(b)(1) Other" Program (3406(b)(1)) Core Program	Delta Actions(3406(b) (4-5 & 14-15)) Multiple Option Program	Shasta Temperature Control Device (3406(b)(6)) Core Program	Red Bluff Diversion Dam Operations (3406(b)(10)) Multiple Option Program	Non-flow Stream Restoration Actions (3406(b)(1, 11-13, 17, 20, & 21)) Core Program	Seasonal Field Flooding (3406(b)(22)) Core Program	Refuge Water Supplies (3406(d)(1-2)) Multiple Option Program	Land Retirement (3408(h)) Core Program
Supplemental Analysis 1g	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Tiered Pricing: as in Preferred Alternative without Ability-to-Pay	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1h	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Preferred Alternative
Supplemental Analysis 1i	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Gates open all year	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Alternative 2	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Acquire 60,000 af on Stanislaus and Tuolumne rivers, each, and 50,000 af on Merced River. Do not export acquired water	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	CVP provides Level 2 with shortage criteria per Shasta Index & acquires Level 4 supplies with shortages per water supply	Same as Alternative 1
Supplemental Analysis 2a	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Preferred Alternative	Structural Barriers for the Old River Barrier and Georgiana Slough	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1
Supplemental Analysis 2b	Same as No-Action Alternative	Water Transfers without additional transfer fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1

TABLE II-4. CONTINUED

	Contract Renewals (3404(c)) Core Program	Water Transfer Actions (3405(a)) Core Program	Water Measurement (3405(b)) Core Program	Water Pricing Actions (3405(d)) Core Program	Water Conservation (3405(e)) Core Program	Reoperation and (b)(2) Water (3406(b)(1 & 2)) Multiple Option Program	Water Acquisition for Streams (3406(b)(3)) Multiple Option Program	"(b)(1) Other" Program (3406(b)(1)) Core Program	Delta Actions(3406(b) (4-5 & 14-15)) Multiple Option Program	Shasta Temperature Control Device (3406(b)(6)) Core Program	Red Bluff Diversion Dam Operations (3406(b)(10)) Multiple Option Program	Non-flow Stream Restoration Actions (3406(b)(1, 11-13, 17, 20, & 21)) Core Program	Seasonal Field Flooding (3406(b)(22)) Core Program	Refuge Water Supplies (3406(d)(1-2)) Multiple Option Program	Land Retirement (3408(h)) Core Program
Supplemental Analysis 2c	Same as No-Action Alternative	Water Transfers with $50/af additional transfer fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1
Supplemental Analysis 2d	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Tiered Pricing: As in Supplemental Analysis 1c	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1
Alternative 3	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Acquire 200,000 af on Stanislaus, Tuolumne, and Merced rivers, each; 30,000 af on Calaveras River; 70,000 af on Mokelumne River; and 100,000 af on Yuba River. Can export acquired water.	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1
Supplemental Analysis 3a	Same as No-Action Alternative	Water transfers without additional transfer fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 3	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1

TABLE II-4. CONTINUED

	Contract Renewals (3404(c)) Core Program	Water Transfer Actions (3405(a)) Core Program	Water Measurement (3405(b)) Core Program	Water Pricing Actions (3405(d)) Core Program	Water Conservation (3405(e)) Core Program	Reoperation and (b)(2) Water (3406(b)(1 & 2)) Multiple Option Program	Water Acquisition for Streams (3406(b)(3)) Multiple Option Program	"(b)(1) Other" Program (3406(b)(1)) Core Program	Delta Actions(3406(b)(4-5 & 14-15)) Multiple Option Program	Shasta Temperature Control Device (3406(b)(6)) Core Program	Red Bluff Diversion Dam Operations (3406(b)(10)) Multiple Option Program	Non-flow Stream Restoration Actions (3406(b)(1, 11-13, 17, 20, & 21)) Core Program	Seasonal Field Flooding (3406(b)(22)) Core Program	Refuge Water Supplies (3406(d)(1-2)) Multiple Option Program	Land Retirement (3408(h)) Core Program
Alternative 4	Same as No-Action Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Bay-Delta Plan Component, Instream Component, and Delta Components	Same as Alternative 3. Do not export acquired water	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative 1
Supplemental Analysis 4a	Same as No-Action Alternative	Water transfers without additional transfer fees	Same as Preferred Alternative	Same as Preferred Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 4	Same as Preferred Alternative	Same as Alternative 1	Same as Preferred Alternative	Same as No-Action Alternative	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 2	Same as Alternative

- Renew all CVP service, water rights, and exchange contracts
- Implement water measurement and water conservation measures
- Implement Non-flow Improvements for Anadromous Fish Restoration Program
- Implement (b)(1) "other" program
- Upgrade Tracy and Contra Costa pumping plants fish protection facilities
- Construct Shasta Temperature Control Device
- Complete improvements to Coleman National Fish Hatchery
- Complete habitat improvements in Clear Creek
- Implement Non-Flow Stream Restoration Actions to replace gravels in Central Valley streams
- Complete modifications to Anderson-Cottonwood Irrigation District and Glenn-Colusa Irrigation District diversion facilities for fish protection
- Avoid juvenile fish loss at diversions
- Implement seasonal field flooding
- Purchase 30,000 acres of retired land (in addition to 45,000 acres presumed purchased under the No-Action Alternative)

Actions with multiple option methods formed the basis for differentiating the alternatives. The multiple implementation methods were combined into four Alternatives and 15 Supplemental Analyses. The Alternatives represented specific assumptions for well-defined multiple implementation methods. The Supplemental Analyses were developed to allow sensitivity analyses between more general assumptions for less defined option programs.

The Supplemental Analyses were based upon specific alternatives to provide additional comparisons. Six of the Supplemental Analyses were developed specifically as alternatives to evaluate water transfer opportunities under CVPIA provisions. The following actions were considered in multiple option programs:

- Implement Fish and Wildlife actions per Sections 3406(b)(2) and (3) of CVPIA
- Provide Level 2 and Level 4 refuge water supplies
- Implement water pricing actions
- Modify Red Bluff Diversion Dam
- Construct Delta Fish Barriers
- Provide for water transfers
- Revegetate retired lands

This section describes the implementation methods included in the Core Programs and in the alternatives. The following section of this chapter compares the structure of the PEIS alternatives and how the decision maker could use the alternatives to make a decision and implement the next steps.

CORE PROGRAMS INCLUDED IN ALL ALTERNATIVES

The Core Programs are implemented in the same manner in all alternatives and supplemental analyses. Several of the Core Programs included actions that were initiated prior to implementation of the CVPIA but were not completed at the time of the PEIS preparation. For these programs, preliminary information was used to develop the assumptions. The Core Programs are listed in Table II-5. Additional details for two of these programs—Implementation of the (b)(1) "other" Program, and Land Retirement—are provided below because these are the major programmatic elements of the Core Programs. As the Core Programs are implemented, the actions will require additional technical and environmental analyses and evaluation by the public and interest groups.

Implementation of the (b)(1) "other" Program

In the course of implementing the CVPIA, all reasonable efforts would be made, consistent with the requirements of Section 3406 of CVPIA, to address other identified adverse environmental impacts of the CVP not specifically enumerated in this section. Generally, projects that address this "other" mitigation component would be identified during other efforts, including but not limited to: Section 7 consultation for interim CVP contract renewals, short- and long-term conservation programs developed as a result of the Friant contract renewal consultation and CVP long-term contract renewals, and implementation of other CVPIA activities. Representative projects include the identification, protection, and restoration of habitat suitable for conservation of native species in areas impacted by the CVP.

The initial focus of the (b)(1) "other" Program would be based on the ranking of habitats and species of concern; the assessment of factors limiting native fish, wildlife, and associated habitats; and geographic areas within the Central Valley Project service areas where those habitats, species, and factors converge to the greatest degree. This would not be to the exclusion of other concerns or opportunities. Species and habitat prioritizations would be reevaluated throughout implementation of the CVPIA, through regular prioritization meetings, close coordination with CDFG, and annual critical needs analysis.

Habitats known or believed to have experienced the greatest percentage decline in quantity and quality since construction of the CVP, and whose impacts can be attributed, at least partially, to its construction and operation, would be a focus for the (b)(1) "other" Program. These habitats include riparian, alkali desert scrub, wetlands (including vernal pools), chaparral, valley foothill hardwood, and grasslands.

Populations of native species impacted by the CVP, not specifically addressed in other portions of Section 3406 of the CVPIA, would be addressed in the (b)(1) "other" Program. Initial focus would be provided to Federally-listed, proposed or candidate species; other non-listed species of special concern including resident fish and migratory birds; and other native wildlife species associated with habitat types listed above. Projects implemented through the (b)(1) "other" Program also would benefit Federally listed and other native species associated with riparian alkali sink, vernal pool, chaparral, oak woodland and grassland habitat. Many of the types of activities to be funded by the (b)(1) "other" Program also could be listed under the CVP Conservation Program. Partnerships have been an integral part of most of the projects for both funding and management.

TABLE II-5

CORE PROGRAMS INCLUDED IN PEIS ALTERNATIVES

Core Program Action	CVPIA Section
Renew all CVP Service, Water Rights, and Exchange Contracts (no change from No-Action Alternative).	Section 3404(c)
Implement water measurement: Implement with measurement devices at point of diversion from CVP supplies and estimates for individual users, or with measurement devices at point of use.	Section 3405(b)
Implement water conservation standards: Include water conservation for municipal and on-farm uses assumed in the DWR Bulletin 160-93; and conservation plans completed under the 1982 Reclamation Reform Act with implementation of Best Management Practices that are critical and/or economical, such as measurement devices, pricing structures, demand management, public information; and financial incentives.	Section 3405(e)
Implement Non-Flow Improvements for Anadromous Fish Restoration (see Attachment F)	Section 3406(b)(1)
Implement (b)(1) "other" Program (see text for description)	Section 3406(b)(1)
Upgrade Tracy and Contra Costa Pumping Plants fish protection facilities	Sections 3406(b)(4-5)
Construct Shasta Temperature Control Device (same facilities as in the No-Action Alternative with funding per CVPIA)	Section 3406 (b)(6)
Complete improvements to Coleman National Fish Hatchery	Section 3406(b)(11)
Complete habitat improvements in Clear Creek (expand spawning and rearing areas, and periodically clear the McCormick-Saeltzer Dam sediment trap)	Section 3406(b)(12)
Implement Non-Flow Stream Restoration Actions to replace gravel in the Stanislaus, American, and Sacramento rivers (Included in Attachment F)	Section 3406(b)(13)
Complete modifications to Anderson-Cottonwood Irrigation District Diversion to protect fish	Section 3406(b)(17)
Complete modifications to Glenn-Colusa Irrigation District Diversion Facility to protect fish	Section 3406(b)(20)
Avoidance of juvenile anadromous fish loss at diversions including construction of screens, bypasses, fish ladders, and modification of diversion (see Attachment F of the PEIS for list of potential actions)	Section 3406(b)(21)
Implement Seasonal Field Flooding: Flood up to 80,000 acres in Central Valley with payments up to $25/acre (1992 dollars). Land to be flooded primarily would be rice fields that are designed to be flooded.	Section 3406(b(22)
Purchase 30,000 acres of retired lands from willing sellers (see text for description)	Section 3408(h)

Land Retirement Actions

The extent of the land retirement program is currently being determined. For the purposes of the PEIS, it was assumed that the land retirement program would be similar in nature to the land retirement program described by the San Joaquin Valley Drainage Program (SJVDP) for selective purchase from willing sellers of irrigated lands that are characterized by low productivity, poor drainage, and high selenium concentrations in shallow groundwater. Up to 30,000 acres of land would be retired under the PEIS alternatives using mechanisms provided by CVPIA. That total is in addition to the 45,000 acres presumed to be purchased under the No-Action Alternative. It is assumed that the land would be located in the San Joaquin and Tulare Lake Regions of the study area and that the associated water would remain with the district. This programmatic approach for the PEIS provides an analysis of changing crop patterns in the area of the Central Valley characterized by drainage problems without specifically addressing the retirement of individual parcels.

As other studies are completed, the land retirement program could be expanded to include other lands and/or the purchase of water with the land. The environmental documentation to address the other areas will be completed with the site-specific documents.

MULTIPLE OPTION PROGRAMS WHICH VARY AMONG ALTERNATIVES

The multiple option programs considered in the PEIS alternatives and the supplemental analyses are listed in Table II-6. Additional information is presented below for programs or actions related to fish and wildlife, water pricing, and water transfers, because these are the major programmatic elements of the Multiple Option Programs.

Fish and Wildlife Management Programs

The Fish and Wildlife Management Programs in the Multiple Option Programs included methods to improve habitat, as defined by the Anadromous Fish Restoration Program (AFRP) and refuge water supplies. The program associated with refuge water supplies was defined in a 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan completed by Reclamation. The following subsections describe the Anadromous Fish Restoration Program (AFRP) actions that focused on flow management and how these flow actions were included in the PEIS alternatives. Level 2 and Level 4 refuge water supplies assumed in the alternatives are listed in Tables II-7 and II-8, respectively.

Anadromous Fish Restoration Program. 3406(b) of the CVPIA directs the development and implementation of the AFRP. The goal of the AFRP is to develop reasonable efforts to ensure that, by the Year 2002, natural production of anadromous fish in the Central Valley rivers and streams would be sustainable on a long-term basis at levels not less than twice the average levels attained during the period of 1967 through 1991. Total fish sustainable population objectives in Central Valley streams are:

TABLE II-6

MULTIPLE OPTION PROGRAMS IN PEIS ACTION ALTERNATIVES

Multiple Option Program Actions	CVPIA Section	Alternative or Supplemental Analysis
Fish and Wildlife Water Management Actions: Implement CVP reoperation or "(b)(1) water", and dedication of 800,000 acre-feet of CVP water or "(b)(2) water" from Anadromous Fish Restoration Program.	Section 3406(b)(1-2)	***Preferred Alternative:*** Reoperate CVP facilities ("(b)(1) water") and release CVP water in Sacramento, American, Stanislaus, and lower San Joaquin rivers and Clear Creek and in the Delta (including the CVP-portion of the Bay-Delta Plan Accord) up to 800,000 acre-feet of CVP yield ("(b)(2) water"). **Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a:** Implement reoperation and (b)(2) water in the CVP-controlled streams (Sacramento, American, Stanislaus, and lower San Joaquin rivers and Clear Creek), and reoperation in the Delta (see text for additional details). **Alternative 4 & Supplemental Analyses 1a:** In addition, implement (b)(2) water in the Delta (see text for additional details)
Fish and Wildlife Water Management Actions: Implement water acquisition or "(b)(3) water" from willing sellers on the streams from Anadromous Fish Restoration Program.	Section 3406(b)(3)	***Preferred Alternative:*** Evaluate fish and wildlife management needs on a watershed basis. Implement flow changes in Central Valley streams and the Delta in accordance with information developed in the Anadromous Fish Restoration Program using water acquired from willing sellers on the streams. Purchase water from willing sellers on tributary streams of the Delta. Use water to increase instream fish flows and Delta outflow. Purchases of about 110,000 acre-feet/year on the San Joaquin River tributaries based on the preliminary San Joaquin River Agreement, as outlined in the November 20, 1997 Administrative Paper. Purchases of about 30,000 acre-feet/year in the Sacramento River Tributaries, such as Yuba River and on streams that support spring-run chinook salmon. Approximately 50 percent of the acquired water would be managed to improve flows in the Delta, and approximately 50 percent could be exported if the Bay-Delta Plan conditions were met. **Alternatives 2 and 4 & Supplemental Analyses 2a through 2d, and 4a:** Purchase water from willing sellers on tributary streams of the Delta. Use water to increase instream fish flows and Delta outflow (see text for additional details). **Alternative 3 and Supplemental Analysis 3a:** Purchase water from willing sellers on tributary streams to increase instream fish flows. Do not specifically use water to increase Delta outflow (see text for additional details).

TABLE II-6. CONTINUED

Multiple Option Program Actions	CVPIA Section	Alternative or Supplemental Analysis
Refuge Water Supply Actions: Provide firm CVP water supplies to meet average historical refuge water deliveries "Level 2 Supplies", as described in the 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan. Level 2 Supplies are presented in Table II-7.	Section 3406(d)(1-2)	***Preferred Alternative*:** Provide firm CVP water supplies to refuges at average historic water supply levels. The Level 2 water supplies would be subject to hydrologic shortages described by the 40-30-30 Index with a maximum shortage of 25 percent of the total amount (no change from the No-Action Alternative). **Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a through 1c, 1e through 1i, 2a through 2d, 3a, and 4a:** Provide firm CVP water supplies to refuges at average historic water supply levels. The Level 2 water supplies would be subject to hydrologic shortages described by the Shasta criteria with a maximum shortage of 25 percent of the total amount (no change from the No-Action Alternative). **Supplemental Analysis 1d:** Same as above; however, the Level 2 water supplies would not be subject to hydrologic shortages.
Refuge Water Supply Actions: Purchase water from willing sellers to meet "ultimate" refuge water deliveries "Level 4 Supplies", as described in the 1989 Refuge Water Supply Study and the San Joaquin Basin Action Plan. Level 4 Supplies are presented in Table II-8.	Section 3406(d)(1-2)	***Preferred Alternative,* Alternatives 2, 3, and 4 & Supplemental Analyses 2a through 2d, 3a, and 4a:** Purchase water from willing sellers to increase water supply levels from Level 2 to Level 4. The additional water supplies would be subject to hydrologic shortages associated with the purchased water.
Water Pricing Actions: Implement tiered water pricing for CVP water service contracts.	Section 3405(d)	***Preferred Alternative,* Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a, 1b, 1d through 1f, 1h, 1i, 2a through 2c, 3a, and 4a:** Based upon "80/10/10 Tiered Water Pricing up to Full Cost Approach" and the use of the Ability-to-Pay policies (see text for discussion). **Supplemental Analyses 1c and 2d:** Based upon "80/10/10 Tiered Water Pricing up to Full Cost Plus Approach" and the use of the Ability-to-Pay policies (see text for discussion). **Supplemental Analysis 1g:** Based upon "80/10/10 Tiered Water Pricing up to Full Cost Approach" without the use of the Ability-to-

TABLE II-6. CONTINUED

Multiple Option Program Actions	CVPIA Section	Alternative or Supplemental Analysis
		Pay policies (see text for discussion).
Red Bluff Diversion Dam Actions: Modify Red Bluff Diversion Dam gate operations to protect juvenile chinook salmon from injury and disorientation while passing through diversion dam. The dam structure allows water to move from the Sacramento River to the Tehama-Colusa Canal and Corning Canal. The modifications also would protect the salmon from predation by squawfish below the dam.	Section 3406(b)(10)	***Preferred Alternative,* Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a through 1h, 2a through 2c, 3a, and 4a:** Fish passage improvements to Red Bluff Diversion Dam based upon findings from ongoing fish screen studies. Gates would continue to be open from mid-September through mid-May as required by the winter-run chinook salmon biological opinion. Gates would be closed mid-May through mid-September which would form Lake Red Bluff. Diversions would continue at No-Action Alternative levels. **Supplemental Analysis 1i:** Fish passage improvements to Red Bluff Diversion Dam based upon findings from ongoing fish screen studies. Gates would be open all year. Diversions would continue at No-Action Alternative levels.
Delta Fish Barrier Actions: Construct fish barrier in Georgiana Slough and permanent barrier in Old River.	Sections 3406(b)(14-15)	***Preferred Alternative:*** Specific actions for fish barriers in Georgiana Slough and in Old River not defined, general benefits are assumed in the PEIS. **Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a, 1c through 1i, 2b through 2c, 3a, and 4a:** Fish barriers would be non-structural. **Supplemental Analyses 1b and 2a:** Fish barriers would be structural.
Water Transfer Actions: Provide for water transfers to meet agricultural and municipal water needs in California.	Section 3405(a)	**TRANSFER ALTERNATIVES: *Preferred Alternative,* Supplemental Analyses 1e, 2b, 3a, and 4a:** Water transfers would occur between all parties based upon demand, capacity of conveyance facilities, and economic effectiveness. Cost of transferred CVP water would be equal to the cost of service for municipal CVP water, and the higher cost of service or full cost for agricultural CVP water. Costs of transferred CVP water and all other water supplies also would include the cost to the seller to make the water available, including the amount of lost income. A $25/acre-

TABLE II-6. CONTINUED

Multiple Option Program Actions	CVPIA Section	Alternative or Supplemental Analysis
		foot (1992 dollars) charge per CVPIA user would be added to transfer agricultural CVP water to non-CVP municipal water users. The Restoration Fund charge would be increased for the transfer of agricultural CVP water to CVP municipal water users. **TRANSFER ALTERNATIVES: Supplemental Analyses 1f and 2c:** All charges described above for Supplemental Analyses 1e, 2b, 3a, and 4a, plus an additional $50/acre-foot (1992 dollars) charge on all CVP water transfers. The additional monies would increase contributions to the Restoration Fund. The additional charge would require additional Congressional authorization. **Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a through 1d, 1g through 1i, 2a, and 2d:** Only CVP water could be transferred within the CVP service area. San Joaquin River Exchange Contractors cannot transfer CVP water. Individuals cannot transfer CVP water. Agricultural CVP water cannot be transferred to municipal CVP users. No change from No-Action Alternative.
Revegetation of 30,000 acres of retired lands purchased from willing sellers: Assume for purposes of PEIS, retirement of 30,000 acres of land with drainage problems in the area identified in the San Joaquin Valley Drainage Program. This amount is in addition to retirement of 45,000 acres with drainage problems in the same general location under the No-Action Alternative. Retired lands would remain vacant or minimal dry farming could occur. The uncultivated land would be irrigated at least once to allow revegetation to avoid erosion.	Section 3408(h)	***Preferred Alternative,* Supplemental Analysis 1h:** Specific revegetation programs and animal reintroduction programs would be implemented on fallowed lands to improve the land for special-status species. **Alternatives 1, 2, 3, and 4 & Supplemental Analyses 1a through 1g, 1i, 2a through 2c, 3a, and 4a:** Fallowed lands would remain vacant or minimal dry farming could occur. The uncultivated land would be irrigated at least once to allow revegetation to avoid erosion. However, most plants would be weedy species and animals probably would not be special-status species.

TABLE II-7

LEVEL 2 REFUGE WATER SUPPLIES IN PEIS ALTERNATIVES

Refuge	Level 2 Supply At Refuge Boundary	Conveyance Loss	Amount To Be Diverted
Sacramento Valley Refuges			
Sacramento National Wildlife Refuge	46.4	15.5	61.9
Delevan National Wildlife Refuge	20.9	7.0	27.9
Colusa National Wildlife Refuge	25.0	8.3	33.3
Sutter National Wildlife Refuge	23.5	2.6	26.1
Grey Lodge National Wildlife Refuge	35.4	5.2	40.6
Total for Sacramento Valley Refuges	**151.2**	**38.6**	**189.8**
San Joaquin Valley Refuges			
San Luis National Wildlife Refuge	19.0	6.3	25.3
Kesterson National Wildlife Refuge	10.0	1.1	11.1
Volta Wildlife Management Area	13.0	0.0	13.0
Los Banos Wildlife Management Area	16.6	2.8	19.4
San Joaquin Basin Action Lands			
Freitas	5.3	1.8	7.1
West Gallo	10.8	3.6	14.4
Salt Slough	6.7	1.2	7.9
China Island	7.0	1.2	8.2
Grasslands Resource Conservation District	125.0	22.1	147.1
Mendota Wildlife Management Area	27.6	0.0	27.6
Merced National Wildlife Refuge	15.0	5.0	20.0
East Gallo	8.9	2.9	11.8
Kern National Wildlife Refuge	9.9	1.5	11.4
Pixley National Wildlife Refuge	1.3	0.0	1.3
Total for San Joaquin Valley Refuges	**276.1**	**49.5**	**325.6**
TOTAL FOR ALL REFUGES	**427.3**	**88.1**	**515.4**

NOTE:
Values based upon the 1989 Refuge Water Supply Study and San Joaquin Basin Action Plan. Values have been subsequently modified to reflect more recent data.
All values in 1,000 acre-feet.

TABLE II-8

LEVEL 4 REFUGE WATER SUPPLIES IN PEIS ALTERNATIVES

Refuge	Level 4 Supply At Refuge Boundary	Conveyance Loss	Amount To Be Diverted
Sacramento Valley Refuges			
Sacramento National Wildlife Refuge	50.0	16.7	66.7
Delevan National Wildlife Refuge	30.0	10.0	40.0
Colusa National Wildlife Refuge	25.0	8.3	33.3
Sutter National Wildlife Refuge	30.0	3.3	33.3
Grey Lodge National Wildlife Refuge	44.0	7.0	51.0
Total for Sacramento Valley Refuges	**179.0**	**45.3**	**224.3**
San Joaquin Valley Refuges			
San Luis National Wildlife Refuge	19.0	6.3	25.3
Kesterson National Wildlife Refuge	10.0	1.1	11.1
Volta Wildlife Management Area	16.0	0.0	16.0
Los Banos Wildlife Management Area	25.5	5.1	30.6
San Joaquin Basin Action Lands			
Freitas	5.3	1.8	7.1
West Gallo	10.8	3.6	14.4
Salt Slough	10.0	1.8	11.8
China Island	10.5	1.8	12.3
Grasslands Resource Conservation District	180.0	31.8	211.8
Mendota Wildlife Management Area	29.7	0.0	29.7
Merced National Wildlife Refuge	16.0	5.3	21.3
East Gallo	13.3	4.4	17.7
Kern National Wildlife Refuge	25.0	3.7	28.7
Pixley National Wildlife Refuge	6.0	0.8	6.8
Total for San Joaquin Valley Refuges	**377.0**	**67.7**	**444.7**
TOTAL FOR ALL REFUGES	**556.0**	**113.0**	**669.0**

NOTE:
Values based upon values in 1989 Refuge Water Supply Study and San Joaquin Basin Action Plan. Values have been subsequently modified to reflect more recent data.
All values in 1,000 acre-feet.

♦ Chinook salmon, all races	990,000
♦ Steelhead (spawing upstream of Red Bluff Diversion Dam)	13,000
♦ Striped bass	2,500,000
♦ American shad	4,300
♦ White sturgeon	11,000
♦ Green sturgeon	2,000

The Service is taking the following steps to develop the AFRP: 1) attain the best available scientific and commercial data; 2) develop a long-term Restoration Plan that identifies the general approaches and actions to attain the goal; and 3) develop short-term implementation plans as tiers to the Restoration Plan. The tiered implementation plans would be revised at least every 3 to 5 years. The AFRP also will be reviewed and updated every 5 years.

The AFRP preliminary recommendations are based upon best available scientific information to provide a platform on which participating agencies and the public could develop reasonable actions. Information used in the AFRP was collected from available reports, input from stakeholders, and input from the scientific community. In December 1995, the Service prepared a Draft Restoration Plan. The purpose of this plan was to identify general approaches and actions to attain the objectives of AFRP. The Draft Restoration Plan was reviewed by the public and interested agencies and groups. The Revised Draft Restoration Plan was released in1996, as summarized in Attachments G4 and G5 of the PEIS. The Revised Draft Restoration Plan included actions based upon scientific knowledge and the following reasonableness criteria:

- The technical and legal basis of the actions must be reasonable.
- Interior or supportive partners must have the authority to implement the actions.
- Potential partners that would be required to implement actions must be supportive.

Based on current information, Interior believes a reasonable program will achieve doubling goals for some species and discrete runs on some streams. In almost all cases, Interior believes that improvement can occur to identified anadromous species populations even if doubling goals are not achieved. The Comprehensive Assessment and Monitoring Program (CAMP) (3406 (b)(16)) will be used extensively to provide information about ecosystem responses to AFRP implementation. Information from all monitoring programs including CAMP will be used to assist in the adaptive management of the AFRP. In addition, Interior would use partnerships with other Federal, State, and private entities to meet the overall goals.

Implementation of the Anadromous Fish Restoration Program in the Draft PEIS Alternatives. The AFRP was implemented in the PEIS alternatives through the instream and Delta habitat and flow improvements. The habitat improvements were included in the Revised Draft Restoration Plan as “ACTIONS” to be completed in each watershed (a list is included in Attachment F of the PEIS).

The flow improvements for Alternatives 1 through 4 were developed based upon information developed by the Service in October 1996 (the basis for the flow improvements are included in

Attachment G of the PEIS). Flow improvements presented in the November 1997 Administrative Paper (Attachment G) were reflected in modeling the Preferred Alternative.

The following three actions were identified in the CVPIA to improve flows. The definitions were developed for the purposes of the PEIS, as shown in Table II-6.

- ***Reoperation of the CVP in accordance with Section 3406(b)(1)(B)***. Reoperation is defined as changes in CVP operations that do not impact water deliveries to CVP water users.

- ***Dedication of 800,000 acre-feet of CVP water in accordance with Section 3406(b)(2) (or "(b)(2) Water")***. The "(b)(2) Water Management" is defined as operation of the CVP in a manner that would allow the CVP to dedicate and manage 800,000 acre-feet/year of CVP yield for fish and wildlife purposes, as limited by the requirements of the SWRCB and the winter-run chinook salmon biological opinion. The Preferred Alternative is to dedicate and manage 800,000 acre-feet/year of CVP yield consistent with the October 5, 1999 decision. As explained in Chapter 1, the analysis of the Preferred Alternative displays the impact of using 800,000 acre feet of project yield in a combination of quantitative and qualitative analyses.

  Actions considered in the quantitative modeling for (b)(2) Water Management, as described in the following subsection, include reservoir releases to improve instream flows on CVP-controlled rivers and to meet SWRCB Order 95-06; export limitations to meet SWRCB Order 95-06 and, in several alternatives, as suggested in Revised Draft Restoration Plan for AFRP; and instream releases and export limitations similar to measures set out in the November 1997 Administrative Paper.

- ***Water Acquisitions in accordance with Section 3406(b)(3).*** Water Acquisitions from willing sellers would be used to provide increased instream flows in specific months to improve habitat, in accordance with preliminary information developed by AFRP.

For the PEIS alternatives, water facilities operations were modified to reflect the use of these three actions. Because the PEIS and the AFRP were being developed at the same time, preliminary water management targets from the AFRP were used in development of the PEIS alternatives, as described below. The formal Water Management Plan process between Reclamation and the Service to develop a long-term operations plan is being developed. A simplified version of the process was developed for the PEIS based upon conservative assumptions. The alternatives may not meet the doubling goals as defined within the Service's Revised Draft Restoration Plan. Modeling assumptions were based upon preliminary information. Actual instream flow and storage targets would be more appropriately based on observed conditions and protection of special-status species. If, as a result of hydrology or other factors, conditions were to fall outside critical needs for the special-status species, the appropriate course of action under Section 7 of the ESA would be followed.

Reoperation and (b)(2) Water Management. To develop alternatives for Reoperation and (b)(2) Water Management, preliminary AFRP information was used in an iterative process to develop target flows for the CVP-controlled streams and the Delta. "Reoperation" is defined as changes in CVP operations that do not impact water deliveries to CVP water users. Reoperation had been initiated prior to the passage of CVPIA through adaptive management programs between Reclamation, the Service, and Department of Fish and Game. Reoperation can only affect flows on CVP-controlled streams identified in the CVPIA: Sacramento, American, Stanislaus, and lower San Joaquin rivers and Clear Creek.

The "(b)(2) Water Management" is defined as operation of the CVP in a manner that would allow the CVP to dedicate and manage 800,000 acre-feet/year of CVP yield for fish and wildlife purposes.

The (b)(2) Water Management cannot adversely impact non-CVP water rights holders (including the SWP), Sacramento River Water Rights Contractors, or San Joaquin River Exchange Contractors as compared to the No-Action Alternative. In addition, the (b)(2) Water Management cannot impact the ability of the CVP to meet the winter-run chinook salmon or delta smelt biological opinion. The (b)(2) Water Management process can reduce deliveries to agricultural CVP water service contractors as much as 100 percent of the allocation under the No-Action Alternative. However, the (b)(2) Water Management was defined in the PEIS alternative to not reduce municipal CVP water service contract deliveries more than 50 percent because municipal users frequently do not have options to operate without CVP water.

The (b)(2) Water Management included the following three components:

- ♦ Bay-Delta Plan Component
- ♦ Instream Component
- ♦ Delta Component (in addition to the Bay-Delta Plan Component)

The "Bay-Delta Plan Component" includes the reduction in CVP water deliveries that occurred due to implementation of the Bay-Delta Plan Accord, as described in the Accord. This reduction in deliveries also was included in the No-Action Alternative. The Bay-Delta Plan Component is included in all alternatives and supplemental analyses.

The "Instream Component" refers to use of (b)(2) water on the CVP-controlled streams to further supplement the Draft AFRP target flows. The primary goal of the (b)(2) Water Management Instream Component was to provide water for AFRP salmon and steelhead target flows in the Sacramento, American, Stanislaus, and Lower San Joaquin rivers and in Clear Creek. The Instream Component is included in all alternatives and supplemental analyses.

The "Delta Component" refers to the use of (b)(2) water in the Delta to meet Draft AFRP target flows and operational considerations in excess of those identified in the Bay-Delta Plan. The Delta Component is only included in the Preferred Alternative, Alternative 4, and Supplemental Analysis 1a.

Water Acquisitions to Meet Instream Target Flows. Water acquisitions in the PEIS alternatives would be implemented in accordance with the requirements of the State Water Resources Control Board (SWRCB). This approval process would require compliance with the State Water Code. The Water Code prevents transfers that would have an unreasonable impact on fish, wildlife, or instream uses (Water Code Sections 1025.5(b), 1725, 1736) or harm other users. The Water Code also prevents public agencies from conveying transferred water if fish, wildlife, or other beneficial instream uses are unreasonably affected or if the overall economy or environment in the county where the water originates would be unreasonably affected (Water Code Section 1810(d)). The SWRCB would need to confirm that adverse impacts would not occur or would be mitigated. For example, the willing seller may need to consider downstream uses of water, such as water supply or water quality purposes. To avoid adverse impacts, the willing seller may need to provide additional flows in specific periods to avoid affecting downstream users.

For the purposes of the PEIS, it was assumed that municipalities would not be willing sellers because projected water demands exceed projected supplies. In addition, it was assumed that agricultural SWP contractors would not be willing sellers because the municipal SWP contractors would have first right of refusal for all transfers, and that the SWP municipal contractors would purchase the water.

The following water acquisition alternatives were developed in the PEIS alternatives to improve instream fishery flows.

- **Alternative 1 and Supplemental Analyses 1a through 1i:** No water would be acquired to improve instream fishery flows.

- **Alternative 2 and Supplemental Analyses 2a through 2d:** Water would be acquired from willing sellers on the Stanislaus, Tuolumne, and Merced rivers and on the tributary creeks of the Upper Sacramento River that support spring-run. The acquired water would be managed toward meeting target flows for the streams. The acquired water also would be used to improve flows in the Delta. Therefore, the acquired water could not be exported by the CVP or SWP.

- **Alternative 3 and Supplemental Analysis 3a:** Water would be acquired from willing sellers on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers and on the tributary creeks of the Upper Sacramento River to improve instream flows in accordance with target flows. The acquired water would not be managed for increased flows through the Delta. Therefore, the acquired water could be exported if Bay-Delta Plan conditions were met.

- **Alternative 4 and Supplemental Analysis 4a:** Water would be acquired for the streams as under Alternative 3. The acquired water would be managed toward meeting target flows for the streams and to improve flows in the Delta. Therefore, the acquired water could not be exported by the CVP or SWP.

- **Preferred Alternative:** Water would be acquired from willing sellers on the Stanislaus, Tuolumne, and Merced rivers and on tributary creeks of the upper Sacramento River to improve instream and Delta flows. A portion of the acquired water would be managed for increased flows through the Delta. The remaining portion of the acquired water could be exported.

Water acquisitions were not considered on the Sacramento River because changes in operations would have impacted the ability of the CVP to operate to the winter-run chinook salmon biological opinion. Water acquisitions were not considered on the American River because most of the water is used to serve municipal users.

The amounts of water to be acquired are presented in Table II-9. The amounts of water acquired under the alternatives were limited by costs. Purchase of the acquired water was assumed to be funded with Restoration Funds authorized under CVPIA. It was assumed that a long-term average total of $50 million/year (1992 dollars) would be collected in the Restoration Fund. Under Alternative 2, it was assumed that flow and non-flow habitat improvement actions and other CVPIA programs would be funded within the $50 million/year limitation (1992 dollars). Therefore, based upon estimated costs for non-flow habitat improvements and other CVPIA programs, funding limitations for water acquisition were determined as described in the following portion of this chapter.

TABLE II-9

WATER ACQUISITION GOALS FOR INSTREAM FISHERY HABITAT IN PEIS ALTERNATIVES

Stream(s)	Preferred Alternative	Alternative 2 and Supplemental Analyses 2a -2d	Alternatives 3 and 4 and Supplemental Analyses 3a and 4a
Mill, Deer, Battle, Chico, Antelope, Cow, and Butte Creeks and Bear River	Amount not Quantified for PEIS Alternatives	Amount not Quantified for PEIS Alternatives	Amount not Quantified for PEIS Alternatives
Other Sacramento River Tributaries	30	None	100
Mokelumne River	0	None	70
Calaveras River	0	None	40
Stanislaus River	110 per 11/20/97	60	200
Tuolumne River	Administrative	60	200
Merced River	Paper	50	200

NOTE:
All values in 1,000 acre-feet

Under Alternatives 3 and 4, the cost limitation was increased to $120 million/year (1992 dollars). The higher cost limitation reflected three factors that could occur. First, some of the non-flow habitat improvement actions could be funded by non-CVPIA programs, such as CALFED; therefore, more funds may be available for water acquisition. Second, if no willing sellers only occurred in some watersheds, more funds could be used in the remaining watersheds to purchase more water. This analysis considers higher amounts of water than probably could be purchased under average conditions to allow for this scenario. Finally, if the price of water were less than what is used in this analysis, the remaining Restoration Funds could purchase more water in the watersheds than considered under this analysis, if the water were available.

Use of the acquired water within an operational pattern was determined by comparing the available water to biological priorities developed in the preliminary AFRP information. Base instream flows in the No-Action Alternative were compared to the biological priorities (described in Attachment G). Acquired water was used to meet the next set of priorities, or target flows, identified by the AFRP. The overall goal was to increase instream flows toward conditions that exist during wet weather periods. The overall goals were not met except in several extremely wet years for limited periods of time. Therefore, for the purpose of the PEIS, instream target flows were developed to use the amount of acquired water considered in the alternatives in the most appropriate manner based upon available information.

Base flows are not known for the creeks that are tributary to the upper Sacramento River. Therefore, it was difficult to determine quantities for development of target flows. It also was difficult to develop a water operation to meet target flows on the Bear River without impacting the SWP operations. Therefore, quantities were not developed for acquisition in the Bear River watershed. Approximate costs and benefits were estimated due to water acquisition on these watersheds for the purposes of the PEIS analysis.

The analysis of agricultural economics was used to determine the actions that would be implemented to make the water available for acquisition. These actions included increased water conservation that would not be economical without the revenue from water sales, changes in crop patterns, and land fallowing. Under Alternative 2, the amount of fallowed land was relatively small as compared to irrigated acreage in the affected watersheds. However, under Alternatives 3 and 4, the amount of fallowed land increased significantly especially in the Stanislaus, Tuolumne, and Merced river watersheds. Therefore, to improve fish and wildlife habitat, it was assumed under Alternatives 3 and 4 that up to 15 percent of the fallowed land conservation occured in the Tuolumne, and Merced river watersheds. Therefore, to improve fish and wildlife habitat, it was assumed under Alternatives 3 and 4 that up to 15 percent of the fallowed land conservation easements could be purchased by Interior to allow habitat restoration for special status species and other native species.

Water Pricing Actions

Three different water pricing concepts were considered in the PEIS alternatives as described below.

Tiered Water Pricing from Contract Rate to Full Cost Rate. The water pricing actions under the Preferred Alternative; Alternatives 1, 2, 3, and 4; and Supplemental Analyses 1a, 1b, 1e through 1i, 2a through 2c, 3a, and 4a were based upon use of a "80/10/10" tiered approach consistent with applicable ability-to-pay policy. Under this approach, the first 80 percent of contract quantity would be priced at the applicable Contract Rate. With the exception of documented ability-to-pay limitations and minimum water rate requirements, such rate is the cost of service water rate as computed by the applicable CVP ratesetting policy. The next 10 percent of the contract quantity would be priced at the average of the applicable Contract Rage and Full Cost Rate, the latter of which is computed in accordance with the applicable Reclamation Reform Act definition of Full Cost. The final 10 percent of the contract quantity would be priced at the Full Cost Rate.

With the exception of contracts covered by a documented ability-to-pay limitation, the Contract Rate for agricultural contracts is equal to an allocated share of the CVP-main project facilities operation and maintenance expenses and capital cost without interest. The Full Cost Rate for agricultural contracts includes interest calculated at the Reclamation Reform Act prescribed interest rate. Tiered water rates from Contract Rate to Full Cost Rate are illustrated in the example below.

The three M&I water rate tiers are similar to those applicable to agricultural water. In addition to allocated O&M and capital expenses associated with CVP main project facilities, the Contract Rate for municipal and industrial water includes an interest component calculated at the authorized CVP interest rate. The M&I Full Cost rate includes the same components; however, the interest component is established at the higher Reclamation Reform Act specified interest.

The applicable Contract Rate would continue to be determined in accordance with Section 105 of Public Law 99-546 and the applicable CVP ratesetting policy. The Contract Rate for agricultural water, however, would be adjusted to reflect current ability-to-pay limitations, if any, determined by the Secretary to be applicable to the specific contractor's water users. The ability-to-pay policy provides financial relief to agricultural water users relative to the repayment of capital costs of CVP main project facilities. Relative to the Contract Rate, the relief could be as great as 100 percent of the assigned capital cost component. The exact amount of such relief, if any, is determined through development of local farm production budgets. Ability-to-pay relief is not applicable to CVP operation and maintenance costs or non-CVP related costs, including any loans for construction of irrigation facilities pursuant to various Federal Reclamation programs. With limitation exception, relief based upon ability-to-pay limitations is not available relative to repayment of CVP distribution facilities.

The CVPIA mandates that the third tier water rate be no less than the Full Cost Rate. Accordingly, there is no adjustment permitted to the capital component of the rate of the agricultural water rate if an ability-to-pay limitation is demonstrated. As the second tier water rate is the average of the first time (Contract Rate with or without adjustment for ability-to-pay) and the third tier rate (no less than the Full Cost Rate), the second tier agricultural water rate will reflect partial adjustment for ability-to-pay if a need for financial relief is documented.

In addition to the applicable CVP water rate, CVP water service contractors are required by the CVPIA to pay a Restoration Payment for CVP Water which is "delivered and sold." The rates are $6 (1992 dollars) and $12 (1992 dollars) for agricultural and M&I water, respectively. Ability-to-pay relief also applies to the Restoration Payment applicable to water used for agricultural purposes. Such relief may be for part or all of the Restoration Payment depending upon the Secretary's determination.

With very limited exception, the CVPIA requires application of an additional mitigation and restoration payment (frequently called the PreRenewal Surcharge) on each acre-foot of CVP water delivered to those contractors having existing long-term CVP water service contracts who do not agree to renew early consistent with the applicable provisions of the CVPIA. For the purposes of this PEIS, it is assumed that all such long-term contracts will be renewed early to include the applicable CVPIA contracting requirements in order to avoid these additional charges upon completion of the PEIS.

Tiered Water Pricing from Full Cost Rate to Full Cost Plus Rate. The water pricing actions under Supplemental Analysis 1c and 2d would be based upon a "80/10/10 Tiered Water Pricing from Full Cost Rate to Full Cost Plus" approach with Ability-to-Pay policies. The first 80 percent of contract volume would be priced at the Full Cost rate. The next 10 percent of the contract volume would be priced at a value 10 percent higher than Full Cost rate. The final 10 percent of the contract volume would be priced at a value 20 percent higher than Full Cost rate, as shown in the following example. The rates would continue to be determined in accordance with the Reclamation Reform Act and current pricing policies as in the No-Action Alternative, including the current Ability-to-Pay policies. The price for CVP water also would include collection of the Restoration Payments.

EXAMPLES OF TIERED PRICING

No-Action Alternative:	
Contract Amount =	100,000 acre-feet
Contract Rate =	$20/acre-foot
Full Cost Rate =	$60/acre-foot
Cost of Full Deliveries =	(100,000 af) x ($20/af) = $2,000,000
Tiered Pricing from Contract Rate to Full Cost Rate:	
Contract Amount =	100,000 acre-feet
Contract Rate =	$20/acre-foot
Full Cost Rate =	$60/acre-foot
Cost of Full Deliveries =	(80,000 af) x ($20/af) +
	(10,000 af) x ($40/af) +
	(10,000 af) x ($60/af) = $2,600,000
Tiered Pricing from Full Cost Rate to Full Cost Plus Rate:	
Contract Amount =	100,000 acre-feet
Contract Rate =	$20/acre-foot
Full Cost Rate =	$60/acre-foot
Cost of Full Deliveries =	(80,000 af) x ($60/af) +
	(10,000 af) x ($66/af) +
	(10,000 af) x ($72/af) = $6,180,000

Tiered Water Pricing without Ability-to-Pay Policies. Actions under Supplemental Analysis 1g would be identical to those discussed under Tiered Water Pricing from Contract Rate to Full Cost Rate, except there would be no relief for the capital cost portion of the repayment price under the Ability-to-Pay policies. The Ability-to-Pay policy would apply to the Restoration Fund charges for agricultural water service contractors.

Contract Total. While the PEIS evaluated the pricing alternatives described above, it did not analyze alternative definitions of the amount of contract total to which the tiered pricing would be applied. That analysis would be done in site-specific analysis to better reflect the potential differences in approach from one project division to another.

Water Transfer Programs

The potential impacts of CVPIA water transfers were assessed by implementing transfers as Supplemental Analyses on the main alternatives. The main alternatives did not include transfers because transfers under CVPIA would be voluntary between buyer and seller. In addition, alternatives with transfers are not defined clearly enough at this time to allow the quantitative analysis used for the main alternatives.

Therefore, water transfers are evaluated as opportunities for water transfers and how implementation of CVPIA may affect those opportunities. The specific volumes of water described in the PEIS alternatives should not be considered as predictions, but rather as reasonable representations of the potential water market. The alternatives with transfers assume that all CVP water would be transferrable. The analysis generally identified water transfer opportunities as buying and selling by region at a programmatic level. The analysis evaluated average and dry water year conditions to determine the sensitivity of the market.

The alternatives with transfers assumed that there would be no new facilities constructed. Therefore, transfers may be limited by existing conveyance capacities. In addition, no new groundwater wells or recharge facilities would be constructed to provide for conjunctive use programs. If new facilities were constructed, the opportunities for water transfers may increase more than discussed in the PEIS alternatives.

The No-Action Alternative for the PEIS does not include any types of transfers. Because of the speculative nature of the transfer market, it is not possible to predict the transfer market in the Year 2025 with or without implementation of CVPIA. For the purposes of developing and comparing the alternatives with transfers, a Base Transfer Scenario was created. The Base Transfer Scenario included the No-Action Alternative assumptions and a water transfer market defined by comparing available water supplies, associated costs of those water supplies, general capacity of major conveyance facilities, and water shortages as determined by water supply analyses and population projections. These same factors were considered for the alternatives with transfers with the introduction of CVP water into the transfer market.

All transfers would occur under the same rules that were described above under Water Acquisitions for fish and wildlife purposes. Therefore, specific environmental documentation would be required prior to the implementation of transfers with and without CVPIA.

It is assumed that the cost of the transferred water would be equal to the capital and operation and maintenance costs to make the water available, including the amount of lost income. The cost of transferred water also would include specific transfer costs. Under Supplemental Analyses 1e, 2b, 3a, and 4a, the costs would include a $25/acre-foot charge in accordance with the CVPIA. Actions under Supplemental Analyses 1f and 2c are similar to those under Supplemental Analysis 1e and 2b, except that an additional water transfer fee would be included in the cost of water. The addition of a $50/acre-foot fee on all CVP water transfers was identified during the screening process for alternatives development as one possible way of increasing contributions to the Restoration Fund, if needed.

IMPLEMENTATION OF INCREASED INSTREAM FISH FLOW RELEASES IN THE TRINITY RIVER

Increased instream flows in Trinity River, although a provision of CVPIA, are not a part of the Federal action proposed in this PEIS, and this PEIS alone will not provide the basis for a decision to implement the increased releases. The Trinity River Mainstem Fishery Restoration EIS/EIR, a separate and concurrent NEPA document, analyzes a range of alternatives to restore and maintain the natural production of anadromous fish populations of the Trinity River mainstem downstream of Lewiston Dam. The alternatives considered in that EIS/EIR include many factors, including several different instream flow patterns.

If implemented, the increased flows in Trinity River would be a related action that would have a cumulative effect together with the Federal action proposed in this PEIS. Therefore, this PEIS makes assumptions about increased flows in Trinity River solely for the purposes of programmatic analysis. These assumed increased flows are analyzed in this PEIS only to the extent that they would have a cumulative effect with the provisions actually proposed in this action. However, the assumed increased flows in Trinity River are closely related to the action proposed here and would have wide-ranging interactive effects with the action proposed here. Accordingly, the environmental analysis in the PEIS considers increased flows in Trinity River in the analysis of direct effects, indirect effects, and cumulative effects. Indeed, it would not be possible to provide a meaningful and complete analysis of the direct and indirect effects of the action proposed here without incorporating the cumulative effect of increased flows in Trinity River.

Changes in the instream fish flow release pattern affect the amount of water that can be exported to the Central Valley from the Trinity River. Changes in the amount of CVP exports from the Trinity River can significantly affect how the CVP is operated. Therefore, to provide an appropriate analysis of changes in CVP operations for the PEIS Alternatives, it was necessary to develop an assumption for the instream fish flow releases in the Trinity River.

For the PEIS analysis, the Service developed a preliminary instream fisheries flow release pattern for the Trinity River that ranges from 390,000 acre-feet in critical dry years to 750,000 acre-feet in wet years, as included in Attachment G of the PEIS. This instream fisheries flow release pattern was incorporated into all PEIS alternatives and supplemental analyses.

During the completion of the PEIS, the Trinity River Flow Evaluation was published. The flows in the Flow Evaluation and several other alternatives are evaluated in the Trinity River Mainstem Fishery Restoration EIR/EIS. The actual instream fish flows for the Trinity River will be determined by the Secretary of the Interior following the completion of the EIR/EIS. However, to evaluate this potential instream flow pattern, the Recommended Instream Flows were included in the Cumulative Effects quantitative analysis. The Recommended Flows range from 369,000 acre-feet in critical dry years to 817,000 acre-feet in wet years. Therefore, the analysis of environmental consequences in Chapter IV and the cumulative effects analysis in Chapter V compare the cumulative effects of increased flows in the Trinity River under two different, but similar, flow assumptions.

FUNDING OF CVPIA ACTIONS

The extent of the CVPIA actions evaluated in the PEIS alternatives was limited by the estimated funding availability, as discussed above. Many of the non-flow restoration actions would be partially funded by the Restoration Fund, by Federal funds not reimbursed by the CVP users, and by the State of California. In addition, water acquisition, land retirement, refuge water conveyance facilities, and the (b)(1) “other” program required funding from these sources.

General cost estimates were developed for the non-flow actions listed in Attachment F. Costs for structural provisions to improve fish passage and fish protection are estimated at approximately $368 million in capital costs and $14 million/year in operation and maintenance costs. Costs for non-flow actions for other types of habitat restoration are estimated at approximately $300 million in capital costs and $10 million/year in operation and maintenance. A portion of these costs would be funded by Restoration Fund, a portion would be funded through other Federal funds that are not identified at this time, and a portion would be funded through State funds that are not identified at this time. The estimated costs for the actions to be entirely or partially funded under the Restoration Funds under PEIS alternatives are summarized in Table II-10.

The Restoration Fund has an overall limit of $50 million/year (1992 dollars) that can be collected. However, the actual amount of funds that would be collected would be less than this amount if full contract amounts cannot be delivered to CVP water service contracts due to shortages. It is estimated that the Restoration Fund would collect $40 to $45 million/year (1992 dollars) under each alternative if no water transfers occurred or if funding is constrained by other actions. This could limit the capability of Interior to implement the actions listed under CVPIA, including those actions listed under AFRP, depending upon final implementation plans.

TABLE II-10

ESTIMATED ANNUAL COSTS FOR PEIS ALTERNATIVES

Alternative and Fund Type	Action						
	Non-Flow Restoration[1]	Land Retirement[2]	Level 2 Refuge Water supply Conveyance Costs	Level 4 Refuge Water Supplies	(b)(1)"other" Program[3]	Water Acquisition[2]	Total Costs[4]
Preferred Alternative:							
Restoration Funds	$35	$2	$5	—	$2	$6	$50
Other Federal Funds	10	—	$5	$7	—	—	22
State Funds	15	—	—	3	—	—	18
Alternative 1:							
Restoration Funds	$35	$2	$5	—	$2	$0	$44
Other Federal Funds	10	—	5	—	—	—	15
State Funds	15	—	—	—	—	—	15
Alternative 2:							
Restoration Funds	$35	$2	$5	—	—	$2	$10
Other Federal Funds	10	—	5	$7	—	—	22
State Funds	15	—	—	3	—	—	18
Alternative 3:							
Restoration Funds	$35	$2	$5	—	$2	$64	$108
Other Federal Funds	10	—	5	$7	—	—	22
State Funds	15	—	—	3	—	—	18
Alternative 4:							
Restoration Funds	$35	$2	$5	—	$2	$64	$108
Other Federal Funds	10	—	5	$7	—	—	22
State Funds	15	—	—	3	—	—	18

Notes:
(1) The estimated costs for non-flow restoration actions are presented as amortized capital costs over 30 years with annual operation and maintenance costs as appropriate.
(2) Estimated costs for water acquisition and land retirement are shown as amortized capital costs over 30 years.
(3) Annual costs for the (b)(1)"other" program assume a similar annual expenditure under the Conservation Program which is included in the No-Action Alternative and all other alternatives.
(4) All restoration costs in 1992 million dollars.

COMPARISON OF THE PEIS ALTERNATIVES WITH CVPIA PROVISIONS

As described above, for some CVPIA provisions only one implementation method was identified at a programmatic level (Core Programs). For other provisions, several implementation methods were identified. To combine the multiple implementation methods into alternatives, the main alternatives were developed with the Core Programs and sequential implementation of more defined programs for AFRP and refuge water supply. Therefore, the main alternatives built upon each other as well as the No-Action Alternative. The less defined programs with multiple implementation methods were used to develop the Supplemental Analyses which built upon the main alternatives. The Supplemental Analyses were compared to the main alternatives which were compared to the No-Action Alternative. A comparison of the CVPIA provisions to the PEIS alternatives is shown in Table II-4.

COMPARISON OF THE PEIS ALTERNATIVES WITH CVPIA OBJECTIVES

The PEIS alternatives were developed to meet the following objectives of the CVPIA, as identified in Section 3402 of the law.

- 3402 (a) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;
- 3402 (b) to address impacts of the CVP on fish, wildlife, and associated habitats;
- 3402 (c) to improve the operational flexibility of the CVP;
- 3402 (d) to increase water-related benefits provided by the CVP to the State of California through expanded use of voluntary water transfers and improved water conservation;
- 3402 (e) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and
- 3402 (f) to achieve a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agriculture, municipal and industrial and power contractors.

The alternatives addressed these objectives through development of multiple implementation methods of various actions addressed in the CVPIA. The assignment of the different implementation methods to each alternative is summarized in Table II-11.

Improvements to Fish and Wildlife Habitat (Section 3402(a) and (b))

The Preferred Alternative included methods to meet the objectives in Sections 3402 (a) and (b) to protect, restore, and enhance fish and wildlife habitat in the Central Valley and Trinity River Basin. This was accomplished through the implementation of the AFRP programs with flow and non-flow restoration actions, increased instream fish flow releases in the Trinity River, and

TABLE II-11

COMPARISON OF ASSUMPTIONS IN PEIS ALTERNATIVES WITH CVPIA OBJECTIVES

PEIS Alternative	Protect, Restore, and Enhance Fish and Wildlife Habitat (3402(a -b))	Improve Operational Flexibility (3402(c))	Increase Water-Related Benefits Through Water Transfers and Conservation (3402(d))	Improve Protection of Bay-Delta (3402(e))	Achieve a Reasonable Balance Between Competing Demands (3402(f))
Preferred Alternative	Improvements due to Non-Flow Habitat Improvements, (b)(1) "other" programs, Reoperation and (b)(2) Water Management with Bay-Delta Plan and Instream Components, acquisition of water on San Joaquin River and Sacramento River tributaries to improve instream and Delta fisheries habitat, increased instream fish flow releases in Trinity River, Levels 2 and 4 refuge water supplies.	Improvements for fish and wildlife habitat and recreational opportunities. Reduced overall flexibility for water supply and power generation uses, however, modified CVP operations to maximize water deliveries to extent possible under the Preferred Alternative assumptions and objectives.	Improvements due to mandatory implementation of all economical and appropriate water conservation programs for CVP water service contractors, and due to transfers under the Water Acquisition Program to improve instream and Delta flows.	Improvements due to implementation of Non-Flow Habitat Improvements, (b)(1) "other" programs, Reoperation and (b)(2) Water Management for instream and Delta components, and acquisition of water on San Joaquin River and Sacramento River tributaries to improve instream and Delta fisheries habitat.	Actions to meet fish and wildlife needs in streams and in the Delta while attempting to maximize CVP water supply operations and integrate acquired water.
Alternative 1	Non-Flow Habitat Improvements, (b)(1) "other" program, Reoperation and (b)(2) Water Management with Bay-Delta Plan and Instream Components, increased instream fish flow releases in Trinity River, and Level 2 refuge water supplies	Provisions for fish and wildlife habitat and recreational opportunities. Reduced overall flexibility for water supply and power generation uses.	Water conservation actions for CVP contractors	Non-Flow Habitat Improvements, (b)(1) "other" programs, Reoperation and (b)(2) Water Management with Bay-Delta Plan and Instream Components	Additional actions to meet fish and wildlife needs while attempting to maximize water supply operations
Supplemental Analysis 1a	Assumptions in Preferred Alternative plus implementation of Delta components of (b)(2) water management	Assumptions in Alternative 1 plus further provisions for fish and wildlife purposes	Same as Alternative 1	Assumptions in Alternative 1 plus Delta components of (b)(2) water management	Assumptions in Alternative 1 plus implementation of Delta components of (b)(2) water management
Supplemental Analysis 1b	Assumptions in Preferred Alternative plus fish passage improvements at Georgiana Slough and Old River	Assumptions in Alternative 1 plus further operational flexibility at Georgiana Slough and Old River	Same as Alternative 1	Assumptions in Alternative 1 plus fish passage improvements at Georgiana Slough and Old River	Assumptions in Alternative 1 plus fish passage improvements at Georgiana Slough and Old River
Supplemental Analysis 1c	Potentially same as Preferred Alternative, or potentially increased stream flows or Delta outflows	Assumptions in Alternative 1 plus potential increases in fish and wildlife habitat, water supply, or power generation	Same as Alternative 1	Potentially same as Alternative 1, or potentially increased stream flows or Delta outflows	Assumptions in Alternative 1 plus potential reduction in CVP water demand

TABLE II-11. CONTINUED

PEIS Alternative	Protect, Restore, and Enhance Fish and Wildlife Habitat (3402(a -b))	Improve Operational Flexibility (3402(c))	Increase Water-Related Benefits Through Water Transfers and Conservation (3402(d))	Improve Protection of Bay-Delta (3402(e))	Achieve a Reasonable Balance Between Competing Demands (3402(f))
Supplemental Analysis 1d	Assumptions in Preferred Alternative plus full Level 2 water supplies provided in critical dry years	Assumptions in Alternative 1 plus additional habitat at refuges	Same as Alternative 1	Same as Alternative 1	Assumptions in Alternative 1 plus additional habitat at refuges
Supplemental Analysis 1e	Same as Preferred Alternative	Assumptions in Alternative 1 plus provisions for water transfers	Assumptions in Alternative 1 plus water transfers involving CVP users under CVPIA provisions	Same as Alternative 1	Assumptions in Alternative 1 plus provisions for water transfers
Supplemental Analysis 1f	Same as Preferred Alternative	Same as Supplemental Analyses 1e	Same as Supplemental Analyses 1e	Same as Alternative 1	Same as Supplemental Analyses 1e
Supplemental Analysis 1g	Same as Preferred Alternative	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Supplemental Analysis 1h	Assumptions in Preferred Alternative plus habitat for special-status and native species at land retirement sites	Assumptions in Alternative 1 plus additional habitat	Same as Alternative 1	Same as Alternative 1	Assumptions in Alternative 1 plus additional habitat
Supplemental Analysis 1i	Same as Preferred Alternative	Assumptions in Alternative 1 plus operational flexibility at Lake Red Bluff	Same as Alternative 1	Same as Alternative 1	Assumptions in Alternative 1 plus operational changes at Lake Red Bluff
Alternative 2	Assumptions in Preferred Alternative plus acquisition of water on San Joaquin River tributaries and upper Sacramento River creeks to improve instream and Delta fisheries habitat; and acquisition of water to provide Level 4 refuge water supplies	Assumptions in Alternative 1 plus operational flexibility for fish and wildlife purposes	Assumptions in Alternative 1 plus transfers under the Water Acquisition Program	Assumptions in Alternative 1 plus acquisition of water on San Joaquin River tributaries and upper Sacramento River creeks to improve instream and Delta habitat	Assumptions in Alternative 1 plus water acquisition for instream and Delta purposes and Level 4 refuge water supplies. No change in CVP operations as compared to Alternative 1.
Supplemental Analysis 2a	Assumptions in Alternative 2 plus fish passage improvements at Georgiana Slough and Old River	Assumptions in Alternative 2 plus operational flexibility for fish purposes at Georgiana Slough and Old River	Same as Alternative 2	Assumptions in Alternative 2 plus fish passage improvements at Georgiana Slough and Old River	Assumptions in Alternative 2 plus fish passage improvements at Georgiana Slough and Old River
Supplemental Analysis 2b	Same as Alternative 2	Assumptions in Alternative 2 plus provisions for water transfers	Assumptions in Alternative 2 plus water transfers involving CVP users under CVPIA provisions	Same as Alternative 2	Assumptions in Alternative 2 plus provisions for water transfers
Supplemental Analysis 2c	Same as Supplemental Analysis 2b	Same as Alternative 2	Assumptions in Alternative 2, plus potential improvements due to water transfers involving CVP users under CVPIA provisions, however water transfers would be similar to those without CVPIA due to increased water transfer fees	Same as Alternative 2	Same as Supplemental Analysis 2b

TABLE II-11. CONTINUED

PEIS Alternative	Protect, Restore, and Enhance Fish and Wildlife Habitat (3402(a -b))	Improve Operational Flexibility (3402(c))	Increase Water-Related Benefits Through Water Transfers and Conservation (3402(d))	Improve Protection of Bay-Delta (3402(e))	Achieve a Reasonable Balance Between Competing Demands (3402(f))
Supplemental Analysis 2d	Potentially same as Alternative 2, or potentially increased stream flows or Delta outflows	Assumptions in Alternative 2 plus potential increase in fish and wildlife habitat, water supply, or power generation	Same as Alternative 2	Potentially same as Alternative 2, or potentially increased stream flows or Delta outflows	Assumptions in Alternative 2 plus potential reduction in CVP water demand
Alternative 3	Assumptions in Alternative 2 plus additional acquisition of water on San Joaquin River, Delta, and lower Sacramento River tributaries to improve instream fisheries habitat conditions, and potential acquisition of conservation easements	Assumptions in Alternative 2 plus operational flexibility for fish and wildlife purposes	Assumptions in Alternative 2 plus transfers under the Water Acquisition Program	Assumptions in Alternative 2 plus increased Delta inflow in some months due to water acquisition	Assumptions in Alternative 2 plus water acquisition for instream purposes. Improvements in water supply operations due to use of acquired water only for instream purposes.
Supplemental Analysis 3a	Same as Alternative 3	Assumptions in Alternative 3 plus provisions for water transfers	Assumptions in Alternative 3 plus water transfers involving CVP users under CVPIA provisions	Same as Alternative 3	Assumptions in Alternative 3 plus provisions for water transfers
Alternative 4	Assumptions in Alternative 3 plus use of acquired water in the Delta and additional use of (b)(2) water for the Delta Components	Assumptions in Alternative 3 plus operational flexibility for fish and wildlife purposes	Assumptions in Alternative 3 plus transfers under the Water Acquisition Program	Assumptions in Alternative 3 plus use of acquired water in the Delta and additional use of (b)(2) water for the Delta components	Assumptions in Alternative 3 plus acquired water for instream and Delta purposes, and (b)(2) water for Delta component.
Supplemental Analysis 4a	Same as Alternative 4	Assumptions in Alternative 4 plus provisions for water transfers	Assumptions in Alternative 4 plus water transfers involving CVP users under CVPIA provisions	Same as Alternative 4	Assumptions in Alternative 4 plus provisions for water transfers

improved water supplies for refuges. The AFRP programs that address flow improvements in the streams and in the Delta include the use of reoperation of the CVP, use of (b)(2) water, and water acquisition from willing sellers. These methods were included in the other PEIS alternatives in different ways that were related to changes in instream flows and Delta outflows. The degree to which the alternatives improve conditions varies with specific elements of the alternatives, but all alternatives meet the basic objective of improvement for these resources. The alternative which results in the greatest benefit for fish and wildlife habitat is Alternative 4 because this alternative acquired the largest amount of water for increasing instream flows and Delta outflows. However, the large amount of acquired water in Alternative 4 would cost more than available funds as authorized by CVPIA. The Preferred Alternative provided the greatest benefit for fish and wildlife habitat within the funding limits of CVPIA.

Improvements to Operational Flexibility (Section 3402 (c))

Improvements to operational flexibility, as addressed in Section 3402(c), to meet all purposes of the CVP are difficult to define. The purposes of the CVP include water supply, power generation, flood control, recreational opportunities, navigation on the Sacramento River, and fish and wildlife habitat and enhancement. Many purposes of the CVP require different operational criteria which may result in conflicts or benefits. For example, reservoir releases in the fall to provide storage for flood control increases flood control flexibility, but decreases water storage which may be needed for deliveries or power generation during the next summer if precipitation is low.

The Preferred Alternative improved operational flexibility for fish and wildlife. The other PEIS alternatives also improved conditions to varying degrees depending upon methods used to increase instream flows and Delta outflows. The Preferred Alternative and the other PEIS alternatives did not attempt to change the flood control or navigation criteria used for CVP operations because these criteria are established through separate processes which involve evaluation of public safety by Federal and State agencies. Therefore, the alternatives did not change the existing operational flexibility of flood control or navigation.

The Preferred Alternative improved recreational opportunities associated with birdwatching and hunting at the refuges and fishing in the streams and in the ocean. Recreational opportunities at the refuges would be the same in the Preferred Alternative and Alternatives 2, 3, and 4 because these alternatives provide Level 4 refuge water supplies. Alternative 4 was the largest amount of acquired water for increasing instream flows and Delta outflows that potentially increase fish populations and the highest amount of recreational opportunities. However, the large amount of acquired water in Alternative 4 would cost more than available funds as authorized by CVPIA. The Preferred Alternative provided the greatest benefit for fish and wildlife habitat within the funding limits of CVPIA. The maximum improvement for recreational opportunities is under Alternative 4 because the refuges receive Level 4 water supplies with limited shortages and improvements to fishery conditions are the greatest of all the alternatives considered.

Operational flexibility with respect to water supplies and power generation was severely reduced under the No-Action Alternative as compared to the recent conditions due to non-CVPIA actions.

Recent requirements established through the winter-run chinook salmon and Delta smelt biological opinions and through the Bay-Delta Plan Accord reduced operational flexibility to allow improvement to water quality and fish and wildlife habitat. Operational flexibility was further reduced under the No-Action Alternative due to the need to deliver water from CVP-controlled streams to water rights users. Diversions for water rights holders are projected to increase by more than 200,000 acre-feet of water over recent conditions, as described in the Pre-CVPIA Conditions and No-Action Alternative technical appendices. The projected increases in diversions will all be used for municipal uses, which will change the storage and release patterns from the reservoirs. As discussed in the Pre-CVPIA Conditions and Surface Water and Facilities Operations technical appendices, under the No-Action Alternative, delivery of CVP water to water service contractors in many months in drier water years is incidental to operations for the Bay-Delta Plan Accord, biological opinions, water rights holders, water rights contractors, and water rights exchange contractors.

Under the Preferred Alternative and the other PEIS alternatives, the overall flexibility of the CVP water supply operations is reduced. However within each alternative, water delivery operations are improved to the greatest extent possible using the available analytical tools through an iterative process. The greatest amount of water supply operational flexibility occurs in Alternative 3 because this alternative acquires the largest amount of water for instream flows and allows export of this water to users located south of the Delta. However, the large amount of acquired water in Alternative 4 would cost more than available funds as authorized by CVPIA and export of all of the acquired water could result in more adverse impacts to fish in the Delta than under any of the other PEIS alternatives. The Preferred Alternative provided the most operational flexibility while minimizing adverse impacts to Delta fisheries within the funding limits of CVPIA..

Under the PEIS alternatives, the operational analyses did not quantitatively attempt to optimize CVP power generation under the alternatives because the monthly programmatic level of analysis used in the PEIS was not adequate to optimize the power generation operations which must be optimized on hourly time step. Because the instream flow releases from CVP reservoirs are similar in the Preferred Alternative and other PEIS alternatives, CVP generation is similar in all alternatives.

Improved Benefits due to Water Transfers and Water Conservation (Section 3402(d))

The Preferred Alternative and all other PEIS alternatives included the same water conservation programs.

The Preferred Alternative includes water transfers under CVPIA for municipal and agricultural purposes. Supplemental Analyses 1e, 1f, 2b, 2c, 3a, and 4a include the same water transfer considerations as the Preferred Alternative. Actual water transfers would be considered on a site-specific basis for which separate environmental documentation would be completed. It was assumed that the water transfers would not impact ongoing water supply operations of the CVP or other water purveyor, or that the impacts would be mitigated. The analyses do indicate that a water market exists for transferred water and that water transfers would occur with or without CVPIA. The analysis shows that if transfers occur under CVPIA, the demand would not change but would be met by CVP users rather than water rights holders. The analyses also indicate that if additional charges are added to the transferred CVP water, the transfer market would be limited.

Protection of the Bay-Delta (Section 3402(e))

The Preferred Alternative and other PEIS alternatives would improve water quality and biological conditions in the Bay-Delta due to the implementation of reoperation and (b)(2) water management, as required under Section 3402(e). The greatest improvement would occur under Alternative 4 because this alternative acquired the largest amount of water for increasing instream flows and Delta outflows. However, the large amount of acquired water in Alternative 4 would cost more than available funds as authorized by CVPIA. The Preferred Alternative provided the greatest benefit for fish and wildlife habitat in the Delta within the funding limits of CVPIA.

Achieving a Reasonable Balance Among Competing Demands (Section 3402(f))

Achieving a reasonable balance among competing uses is a principal purpose of the CVPIA, as required under Section 3402(f). Since Congress has specified a number of required actions that are included in the Preferred Alternative, this alternative implements the Congressional intent of achieving a reasonable balance. Each of the PEIS alternatives combines various elements that modify this balance to some degree, thereby allowing the decision maker a reasonable range of choices based upon public involvement and the analysis in the NEPA process. Supplemental Analysis 4a provides the greatest balance between the competing demands because water transfers to Interior allow improvements in instream and Delta conditions and water transfers to municipal and agricultural users allow users to meet water demands if the water prices are appropriate. However, Supplemental Analysis 4a would cost more than available funds authorized by CVPIA. The Preferred Alternative provides the greatest level of a reasonable balance among competing demands because it provides for increased instream flow and Delta outflows, refuge water supplies, and water transfers within the funding limits of CVPIA.

SUMMARY OF IMPACT ASSESSMENTS

The alternatives considered in the PEIS were analyzed to determine the potential for adverse and beneficial impacts associated with their implementation as compared to continuation of the No-Action Alternative conditions. The results of this analysis are presented in Chapter IV of this PEIS. The most significant changes under the alternatives as compared to the No-Action Alternative are related to water facilities operations and deliveries, power generation, fishery resources, agricultural land use and economics, and waterfowl habitat, as summarized below and in Tables II-12 through II-15.

TABLE II-12

SUMMARY OF IMPACT ASSESSMENT FOR SURFACE WATER, CVP POWER RESOURCES, AND GROUNDWATER

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
No-Action Alternative	**Average Annual CVP Deliveries** 5,770,000 acre-feet **Average Annual SWP Deliveries** 3,330,000 acre-feet **Other Operations** Reservoir operations, river flows, and Delta outflow are generally as described under affected environment, with changes in operations due to increased water rights and M&I demands at a 2025 level of development. Average annual refuge deliveries of about 335,000 acre-feet from historical sources.	**Average Regional Depth to Groundwater** Sacramento River Region (west): 94 feet Sacramento River Region (east): 100 feet San Joaquin River Region: 85 feet Tulare Lake Region (north): 200 feet Tulare Lake Region (south): 313 feet **Potential for Long-Term Change in Subsidence** Sacramento River Region: increase above recent conditions near Davis-Zamora San Joaquin River Region: increase above recent conditions on west side Tulare Lake Region: increase above recent conditions on west side	**CVP Generation** Average annual: 4935 GWh/yr Average annual dry period (1929-1934): 2764 GWh/yr Average monthly available capacity: 1597 MW Average monthly dry period (1929-1934) available capacity: 1380 MW **CVP Project Use** Average annual: 1425 GWh/yr Average annual dry period (1929-1934): 974 GWh/yr Average monthly on-peak capacity: 184 MW Average monthly dry period (1929-1934) on-peak capacity: 142 MW **Energy and Capacity** Average annual energy available for sale: 3511 GWh/yr Average monthly capacity with energy for sale: 756 MW, based on 90 percent exceedence synthetic dry year Average monthly capacity without energy for sale: 708 MW, based on 90 percent exceedence synthetic dry year

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
1 Changes as Compared to the No-Action Alternative	**Average Annual CVP Deliveries** Reduction of 470,000 acre-feet due to instream (b)(2) Water Management component, increased Level 2 refuge deliveries, and increased Trinity River inflows **Average Annual SWP Deliveries** Potential increase of 100,000 acre-feet due to incidental benefit as a result of the actions in Alternative 1. **Other Operations** Increase and stabilize fall/winter Shasta and Folsom lakes releases per AFRP flow targets. Average annual Shasta September carry over storage reduced by 60,000 acre-feet. Increase average annual Folsom Lake September carry over storage by 80,000 acre-feet. Increase Clear Creek flows to meet AFRP flow targets in all but critically dry years. Provide Stanislaus spring pulse flows in April through June in all but critical dry years. Average annual New Melones Reservoir September carryover storage decreases by 100,000 acre-feet. Trinity River flows increase from 50,000 to 410,000 acre-feet/year depending on water year type. Average annual Claire Engle Lake September carryover storage decreases by 200,000 acre-feet. Average Annual Trinity River Basin diversions to the Sacramento River decrease by 180,000 acre-feet. Average annual Delta outflows reduced by 60,000 acre-feet due primarily to the reduction in diversions from the Trinity River Basin. CVP delivers additional 233,000 acre-feet on average to provide annual Level 2 refuge water supplies.	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): no change Sacramento River Region (east): increase depth 2% San Joaquin River Region: increase depth 2% Tulare Lake Region (north): increase depth 3% Tulare Lake Region (south): decrease depth 1% **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: increase from No-Action Alternative Tulare Lake Region: increase from No-Action Alternative	**CVP Generation** Average annual reduction of 5.4% Average annual dry period (1929-1934) reduction of 5.0% Average monthly available capacity reduction of 1.4% Average monthly dry period (1929-1934) available capacity reduction of 4.7% **CVP Project Use** Average annual reduction of 10.3% Average annual dry period (1929-1934) reduction of 10.7% Average monthly on-peak capacity reduction of 8.1% Average monthly dry period (1929-1934) on-peak capacity reduction of 8.9% **Energy and Capacity** 3.4% reduction in average annual energy available for sale 6.0% increase in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year with peak values in spring not summer 12.1% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year 0.1% increase in total average annual market value

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
1a Changes as Compared to Alternative 1	**Average Annual CVP Deliveries** Reduction of 100,000 acre-feet due to use of (b)(2) water management actions in addition to Bay-Delta Plan Accord. **Average Annual SWP Deliveries** Decrease of 40,000 acre-feet in average annual SWP deliveries. **Other Operations** North of Delta reservoir and river operations are similar to Alternative 1 Average annual Delta outflows increased by 140,000 acre-feet, due to use of (b)(2) water management for Delta components. Reduced CVP operational flexibility to fill San Luis Reservoir in the fall and supplement San Luis Reservoir releases in April and May. Average annual refuge deliveries are the same as Alternative 1.	Conditions are similar to Alternative 1 except in Tulare Lake Region (north) where average regional depth to groundwater increases by 6%	CVP power generation would be similar to Alternative 1 CVP Project Use would be reduced due to the decrease in CVP deliveries and Tracy Pumping Plant exports
1b Changes as Compared to Alternative 1	Average annual conditions similar to Alternative 1 Potential need for additional CVP and SWP reservoir releases during dry years to offset potentially higher salinity water entering the Delta due to increased reverse flows in the lower San Joaquin River west of Jersey Point.	Conditions are similar to Alternative 1	Conditions are similar to Alternative 1
1c Changes as Compared to Alternative 1	Reduction of 570,000 acre-feet in CVP average annual deliveries due to increased water pricing. Use of non-delivered CVP water not determined at this time. Options include re-allocation to other CVP contractors, transfer by CVP contractors with reduced demand, or use for fish and wildlife purposes.	Changes in groundwater conditions will depend on revised surface water operations. Use of non-delivered CVP water not determined at this time	Changes in power resources will depend of revised surface water operations. Use of non-delivered CVP water not determined at this time

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
1d Changes as Compared to Alternative 1	**Average Annual CVP Deliveries** Reduction of 50,000 acre-feet in dry period (1928-1934) due to full water deliveries to refuges in critical dry years. **Average Annual SWP Deliveries** Dry period (1928-1934) same as Alternative 1. **Other Operations** Average annual conditions are similar to Alternative 1, plus Increase of 30,000 acre-feet in dry period (1928-1934) average annual refuge deliveries.	Conditions are similar to Supplemental Analysis 1a	Conditions are similar to Alternative 1
1e Changes as Compared to Alternative 1	Conditions are similar to Alternative 1, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.	Conditions are similar to Alternative 1, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required	Conditions are similar to Alternative 1, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required
1f Changes as Compared to Alternative 1	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Supplemental Analysis 1e	Conditions are similar to Supplemental Analysis 1e
1g Changes as Compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1	Conditions are similar to Alternative 1
1h Changes as Compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are the same as Alternative 1	Conditions are the same as Alternative 1
1i Changes as Compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are the same as Alternative 1	Conditions are the same as Alternative 1

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
2 Changes as Compared to the No-Action Alternative	**Average Annual CVP Deliveries** Reduction of 590,000 acre-feet due to actions described under Alternative 1, plus assumed purchase of about 120,000 acre-feet/year for Level 4 refuge supplies from Sacramento River water rights holders and San Joaquin River Exchange Contractors. **Average Annual SWP Deliveries** Potential increase of 80,000 acre-feet due to the actions described under Alternative 1, plus assumed purchase of about 20,000 acre-feet/year for Level 4 refuge supplies from SWP willing sellers south of the Delta. **Other Operations** CVP reservoir operations and river flows as a result of (b)(2) water management are similar to Alternative 1 Increase April through June flows on the Stanislaus River due to acquisition of 60,000 acre-feet/year from willing sellers. Increase April through June flows on the Tuolumne River due to acquisition of 60,000 acre-feet/year from willing sellers. Increase April through June flows on the Merced River due to acquisition of 50,000 acre-feet/year from willing sellers. Acquired water was not exported from the Delta, resulting in an 80,000 acre-feet average annual increase in Delta outflow. Increase of 370,000 acre-feet in average annual refuge deliveries due to the CVP providing Level 2 deliveries and acquisition of additional Level 4 refuge water supplies.	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): increase depth 1% Sacramento River Region (east): increase depth 2% San Joaquin River Region: increase depth 3% Tulare Lake Region (north): increase depth 4% Tulare Lake Region (south): decrease depth 1% **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: similar to Alternative 1 Tulare Lake Region: similar to Alternative 1	**CVP Generation** Average annual reduction of 5.2% Average annual dry period (1929-1934) reduction of 4.7% Average monthly available capacity reduction of 1.4% Average monthly dry period (1929-1934) available capacity reduction of 4.8% **CVP Project Use** Average annual reduction of 10.2%. Average annual dry period (1929-1934) reduction of 10.6% Average monthly on-peak capacity reduction of 7.9% Average monthly dry period (1929-1934) on-peak capacity reduction of 9.3% **Energy and Capacity** 3.2% reduction in average annual energy available for sale 2.8% increase in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year with peak values in spring not summer 8.4% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year 0.9% reduction in total average annual market value

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
2a Changes as Compared to Alternative 2	Average annual conditions are similar to Alternative 2. Potential need for additional CVP and SWP reservoir releases during dry years to offset potentially higher salinity water entering the Delta due to increased reverse flows in the lower San Joaquin River west of Jersey Point.	Conditions are similar to Alternative 2	Conditions are similar to Alternative 2
2b Changes as Compared to Alternative 2	Conditions are similar to Alternative 2, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.	Conditions are similar to Alternative 2, except in dry years when site-specific transfer operations may affect groundwater operations and groundwater levels. Further site-specific analyses will be required	Conditions are similar to Alternative 2, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required
2c Changes as Compared to Alternative 2	Conditions are similar to Supplemental Analysis 2b.	Conditions are similar to Supplemental Analysis 2b	Conditions are similar to Supplemental Analysis 2b
2d Changes as Compared to Alternative 2	Reduction of CVP average annual deliveries due to increased water pricing are similar to Supplemental Analysis 1c. Use of non-delivered CVP water not determined at this time. Options include re-allocation to other CVP contractors, transfer by CVP contractors with reduced demand, or use for fish and wildlife purposes.	Changes in groundwater conditions will depend on revised surface water operations. Use of non-delivered CVP water not determined at this time	Changes in power resources will depend of revised surface water operations. Use of non-delivered CVP water not determined at this time

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
3 Changes as Compared to the No-Action Alternative	**<u>Average Annual CVP Deliveries</u>** Reduction of 390,000 acre-feet due to actions described under Alternative 2 and export of acquired water. Purchase of 120,000 acre-feet/year for Level 4 refuge supplies from Sacramento River water rights holders and San Joaquin River Exchange Contractors. **<u>Average Annual SWP Deliveries</u>** Potential increase of 270,000 acre-feet due to ability to export acquired water. Purchase of 20,000 acre-feet/year for Level 4 refuge supplies from SWP users. **<u>Other Operations</u>** North of Delta CVP reservoir operations and river flows similar to Alternative 1. Increase flows on the Stanislaus River in fall and winter months with pulse flows in April through June, due to acquisition of 200,000 acre-feet/year. Increase flows on the Tuolumne and Merced rivers in most months with pulse flows in April through June, due to acquisition of 200,000 acre-feet/year/river. Increase winter and spring flows and decrease summer and fall flows on the Calaveras River, due to acquisition of 30,000 acre-feet/year. Increase fall through spring flows on the Mokelumne River due to acquisition of 70,000 acre-feet/year. Increase spring, summer, and fall flows on the Yuba River due to acquisition of 100,000 acre-feet/year. Increase flows on the San Joaquin River at Vernalis in nearly all months due to additional releases from tributaries with pulse flows in April and May. Average annual Delta outflows increase by about 200,000 acre-feet/year Refuge deliveries are same as Alternative 2.	**<u>Change in Average Regional Depth to Groundwater</u>** Sacramento River Region (west): increase depth 1% Sacramento River Region (east): increase depth 5% San Joaquin River Region: increase depth 4% Tulare Lake Region (north): increase depth 1% Tulare Lake Region (south): decrease depth 3% **<u>Potential for Long-Term Change in Subsidence</u>** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: less than Alternative 1 Tulare Lake Region: less than Alternative 1	**<u>CVP Generation</u>** Average annual reduction of 5.3% Average annual dry period (1929-1934) reduction of 5.3% Average monthly available capacity reduction of 1.3% Average monthly dry period (1929-1934) available capacity reduction of 4.9% **<u>CVP Project Use</u>** Average annual reduction of 4.0% Average annual dry period (1929-1934) increase of 1.6% Average monthly on-peak capacity reduction of 2.8% Average monthly dry period (1929-1934) on-peak capacity increase of 0.2% **<u>Energy and Capacity</u>** 5.8% reduction in average annual energy available for sale 3.2% increase in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year with peak values in spring not summer 13.7% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year. 2.2% reduction in total average annual market value

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
3a Changes as Compared to Alternative 3	Conditions are similar to Alternative 3, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.	Conditions are similar to Alternative 3, except in dry years when transfers could affect groundwater conditions. Further site-specific analyses will be required.	Conditions are similar to Alternative 3, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required.
4 Changes as Compared to the No-Action Alternative	**Average Annual CVP Deliveries** Reduction of 620,000 acre-feet due to actions in Alternative 3 plus use of (b)(2) water management for Delta components. Purchase of about 120,000 acre-feet/year for Level 4 refuge supplies from Sacramento River water rights holders and San Joaquin River Exchange Contractors. **Average Annual SWP Deliveries** Average annual SWP deliveries are similar to the No-Action Alternative. Purchase of about 20,000 acre-feet/year for Level 4 refuge supplies from SWP willing sellers south of the Delta. **Other Operations** North of Delta CVP reservoir operations and river flows as a result of (b)(2) water management are similar to Alternative 1. Tracy Pumping Plant exports are reduced due to (b)(2) actions in the Delta. Increases in stream flows due to acquired water are the same as Alternative 3. Acquired water was not exported from the Delta, resulting in an 780,000 acre-feet average annual increase in Delta outflow. Refuge deliveries are the same as Alternative 2.	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): increase depth 1% Sacramento River Region (east): increase depth 5% San Joaquin River Region: increase depth 5% Tulare Lake Region (north): increase depth 5% Tulare Lake Region (south): decrease depth 1% **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: similar to Alternative 1 Tulare Lake Region: increase from Alternative 1	**CVP Generation** Average annual reduction of 5.1% Average annual dry period (1929-1934) reduction of 4.8% Average monthly available capacity reduction of 1.6% Average monthly dry period (1929-1934) available capacity reduction of 4.8% **CVP Project Use** Average annual reduction of 11.3% Average annual dry period (1929-1934) reduction of 11.5% Average monthly on-peak capacity reduction of 10.0% Average monthly dry period (1929-1934) on-peak capacity reduction of 9.9% **Energy and Capacity** 2.6% reduction in average annual energy available for sale 2.6% increase in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year with peak values in spring not summer 15.9% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year 1.4% reduction in total average annual market value

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
4a Changes as Compared to Alternative 4	Conditions are similar to Alternative 4, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.	Conditions are similar to Alternative 4, except in dry years when transfers could affect groundwater conditions. Further site-specific analyses will be required.	Conditions are similar to Alternative 4, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting from implementing the Preferred Alternative.	**Average Annual CVP Deliveries** 5,690,000 acre-feet **Average Annual SWP Deliveries** 3,320,000 acre-feet **Other Operations** Reservoir operations, river flows, and Delta outflow are generally as described under affected environment, with changes in operations due to increased water rights and M&I demands at a 2025 level of development. Average annual refuge deliveries of about 335,000 acre-feet from historical sources.	**Average Regional Depth to Groundwater** Sacramento River Region (west): 94 feet Sacramento River Region (east): 101 feet San Joaquin River Region: 85 feet Tulare Lake Region (north): 201 feet Tulare Lake Region (south): 322 feet **Potential for Long-Term Change in Subsidence** Sacramento River Region: increase above recent conditions near Davis-Zamora San Joaquin River Region: increase above recent conditions on wes tside Tulare Lake Region: increase above recent conditions on west side	**CVP Generation** Average annual: 5169 GWh/yr Average annual dry period (1929-1934): 2946 GWh/yr Average monthly available capacity: 1656 MW Average monthly dry period (1929-1934) available capacity: 1404 MW **CVP Project Use** Average annual: 1394 Gwh/yr Average annual dry period (1929-1934): 901 Gwh/yr Average monthly on-peak capacity: 166 MW Average monthly dry period (1929-1934) on-peak capacity: 122 MW **Energy and Capacity** Average annual energy available for sale: 3779 GWh/yr Average monthly capacity with energy for sale: 747 MW, based on 90 percent exceedence synthetic dry year Average monthly capacity without energy for sale: 739 MW, based on 90 percent exceedence synthetic dry year
Preferred Alternative Changes as Compared to the Revised No-Action Alternative	**Average Annual CVP Deliveries** Reduction of 560,000 acre-feet due to instream (b)(2) Water Management component, increased Level 2 and Level 4 refuge deliveries, and increased Trinity River inflows.	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): no change Sacramento River Region (east): increase depth 1% San Joaquin River Region: increase depth 3% Tulare Lake Region (north): increase depth 5%	**CVP Generation** Average annual reduction of 6%Average annual dry period (1929-1934) reduction of 12% Average monthly available capacity reduction of 2% Average monthly dry period (1929-1934) available capacity reduction of 8%

TABLE II-12. CONTINUED

Alternative or Supplemental Analysis	Surface Water	Groundwater	CVP Power Resources
	Average Annual SWP Deliveries Reduction of 70,000 acre-feet due to assumed coordination with (b)(2) water management actions. **Other Operations** Increase and stabilize fall/winter Shasta and Folsom lakes releases per AFRP flow targets. Average annual Shasta September carryover storage reduced by 130,000 acre-feet. Average annual Folsom Lake September carryover storage remains approximately the same. Increase Clear Creek flows to meet AFRP flow targets in all but critically dry years. Provide Stanislaus spring pulse flows in April through June in all but critical dry years. Average annual New Melones Reservoir September carryover storage decreases by 70,000 acre-feet. Trinity River flows increase from 50,000 to 410,000 acre-feet/year depending on water year type. Average annual Claire Engle Lake September carry over storage decreases by 130,000 acre-feet. Average Annual Trinity River Basin diversions to the Sacramento River decrease by 180,000 acre-feet. Average annual Delta outflows increase by 100,000 acre-feet due primarily to the reduction in diversions from the Trinity River Basin. CVP provides additional 380,000 acre-feet in average annual refuge deliveries to provide Level 2 and Level 4 refuge water supplies.	Tulare Lake Region (south): no change **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: increase from No-Action Alternative Tulare Lake Region: increase from No-Action Alternative	**CVP Project Use** Average annual reduction of 11% Average annual dry period (1929-1934) reduction of 18% Average monthly on-peak capacity reduction of 8% Average monthly dry period (1929-1934) on-peak capacity reduction of 12% **Energy and Capacity** 4% reduction in average annual energy available for sale 8% reduction in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year 7% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year

TABLE II-13

SUMMARY OF IMPACT ASSESSMENT FOR FISHERIES AND VEGETATION AND WILDLIFE RESOURCES

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
No-Action Alternative	Improved downstream temperature conditions in the Sacramento River due to operation of the Shasta Temperature Control Device which provides increased flexibility in the maintenance and use of the cold water pool in Shasta Lake, and due to improved flows under the Bay-Delta Plan Accord.	Conservation Program implemented, and will improve conditions for federally listed, proposed, and candidate species.
1 Changes as compared to No-Action Alternative	Stream flow improvements combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would benefit all life stages of representative fish species including chinook salmon, steelhead trout, sturgeon, American shad, and striped bass. Increases in the Trinity River fishery flow pattern would increase transport for salmon and steelhead trout. Increases in river flows and/or structural actions would improve passage and access to previously unavailable or under-used stream habitats. Conditions for downstream fish movement would decline in the Sacramento River due to decreased flows as a result of lower diversions from the Trinity River Basin. Structural actions would provide improved passage to previously unavailable or under-used stream habitats for adult, egg, and juvenile life stages of representative species in Clear Creek, the minor tributaries to the Sacramento, Yuba, and San Joaquin rivers, and the Delta. Fish screen construction or improvements would benefit representative species on the Sacramento, Feather, Yuba, Bear, American, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, and in the Delta. Decreases in river water temperatures in Clear Creek, minor tributaries to the Sacramento River, the Yuba River, and River. Increase in water temperatures on the American River in June through September, due to reduced summer flows, would adversely affect steelhead trout. Increases in river water temperatures in Sacramento River would adversely affect winter-run chinook salmon. Combined effects of increased instream flows, lower instream water temperatures, habitat restoration, and structural improvements would improve food web and habitat quantity and quality in all rivers except the Merced River.	There are benefits for species through habitat acquisition, management, restoration, and studies in (b)(1) “other” program. 30,000 acres of retired agricultural land provide potential habitat for special-status species and other species associated with grassland and alkali desert scrub habitats. 18,000 acres of fallowed land provide potential habitat. Riparian restoration on the Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species. Improved fisheries provide additional prey for fish-eating predators. Level 2 water deliveries improve wetland management for water birds and shore birds but do not allow for optimal management. Up to 80,000 acres of agricultural fields are flooded to provide additional wetland habitat for migratory water birds and other species.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
1a Changes as compared to Alternative 1	Further reductions in exports at Delta pumping facilities during April and May decrease diversion related losses and improved species survival. Increases in Delta outflow in January through June would improve egg, larval, and juvenile life stage survival of representative species during temporary residence in the Delta, through better movement from less productive habitat in the central and south Delta towards more productive habitat near Suisun Bay Increase in Delta habitat quantity and quality due to increased Delta outflow, reduced exports, and extension of X2 2 ppt isohaline farther downstream in April and May.	Conditions are similar to Alternative 1.
1b Changes as compared to Alternative 1	The decrease in flow into the central Delta from the Sacramento River reduces juvenile life stage diversion-related losses and improves downstream fish movement in the Sacramento River. Representative species are transported towards more productive habitat near Suisun Bay, rather than entering the central Delta. Old River barrier facility would assist the outmigration of juvenile salmon from the San Joaquin River and reduce exposure to CVP and SWP pumping facilities. An increase in losses of striped bass and delta smelt rearing in the north and central Delta would result from barrier closure.	Conditions are similar to Alternative 1.
1c Changes as compared to Alternative 1	Use of non-delivered CVP water not determined at this time. Changes to fisheries conditions due to potential changes in surface water operations will require further site specific analyses.	Impacts could range from those similar to Alternative 1, to additional benefits for riparian vegetation and wildlife habitat near reservoirs and/or rivers in the Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta regions.
1d Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are the same as Alternative 1, except for additional habitat provided for water birds during dry years at federal and state refuges, and at the Grasslands Resource Conservation District.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
1e Changes as compared to Alternative 1	Conditions are similar to Alternative 1, except in dry years when site specific transfer operations may affect reservoir operations, river flows, and Delta exports.	Conditions are similar to Alternative 1.
1f Changes as compared to Alternative 1	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Alternative 1.
1g Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are the same as Alternative 1.
1h Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1, however, restoration of some fallowed lands to natural habitats could benefit indigenous species, including 27 special-status plant and wildlife species.
1i Changes as compared to Alternative 1	Red Bluff Diversion Dam gates would no longer be closed during the summer, thereby reducing mortality of chinook salmon and steelhead trout that migrate in downstream rearing habitats. Restoration of the river reach affected by Lake Red Bluff would create additional spawning and rearing habitat, and reduce predation losses.	Conditions are the same as Alternative 1.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
2 Changes as compared to No-Action Alternative	Benefits to fisheries would be similar to Alternative 1, plus River water temperature conditions would improve due to increased April through June flows on the Tuolumne, Merced, and Stanislaus rivers. Increases in river flows in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers would promote downstream movement of juvenile life stage species in these rivers. Greater flows from the San Joaquin River towards Suisun Bay would further improve Delta flow conditions, reduce diversion losses, and facilitate the movement of organisms into more productive habitat. The combined effects of the actions in Alternative 2 would further improve habitat quality and quantity in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers. The combined affects would also provide further improvement in food web support in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers.	Conditions are the same as Alternative 1, except 55,000 acres of fallowed land provide additional potential habitat. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat for riparian-dependent species, including special status species along the San Joaquin River. Further improvements in fisheries provide additional prey for fish-eating predators. Level 4 water deliveries allow improved wetland habitat management.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
2a Changes as compared to Alternative 2	The decrease in flow into the central Delta from the Sacramento River reduces juvenile life stage diversion-related losses and improves downstream fish movement in the Sacramento River. Representative species are transported towards more productive habitat near Suisun Bay, rather than entering the central Delta. Old River barrier facility would assist the outmigration of juvenile salmon from the San Joaquin River and reduce exposure to CVP and SWP pumping facilities. Increase in losses of striped bass and delta smelt rearing in the north and central Delta would result from barrier closure.	Conditions are similar to Alternative 2.
2b Changes as compared to Alternative 2	Conditions are similar to Alternative 2, except in dry years when site specific transfer operations may affect reservoir operations, river flows, and Delta exports.	Conditions are similar to Alternative 2.
2c Changes as compared to Alternative 2	Conditions are similar to Supplemental Analysis 2b.	Conditions are similar to Supplemental Analysis 2b.
2d Changes as compared to Alternative 2	Use of non-delivered CVP water not determined at this time. Changes to fisheries conditions due to potential changes in surface water operations will require further site specific analyses.	Conditions are similar to Supplemental Analysis 1c.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
3 Changes as compared to No-Action Alternative	Benefits to fisheries would be similar to Alternative 2, plus Further improvements in temperature conditions on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers, and tributaries to the Sacramento River that support spring-run chinook salmon, due to increased spring stream flows in combination with habitat restoration actions, would benefit rearing juvenile and fry chinook salmon and steelhead trout. Reductions in diversions on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers would benefit migrating juvenile chinook salmon and steelhead trout. Overall conditions affecting diversion losses in the Delta would further improve due to increased Delta outflow, even though there are increased Delta exports of acquired water in August through May. Reductions in flow fluctuations on the Yuba and Mokelumne rivers would reduce stranding and benefit egg, fry, and juvenile life stages of chinook salmon and steelhead trout. Pulse flows on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced, and San Joaquin rivers would primarily benefit outmigration of of fall-run juvenile chinook salmon. Further increases in spring and summer net Delta channel flows toward Suisun Bay would increase movement of larval and juvenile striped bass, delta smelt, longfin smelt, and juvenile chinook salmon and steelhead trout toward more productive habitat. The combined effects of the actions in Alternative 3 would further improve habitat quality and quantity in the Bay-Delta and in the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers. The combined effects would also provide further improvement in food web support in the Bay-Delta and in the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers.	Conditions are the same as Alternative 2, except 137,000 acres of fallowed land provide potential habitat. Conservation easements could be acquired on 15% of fallowed land in the San Joaquin River Region. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat for riparian-dependent species along the San Joaquin River. Further improvements in fisheries provide additional prey for fish-eating predators.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
3a Changes as compared to Alternative 3	Conditions are similar to Alternative 3, except in dry years when site specific transfer operations may affect reservoir operations, river flows, and Delta exports.	Conditions are similar to Alternative 3.
4 Changes as compared to No-Action Alternative	Benefits to fisheries water would be similar to Alternative 3, plus Reductions in Delta exports and the corresponding increase in Delta outflow, due to the Delta (b)(2) actions and acquired water, shift the distribution of Delta species downstream into more productive habitat and away from the influence of Delta diverions. The Delta Cross Channel would be closed for Delta (b)(2) actions in November through January of wetter years facilitating the outmigration of juvenile chinook salmon and steelhead trout down the Sacramento River. This would help improve survivial and reduce their movement into the central Delta where they are exposed to increased diversions and predation. Increases in Delta outflow in all months would shift estuarine salinity downstream increasing habitat availability for Sacramento splittail, delta smelt, longfin smelt, and striped bass. Food web support in the Delta would increase due to reduced diversions that entrain food web organisms and nutrients. Also, the downstream shift in estuarine salinity would increase production of prey and benefit rearing life stages of all representative species.	Conditions are the same as Alternative 3, except 160,000 acres of fallowed land provide potential habitat. Conservation easements could be acquired on 15% of fallowed land in the San Joaquin River Region. Further improvements in fisheries provide additional prey for fish-eating predators.
4a Changes as compared to Alternative 4	Conditions are similar to Alternative 4, except in dry years when site specific transfer operations may affect reservoir operations, river flows, and Delta exports.	Conditions are similar to Alternative 4.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Improved downstream temperature conditions in the Sacramento River due to operation of the Shasta Temperature Control Device which provides increased flexibility in the maintenance and use of the cold water pool in Shasta Lake, and due to improved flows under the Bay-Delta Plan Accord.	Conservation Program implemented, and will improve conditions for federally listed, proposed, and candidate species.
Preferred Alternative Changes as compared to No-Action Alternative	Stream flow improvements combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would benefit all life stages of representative fish species including chinook salmon, steelhead trout, sturgeon, American shad, and striped bass. Increases in the Trinity River fishery flow pattern would increase transport for salmon and steelhead trout. Increases in river flows and/or structural actions would improve passage and access to previously unavailable or under-used stream habitats. Conditions for downstream fish movement would decline in the Sacramento River due to decreased flows as a result of lower diversions from the Trinity River Basin. Structural actions would provide improved passage to previously unavailable or under-used stream habitats for adult, egg, and juvenile life stages of representative species in Clear Creek, the minor tributaries to the Sacramento, Yuba, and San Joaquin rivers, and the Delta. Fish screen construction or improvements would benefit representative species on the Sacramento, American, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, and in the Delta. Combined effects of increased instream flows, lower instream water temperatures, habitat restoration, and structural improvements would improve food web and habitat quantity and quality in these rivers. Decreases in river water temperatures in Clear Creek, minor tributaries to the Sacramento River that support spring-run chinook salmon, and Stanislaus, Tuolumne, and Merced rivers. Increase in water temperatures on the American River in June through September, due to reduced summer flows, would adversely affect steelhead trout. Increases in river water temperatures in Sacramento River would adversely affect winter-run chinook salmon.	There are benefits for species through habitat acquisition, management, restoration, and studies in (b)(1) “other” program. 30,000 acres of retired agricultural land provide potential habitat for special-status species and other species associated with grassland and alkali desert scrub habitats. 45,000 acres of fallowed land provide potential habitat. Riparian restoration on the Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species. Improved fisheries provide additional prey for fish-eating predators. Level 4 water deliveries improve wetland management for water birds and shore birds. Use of 40-30-30 Index for refuge water supplies shortage criteria would result in adverse impacts as compared to Alternatives 2, 3, and 4. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat for riparian-dependent species along the San Joaquin River. Further improvements in fisheries provide additional prey for fish-eating predators.

TABLE II-13. CONTINUED

Alternative or Supplemental Analysis	Fishery Resources	Vegetation and Wildlife Resources
	Reductions in diversions on the Stanislaus, Tuolumne, and Merced rivers would benefit migrating juvenile chinook salmon and steelhead trout. Overall conditions affecting diversion losses in the Delta would further improve due to increased Delta outflow, even though there are increased Delta exports. Pulse flows on the Stanislaus, Tuolumne, and Merced, and San Joaquin rivers would primarily benefit outmigration of of fall-run juvenile chinook salmon. Further increases in spring and summer net Delta channel flows toward Suisun Bay would increase movement of larval and juvenile striped bass, delta smelt, longfin smelt, and juvenile chinook salmon and steelhead trout toward more productive habitat. The combined effects of the actions would further improve habitat quality and quantity in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers. The combined effects would also provide further improvement in food web support in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers. Reductions in Delta exports and the corresponding increase in Delta outflow, due to the Delta (b)(2) actions and acquired water, shift the distribution of Delta species downstream into more productive habitat and away from the influence of Delta diverions. Food web support in the Delta would increase due to reduced diversions that entrain food web organisms and nutrients. Also, the downstream shift in estuarine salinity would increase production of prey and benefit rearing life stages of all representative species.	

TABLE II-14

SUMMARY OF IMPACT ASSESSMENT FOR RECREATION, FISH/WILDLIFE/RECREATION ECONOMICS, AND CULTURAL RESOURCES

Alternative or Supplemental Analysis	Recreation	Fish, Wildlife, and Recreation Economics	Cultural Resources
No-Action Alternative	Conditions are similar to Affected Environment.	$145 million per year in recreation-related expenditure at reservoirs and refuges in the Sacramento River Region, and about $85 million per year in the San Joaquin River and Tulare Lake Region combined. Additional, unquantified expenditure and benefits to river recreation in the Sacramento River Region, and to ocean recreation related to anadromous fisheries.	Conditions are similar to Affected Environment.
1 Changes as compared to No-Action Alternative	Lower surface elevations on Pitt River and Sacramento River arms of Shasta Lake constrain boating during the off season. Higher surface elevation at Lake Oroville and Folsom Lake reduces constraints on boating and shoreline activities during the peak and off-peak seasons. Flows maintained within optimal range for boating more frequently on the upper Sacramento River during the peak season. Flows on the American River more frequently below optimum level for swimming during the peak season. Opportunities increased for wildlife observation, hunting, and fishing at refuges Lower surface elevation at New Melones Reservoir constrains boating and increases the frequency when boat ramps are unusable and restricts shoreline recreation opportunities. Flows on the lower Stanislaus River are maintained above the minimum level for boating and swimming more frequently during the peak season.	Small increase in recreation-related expenditures (less than 3%) at reservoirs and rivers. About 25% increase in expenditure at refuges resulting from greater use. Additional, unquantified expenditure and benefit to fisheries and recreational use.	Cultural resources at New Melones Reservoir are potentially exposed to vandalism during periods of reservoir drawdown, which are more extreme than under No-Action Alternative. There is the potential for flooding of or increased erosion of cultural resources at wildlife refuges in the Sacramento River and San Joaquin River regions. Cultural resources in the Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta regions are potentially effected by the construction and operation of new facilities and the modification of existing facilities for anadromous fisheries habitat restoration.

TABLE II-14. CONTINUED

Alternative or Supplemental Analysis	Recreation	Fish, Wildlife, and Recreation Economics	Cultural Resources
1a Changes as compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are similar to Alternative 1.	Conditions are the same as Alternative 1.
1b Changes as compared to Alternative 1	Conditions are the same as Alternative 1, except the barriers at Georgiana Slough and Old River could delay or restrict recreational boat access to portions of the Delta.	Conditions are similar to Alternative 1.	Conditions are the same as Alternative 1.
1c Changes as compared to Alternative 1	Conditions similar to Alternative 1.	Potential reallocation of water for other uses could change quantity and timing of releases from reservoirs and flow in streams, with potential impacts on fisheries, recreational use, and benefits.	Impacts could range from those similar to Alternative 1, to the potential increased risk of exposure of cultural resources near reservoirs and/or rivers in the Sacramento River and San Joaquin River regions.
1d Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.	Conditions are the same as Alternative 1.
1e Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Impacts of water transfers on fish, wildlife, and recreation benefits depends on the timing and location of flows affected by water transfers. Negative impacts could occur if flow is reduced in a stream during a period of high recreational use. These would be offset to some extent by increased flows during other periods. Overall impact is uncertain.	Conditions are similar to Alternative 1, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
1f Changes as compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Alternative 1.
1g changes as compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.

TABLE II-14. CONTINUED

Alternative or Supplemental Analysis	Recreation	Fish, Wildlife, and Recreation Economics	Cultural Resources
1h Changes as compared to Alternative 1	Conditions are the same as Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.
1i Changes as compared to Alternative 1	Conditions are the same as Alternative 1, except flatwater recreation is eliminated at Lake Red Bluff.	Conditions are similar to Alternative 1, but recreational expenditures and benefits associated with Lake Red Bluff would be substantially reduced. Some of this expenditure could shift to other uses or sites within the region. Fisheries may benefit.	Conditions are the same as Alternative 1.
2 Changes as compared to No-Action Alternative	Conditions are the same as Alternative 1, except opportunities are increased over Alternative 1 for wildlife observation, hunting, and fishing at wildlife refuges in the San Joaquin River and Tulare Lake regions.	Impacts in CVP streams and reservoirs are similar to Alternative 1. Estimated increases of 70% in expenditure and benefits to refuge wildlife recreation occur due to Level 4 water deliveries. The purchase of (b)(3) water for instream flow provides potential increases in benefits related to streamflow and fisheries.	Conditions are the same as Alternative 1, except for the potential reduced risk of exposure of cultural resources in the San Joaquin River and Tulare Lake regions due to impacts from cultivation.
2a Changes as compared to Alternative 2	Average annual conditions are the same as Alternative 2, except the barriers at Georgiana Slough and Old River could delay or restrict recreational boat access to portions of the Delta.	Conditions are similar to Alternative 2.	Conditions are the same as Alternative 2.
2b Changes as compared to Alternative 2	Conditions are similar to Alternative 2.	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Alternative 2, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
2c Changes as compared to Alternative 2	Conditions are similar to Alternative 2.	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Supplemental Analysis 2b.

TABLE II-14. CONTINUED

Alternative or Supplemental Analysis	Recreation	Fish, Wildlife, and Recreation Economics	Cultural Resources
2d Changes as compared to Alternative 2	Conditions are similar to Alternative 2.	Changes are similar to those described under Supplemental Analysis 1c.	Conditions are similar to Supplemental Analysis 2c.
3 Changes as compared to No-Action Alternative	Conditions are the same as Alternative 2.	Impacts are similar to those described for Alternative 2. The purchase of additional (b)(3) water for instream flow provides potential increases in benefits related to streamflow and fisheries.	Conditions are the same as Alternative 2 Vandalism on cultural resources on the Stanislaus River is potentially increased due to an increase in the number of recreational visitors. The risk of exposure of cultural resources in the San Joaquin River Region is potentially reduced due to impacts from cultivation.
3a Changes as compared to Alternative 3	Conditions are similar to Alternative 3.	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Alternative 3, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
4 Changes as compared to No-Action Alternative	Conditions are the same as Alternative 3.	Impacts are similar to those described for Alternative 3.	Conditions are the same as Alternative 3, except for the potential reduced risk of exposure of cultural resources in the Sacramento River due to impacts from cultivation.
4a Changes as compared to Alternative 4	Conditions are similar to Alternative 4.	Conditions are similar to Supplemental Analysis 1e.	Conditions are similar to Alternative 4, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.

TABLE II-14. CONTINUED

Alternative or Supplemental Analysis	Recreation	Fish, Wildlife, and Recreation Economics	Cultural Resources
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Conditions similar to Draft PEIS No-Action Alternative except for reduced recreation potential at Shasta Lake and Folsom Lake in critical dry years.	$176 million per year in recreation-related expenditure at reservoirs and refuges in the Sacramento River Region, and about $152 million per year in the San Joaquin River and Tulare Lake Region combined. Additional, unquantified expenditure and benefits to river recreation in the Sacramento River Region, and to ocean recreation related to anadromous fisheries.	Conditions same as Draft PEIS No-Action Alternative.
Preferred Alternative Changes as compared to Revised No-Action Alternative	Lower surface evaluations on McCloud River, Pit River, and Sacramento River arms of Shasta Lake constrain boating during the peak season. Higher surface elevation at Lake Oroville reduces constraints on boating and shoreline activities during the peak and off-peak seasons. Lower surface elevation at Folsom Lake increases constraints on boating and shoreline activities during the peak and off-peak season. Flows maintained within optimal range for boating more frequently on the upper Sacramento River during the peak season. Flows on the American River more frequently below optimum level for swimming during the peak season. Opportunities increased for wildlife observation, hunting, and fishing at refuges. Higher surface elevation at New Melones Reservoir reduces the frequency when boat ramps are unusable and reduces constraints on boating and shoreline recreation opportunities. Flows on the lower Stanisluas River are maintained above the minimum level for boating and swimming more frequently during the peak season.	Small increase in recreation-related expenditures (less than 3%) at reservoirs and rivers. About 70% increase in expenditure at refuges resulting from greater use.	Conditions similar to Alternative 2 with more potential impacts at Shasta and Folsom Lake.

TABLE II-15

SUMMARY OF IMPACT ASSESSMENT FOR AGRICULTURAL ECONOMICS AND LAND USE, MUNICIPAL WATER COSTS, REGIONAL ECONOMICS, AND SOCIAL ANALYSIS

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
No-Action Alternative	6.6 million irrigated acres and $10.2 billion of gross revenue from irrigated acres in Central Valley and San Felipe Division.	Similar to DWR Bulletin 160-93, plus South Coast would develop supplies and increase price to meet 2020 average demand. All municipal water use regions would impose conservation and develop supplies in dry years.	**Central Valley Output** Annual Central Valley output of $221 billion. **Personal Income** Total annual personal income of $119 billion. **Employment** 3.4 million jobs in the Central Valley. 1991 economic data provided as basis for comparison. Jobs in municipalities would increase with population projections. Agricultural jobs would remain predominantly seasonal and may increase. Demand for social services would remain constant.
1 Changes as compared to No-Action Alternative	Reduction of 50,000 acres of irrigated land and $76 million in annual gross revenue, due to Land Retirement Program and reduction in water delivery. Increase in annual CVP and groundwater cost of $46 million, due to water pricing changes and additional groundwater pumping. Increased financial risk due to reduced reliability of CVP water supply. Impacts are concentrated on CVP water service contractors, especially in the Delta export delivery areas.	CVP M&I water supplies are reduced, and restoration payments ($6.4 million on average) and conservation costs increase price and reduce water use. Most of the impact is on CVP contractors with no other supplies. Increased SWP supplies reduce water costs and retail price. Most benefit is in the Central and South Coast Region.	**Central Valley Output** Annual Central Valley output loss of 0.11 percent. Total agricultural losses are partially offset by increases due to enhanced recreation. **Personal Income** Personal income in the Central Valley decreases by 0.09 percent. Total agricultural losses are partially offset by increases in recreation expenditures. **Employment** Central Valley loss of 0.11 percent. Agricultural employment losses are partially offset by increases due to rise in recreation opportunities. May have minimal impact if uniformly distributed. May have significant impact if all near one community. These impacts may result in the need for evaluation under Environmental Justice provisions within future site-specific NEPA documentation.

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
1a Changes as compared to Alternative 1	Additional reduction in CVP water supply is replaced by additional 80,000 acre-feet of groundwater pumping in Central Valley, 2,000 acres of land fallowed in San Felipe Division, and about $4 million annual loss of agricultural net revenue.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1, with some additional negative impacts in CVP water service areas due to higher cost of pumping groundwater.
1b Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.
1c Changes as compared to Alternative 1	Up to 570,000 acre-feet of CVP water could be unaffordable and not used. Impacts would include up to 56,000 acres of land out of production in Sacramento River Region, 337,000 acre-feet of additional groundwater pumped in the San Joaquin River and Tulare Lake regions, and a large aggregate increase in the cost of CVP water. All impacts would fall on CVP water service contractors.	Conditions are similar to Alternative 1, except that M&I payments into the Restoration Fund are increased to $11.5 million annually.	Large additional losses of jobs and income in the Sacramento River Region due to increased amounts of fallowed land. Additional losses in San Joaquin River Region due to higher cost of pumping groundwater.
1d Changes as compared to Alternative 1	Reduced CVP delivery largely in the San Joaquin River Region, replaced by additional groundwater pumping.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1, with small additional negative impacts in CVP water service areas due to higher cost of pumping groundwater.
1e Changes as compared to Alternative 1	Up to 150,000 acre-feet would be sold in an average year, primarily from the Tulare Lake Region. This would fallow about 40,000 acres and provide revenue to sellers of about $18 million. Under a dry condition without CVPIA transfers, up to 1 million acre-feet could be transferred, with over half of this from the Sacramento River Region. Under this alternative, substantially less water would be sold from the Sacramento River Region and more from regions south of Delta, due to CVP water available for transfer. The price of water, and the revenue to sellers, would decline substantially due to the availability of CVP water for transfer.	M&I users in the Sacramento Valley and San Joaquin regions do not participate in water transfer markets. In average years, the Bay Area purchases very little water in the average condition. In the Central and South Coast, 105,000 acre-feet are purchased in the average condition at a cost of $38 million delivered ($1 million savings over no CVPIA transfer scenario) In dry years, the Bay Area purchases about 180,000 acre-feet at a cost of $60 million delivered to retail users ($30 million savings over no CVPIA transfer scenario). In the Central and South Coast, 363,000 acre-feet are purchased in the dry condition at a cost of $172 million delivered ($37 million savings over no CVPIA transfer scenario).	Impacts on the local economy of areas selling water would be similar in direction to those resulting from (b)(3) water acquisition: land fallowed to provide water for transfer would result in losses of jobs and income, offset by a (usually) smaller increase in economic activity generated by spending revenue received for selling water. Regions buying water generally have positive impacts. Water bought can support economic activity at a lower cost than developing or using more expensive alternative supplies. See summary of impacts of Alternatives with Water Transfers.

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
1f Changes as compared to Alternative 1	Results would be similar to Supplemental Analysis 1e, except that non-CVP water would be purchased rather than CVP water, due to the additional $50 per acre-foot fee on CVP water transfers. Also, Restoration Fund revenues may be higher in dry years. Local, within-region transfers of CVP water would likely be eliminated due to the $50 fee.	Quantities purchased would be similar to Supplemental Analysis 1e, but almost no CVP water would be purchased and costs would be higher due to the additional fee imposed on CVP water transferred.	Conditions are similar to Supplemental Analysis 1e.
1g Changes as compared to Alternative 1	Up to 24,000 acre-feet of CVP water could be unaffordable and not used. Some land would go out of production in the Sacramento River Region but most of the water would be replaced with additional groundwater pumping.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1, with some additional negative impacts in Sacramento River Region CVP water service areas due to higher cost of pumping groundwater.
1h Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.
1i Changes as compared to Alternative 1	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.
2 Changes as compared to No-Action Alternative	Impacts to CVP delivery areas are similar to Alternative 1. An additional 40,000 acres of irrigated land could be idled due to the purchase of non-CVP (b)(3) water for instream flow and Level 4 refuge supply. Revenue received for water augments the sellers’ farm income.	Same as Alternative 1.	**Central Valley Output** Annual Cental Valley net output loss of 0.14 percent. Total agricultural losses are partially offset by increases due to income from water sales and enhanced recreation. **Personal Income** Net personal income in the Central Valley decreases by 0.11 percent. Total agricultural losses are partially offset by increases due to income from water sales and increased recreation expenditures. **Employment** Net Central Valley loss of 0.13 percent. Agricultural employment losses are partially offset by increases due to income from water sales and greater recreation opportunities.

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
			Adverse impacts concentrated in the CVP water service areas. Impacts from land fallowing due to (b)(3) water acquisition are somewhat offset by revenue from water sold. Adverse impacts are partially offset by increases in economic activity during the period of construction of restoration actions.
2a Changes as compared to Alternative 2	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 1.	Conditions are similar to Alternative 2.
2b Changes as compared to Alternative 2	Results are similar to those described under Supplemental Analysis 1e, except that (b)(3) water acquisition in the San Joaquin River Region would increase the price of water for transfer. Some water transfer purchases are shifted to Sacramento River and Tulare Lake Regions.	Changes are similar to those described under Supplemental Analysis 1e, except that under average condition transfers to the Central and South Coast cost about $41 million ($2 million increase over no CVPIA transfer scenario). In dry years, the Bay Area would purchase 180,000 acre-feet at a cost of $60 million. In the Central and South Coast, the same amount would be purchased at a cost of $181 million delivered ($28 million savings over no CVPIA transfer scenario).	Conditions are similar to Supplemental Analysis 1e.
2c Changes as compared to Alternative 2	Changes are similar to those described under Supplemental Analysis 1f.	Changes are similar to those described under Supplemental Analysis 1f.	Conditions are similar to Supplemental Analysis 1e.
2d Changes as compared to Alternative 2	Changes are similar to those described under Supplemental Analysis 1c.	Changes are similar to those described under Supplemental Analysis 1c.	Changes are similar to those described under Supplemental Analysis 1c.
3 Changes as compared to No-Action Alternative	Impacts to CVP delivery areas are less than those described under Alternative 1, due to pumping and delivery of some (b)(3) water to CVP contractors. A total of about 172,000 acres of irrigated	Similar to Alternative 1, except SWP supplies increase.	**Central Valley Output** Annual Central Valley net output loss of 0.16 percent. Total agricultural losses are partially offset by increases due to income from water sales and enhanced recreation.

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
	land could be idled due to a combination of the Land Retirement Program, reduction in CVP water delivery, and purchase of (b)(3) water for refuges and instream flow. Revenue received for water augments the sellers' farm income.		**Personal Income** Net personal income in the Central Valley decreases by 0.12 percent. Total agricultural losses are partially offset by increases in income from water sales and increased recreation expenditures. **Employment** Net Central Valley loss of 0.15 percent. Agricultural employment losses are partially offset by increases due to income from water sales and greater recreation opportunities. Adverse impacts in CVP water service areas. Impacts from land fallowing due to (b)(3) water acquisition are somewhat offset by revenue from water sold. Adverse impacts are partially offset by increases in economic activity during the period of construction of restoration actions.
3a Changes as compared to Alternative 3	Changes are similar to those described under Supplemental Analysis 1e, except that water purchased is about 10 percent less. This occurs because higher CVP and SWP delivery in Alternative 3 results in a lower level of demand for transfers.	In the average condition, changes are similar to those described under Supplemental Analysis 1e. In dry years, the Bay Area would purchase the same as under Supplemental Analyses 1e at a cost of $108 million ($18 million over the cost of a no CVPIA transfer scenario). In the Central and South Coast, the same amount would be purchased at a cost of $175 million delivered ($22 million savings over no CVPIA transfer scenario).	Same as Draft PEIS No-Action Alternative

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
4	Impacts to CVP delivery areas are greater than those described under Alternative 1, due to the use of (b)(2) water for Delta restoration actions. A total of about 200,000 acres of irrigated land could be idled due to a combination of the Land Retirement Program, reduction in CVP water delivery, and purchase of (b)(3) water for refuges and instream flow. Revenue received for water augments the sellers' farm income.	Similar to Alternative 1, except SWP supplies are	**Central Valley Output** Annual Central Valley net output loss of 0.20 percent. Total agricultural and M&I related losses are partially offset by increases due to income from water sales and enhanced recreation. **Personal Income** Net personal income in the Central Valley decreases by 0.15 percent. Total agricultural and M&I losses are partially offset by increases due to income from water sales and increased recreation expenditures. **Employment** Net Central Valley loss of 0.18 percent. Agricultural and M&I related employment losses are partially offset by increases due to income from water sales and greater recreation opportunities. Adverse impacts are partially offset by increases in economic activity during the period of construction of restoration actions.
4a Changes as compared to Alternative 4	Changes are similar to those described under Supplemental Analysis 1e, except that the price of water is increased due to (b)(3) water acquisition and greater demand for transfers due to use of (b)(2) water in the Delta.	Changes are similar to those described under Supplemental Analysis 2b. In dry years, the Bay Area would purchase 190,000 acre-feet at a cost of $110 million. In the Central and South Coast, the same amount would be purchased at a cost of $193 million delivered ($16 million savings over no CVPIA transfer scenario).	Conditions are similar to Supplemental Analysis 1e.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	6.6 million irrigated acres and $10.2 billion of gross revenue from irrigated acres in Central Valley and San Felipe Division.	Similar to DWR Bulletin 160-93, plus South Coast would develop supplies and increase price to meet 2020 average demand. All municipal water use regions would impose conservation and develop supplies in dry years.	Same as Draft PEIS No-Action Alternative.

TABLE II-15. CONTINUED

Alternative or Supplemental Analysis	Agricultural Economics and Land Use	Municipal Water Costs	Regional Economics and Social Analysis
Preferred Alternative Changes as compared to Revised No-Action Alternative	Reduction of 54,000 acres of irrigated land and $74 million in annual gross revenue, due to Land Retirement Program and reduction in water delivery. Increase in annual CVP and groundwater cost of $33 million, due to water pricing changes and additional groundwater pumping. Increased financial risk due to reduced reliability of CVP water supply. Impacts are concentrated on CVP water service contractors, especially in the Delta export delivery areas.	CVP M&I water supplies are reduced and restoration payments and conservation costs increase price and reduce water use. Most of the impact is on CVP contractors with no other supplies. Decreased SWP supplies in the average period increase water costs and retail price. Increased SWP supplies in the dry period decrease water costs and retail price. The regions affected are primarily the Central and South Coast regions.	**Central Valley Output** Annual Central Valley net output loss of 0.06 percent. Total agricultural and M&I related losses are partially offset by increases due to income from water sales and enhanced recreation. **Personal Income** Net personal income in the Central Valley decreases by 0.05 percent. Total agricultural and M&I losses are partially offset by increases due to income from water sales and increased recreation expenditures. **Employment** Net Central Valley loss of 0.04 percent. Agricultural and M&I related employment losses are partially offset by increases due to income from water sales and greater recreation opportunities. Larger impacts will occur in the San Joaquin River Region as compared to the Sacramento River Region. May have minimal impact if uniformly distributed. May have significant impact if all near one community. These impacts may result in the need for evaluation under Environmental Justice provisions within future site-specific NEPA documentation.

SUMMARY OF IMPACTS AND BENEFITS

The impacts and benefits of implementing the PEIS alternatives are summarized in Tables II-12 (surface water, CVP power resources, and groundwater), II-3 (fisheries and vegetation/wildlife resources), II-14 (recreation, fish/wildlife/recreation economics, and cultural resources), and II-15 (agricultural economics and land use, municipal water costs, regional economics, and social analysis). Impacts in air quality, mosquitos as a public health risk, drinking water quality considerations in the Delta, soils and geology, and visual resources did not markedly change across the alternatives and therefore are not summarized in these tables. Alternative 4 is the "Environmentally Preferred Alternative" because the most water is provided to fish and wildlife purposes. However, Alternative 4 would require Restoration Funds in excess of $50 million/year, which would not be affordable without additional congressional authorization. The Preferred Alternative represents an alternative that balances environmental benefits, affordability, and technical feasibility. The other alternatives have varying degrees of benefits and impacts to the issue areas as evaluated at the programmatic level.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Because the coverage of most of the CVPIA provisions in this PEIS is programmatic in nature and would require additional environmental documentation, few irreversible and irretrievable commitments of resources would occur as a result of a decision based on this PEIS. Based on this PEIS, a decision to implement the CVPIA provisions stipulated by Congress (and not to proceed with the No-Action Alternative which would require legislative change) means that Reclamation would:

- proceed with negotiating water contract renewals and implement tiered pricing;
- reoperate the CVP to benefit fish while not affecting contract obligations;
- proceed with more specific planning and analysis of how to implement various other provisions of the CVPIA (such as, refuge water supplies, land retirement, facility modifications);
- establish a system for water transfer fees; and
- address revegetation goals for retired lands.

A decision to conduct negotiations on long-term contract renewals would not result in any irretrievable or irreversible commitment of resources (other than staff time). The eventual incorporation of tiered pricing into contracts may reduce the demand for CVP water. The extent that such demand reduction would be irreversible or irretrievable depends on whether the reduced demand is reflected in a lowered maximum contract amount or in a lower yearly request for water deliveries up to the maximum contract amount. Implementation of water transfer fees is not expected to result in any irretrievable or irreversible commitment of resources.

Individually and cumulatively the implementation of flow improvement measures (i.e., (b)(1) reoperation, (b)(1) "other," (b)(2) dedication of 800,000 acre-feet of CVP water, and (b)(3) water acquistions) addressed in this PEIS -- either as proposed programmatic actions or as actions that do not require NEPA compliance but which are included in the PEIS analyses to reflect the reasonably foreseeable direct, indirect, and cumulative impacts of implementing CVPIA -- are expected to have beneficial effects on fish and wildlife. Power lost as a result of reoperations would likely have to be met by other sources.

Subsequent NEPA documents would address more specific and definite environmental impacts, including irretrievable and irreversible commitments of resources, stemming from decisions on how specific programs would be implemented.

SHORT-TERM USES OF THE ENVIRONMENT VERSUS LONG-TERM PRODUCTIVITY

A decision to implement the provisions of CVPIA, as required by statute, would eventually enhance the long-term productivity of the natural and human environments and should create a more balanced and, therefore, sustainable allocation of water among competing needs and demands. If these various programs are eventually implemented, long-term uses of water resources would change; fisheries and water quality would be expected to be restored and long-term productivity enhanced. Long-term productivity of the agricultural sector would be reduced. More defined analysis and evaluation of the short-term uses of the environment and long-term productivity changes would be addressed in site-specific NEPA documents addressing how the specific programs would be implemented.

ENVIRONMENTAL COMMITMENTS AND UNAVOIDABLE ADVERSE IMPACTS

Adverse impacts of implementation of the Preferred Alternative are summarized in Table II-16. Adverse impacts to some issues can be reduced through the adoption of environmental commitments, such as those included in Table II-16.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

During the preparation of the PEIS, many alternatives and components of alternatives were considered. Some of the components were eliminated based upon information gathered as part of interim implementation of portions of the CVPIA. For example, changes were made to methods to implement seasonal flooding of rice fields due to information collected from interim implementation of the program by Interior and/or the State.

TABLE II-16
SUMMARY OF ADVERSE IMPACTS AND PROPOSED MITIGATION MEASURES FOR PEIS ALTERNATIVES

Adverse Impact	Alternatives	Potential Mitigation Measures
Adverse impacts due to Restoration Fund charges to CVP water and power users (see Agricultural Economics and CVP Power Analyses)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	No reasonable mitigation.
Adverse impacts due to reduction in CVP water service deliveries (see Surface Water Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Implement methods to increase CVP yield, including recommendations developed under Section 3408(j) of the CVPIA, and concepts such as discussed in the November 20, 1997 Administrative Paper on Management of Section 3406(b)(2) Water.
Adverse impacts due to reductions in SWP deliveries. (see Surface Water Analysis)	Preferred Alternative; Alternatives 2, 3, and 4; Supplemental Analyses 1a, 2a-2d, 3a, and 4a	Implement concepts such as discussed in November 20, 1997 Management of Section 3406(b)(2) Water Administrative Paper.
Adverse impacts due to reduction in groundwater levels and associated increase in subsidence. (see Groundwater Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Implement methods to increase CVP yield, including recommendations developed under Section 3408(j) of the CVPIA, and concepts such as discussed in the November 20, 1997 Administrative Paper on Management of Section 3406(b)(2) Water. Modify affected structures or regrade property to allow for proper drainage. Assist in the development of groundwater management plans.
Adverse impacts to fish due to increased temperatures in the American River (steelhead) (see Fisheries Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Modify outlet works on Folsom Dam.
Adverse impacts to fish due to increased temperatures in the Sacramento River (winter-run, steelhead) (see Fisheries Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a-1i	While no mitigation is evident as provided by the analysis in this document, reconsultation in compliance with the ESA will address these impacts to protect these species.

TABLE II-16. CONTINUED

Adverse Impact	Alternatives	Potential Mitigation Measures
Adverse impacts to fish due to reduction in flows in the Sacramento River (winter-run, steelhead, fall-run, spring-run) (see Fisheries Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	While no mitigation is evident as provided by the analysis in this document, reconsultation in compliance with the ESA will address these impacts to protect these species.
Adverse impacts to fish due to increased temperatures in the Merced River	Alternative 1; Supplemental Analyses 1a-1i	Relocate diversions to allow increased flow in critical portion of the river.
Adverse impacts to reduction in CVP power generation and shift of power generation to months where the value of power is lower, and increase total cost of power (see CVP Power Resources Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	No reasonable mitigation.
Adverse impacts to potential increase in mosquito abundance (see Mosquitos Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Provide additional abatement.
Adverse impacts to increases in potential for disturbance to Cultural Resources due to increased exposure and recreational opportunities at refuges, CVP reservoirs, and along rivers (see Cultural Resources Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Develop mitigation measures per Section 106 consultation with the Advisory Council and State Historic Preservation Office.
Adverse impacts to potential periodic reductions in swimming opportunities in the American River due to high flows (see Recreational Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Cooperate with local agencies in the development of swimming opportunities along the American River.
Adverse impacts to potential periodic reductions in boating and shoreline use opportunities in portions of Shasta Lake, Folsom Reservoir, and New Melones Reservoir (see Recreational Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Construct or extend boat ramps and facilities for beach use dependent upon the availability of funds.
Adverse impacts to reduction in agricultural-related jobs due to reduction in irrigated acreage (see Regional Economics Analysis)	Preferred Alternative; Alternatives 1, 2, 3, and 4; Supplemental Analyses 1a-1i, 2a-2d, 3a, and 4a	Job training dependent upon the availability of funds.
Adverse impacts to orchard damage due to Stanislaus River flows above 1,500 cfs (see Groundwater Analysis)	Alternatives 3 and 4; Supplemental Analyses 3a and 4a	Obtain easement.

In addition, several alternatives were considered to acquire water to fully meet target flows identified in the Draft AFRP Working Paper for instream and Delta flows. The results of this preliminary analysis are presented in the Evaluation of Preliminary Alternatives Technical Appendix. Three alternatives were considered but eliminated from further analysis due to the application of criteria to determine if the alternatives were reasonable to implement. The preliminary evaluation indicated that either water was not physically available to meet the goals of the alternative, or that the cost of the alternative was extremely high for further consideration at a programmatic level. Portions of the preliminary alternatives are included in the PEIS alternatives. Other portions of the preliminary alternatives may be considered at a future time.

Other alternatives suggested during the scoping phase were eliminated from consideration because the actions would have required an analysis that would be beyond the purpose of this PEIS. These alternatives included elimination of hatcheries to reduce competition between natural and hatchery fish, increased use of hatcheries to improve fish populations, reductions in sport and commercial harvest of salmon to improve fish populations, removal of dams to restore natural habitat, and artificial methods to transport fish from spawning areas to the ocean to reduce predation. Many of these actions would require evaluation by other agencies and could not be implemented under the CVPIA or other Interior authorizations. Some of the evaluations will be considered under the Evaluations to be completed by the AFRP, including the evaluation of the need to revise harvest regulations on both sport and commercial fishing.

Some alternatives were evaluated in more detail than others before being eliminated from further consideration. For example, three alternatives were evaluated based upon preliminary information developed by AFRP. The preliminary information included recommendations based upon scientific information that had not been screened for reasonableness of implementation. These alternatives were named Alternatives 3, 4, and 5. They were subsequently replaced with the current Alternatives 3 and 4 which are based upon AFRP target flows that have been subjected to reasonableness screening. It is possible that at some future time, the target flows may exceed the flows used in the PEIS alternatives. Information from the analysis of the initial Alternatives 3, 4, and 5 could be used to define those future actions. The results of the analysis of initial Alternatives 3, 4, and 5 are included in the Development of the Preliminary Alternatives Technical Appendix.

The alternatives are evaluated in this manner to provide “bookends” to the anlaysis and to identify the most conservative set of impacts that could occur for the different boundary conditions. Therefore, the decision maker can select the boundary conditions for the preferred alternative from the array of different alternatives evaluated in the PEIS.

Another reason that alternatives were developed as “bookends” and the menu approach for development of the preferred alternative is appropriate is because many of the programs addressed in CVPIA require partners. For example, water sales require participation of willing sellers and many of the habitat restoration actions require willing participants either for permission of for financial participation.

It should be noted that actions that require willing sellers cannot be implemented without the participation of the willing sellers. Interior cannot and will not force water users to sell or transfer their water. If there are not willing participants, that portion of the action cannot be implemented.

CHAPTER III

AFFECTED ENVIRONMENT

Chapter III

AFFECTED ENVIRONMENT

This chapter presents a summary of historical and recent conditions for resource areas and issues of interest evaluated in the Draft PEIS. Data presented in the Affected Environment included information that represents historical conditions and conditions that were present when CVPIA was adopted in 1992. It is recognized that conditions have changed since CVPIA was adopted. However, several CVPIA programs have been implemented since 1992. Many of these programs have noticeably changed the environmental conditions, and it is difficult to describe the environment without implementation of CVPIA. Therefore, this chapter does not include a description of conditions that have occurred in the last 5 to 7 years. Recent programs and their results are included in the description of Cumulative Effects in Chapter V of the PEIS.

The resources and issues included in this section were identified through a review of NEPA guidance documents, and through the scoping process described in Chapter VI, Consultation and Coordination. The resources and issues described are as follows.

- Surface Water Supplies and Facilities Operations
- Groundwater
- Fishery Resources
- Agricultural Economics and Land Use
- Municipal and Industrial Land Use and Demographics
- Vegetation and Wildlife Resources
- CVP Power Resources
- Recreation
- Fish, Wildlife, and Recreation Economics
- Regional Economics
- Municipal and Industrial Water Use and Costs
- The Delta as a Source of Drinking Water
- Mosquitos
- Social Conditions
- Cultural Resources
- Air Quality
- Soils
- Visual Resources

SURFACE WATER SUPPLIES AND FACILITIES OPERATIONS

The Central Valley of California is a vast, oblong valley in the interior of the state, extending 400 miles north-to-south and about 50 miles east-to-west. The Central Valley is flanked on the east by the Cascade and Sierra Nevada mountain ranges, and on the west by the Coast Range. Three major drainage areas are present in the Central Valley. The Sacramento River Basin comprises the northern third of the Central Valley, and yields approximately 35 percent of the total outflow of all rivers in the state. The 250-mile-long San Joaquin Valley, which is much drier than the

Sacramento River Basin, comprises the southern two-thirds of the Central Valley and is hydrologically divided between the San Joaquin River Basin and the Tulare Lake Basin. The San Joaquin River watershed includes lands that drain to the San Joaquin River and ultimately flow into the Delta. The Tulare Lake Basin watershed includes lands that primarily drain into the Tulare Lake bed or the Buena Vista Lake bed.

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 Central Valley. Figure III-1 shows major rivers and streams that drain Central Valley watersheds and major dams that affect streamflows.

SURFACE WATER IN THE SACRAMENTO RIVER BASIN

The Sacramento River Basin, shown in Figure III-2, encompasses over 24,000 square miles in the northern portion of the Central Valley. Drainage is provided by the Sacramento River, which flows generally north to south from its source near Mount Shasta to the Delta, and receives contributing flows from numerous major and minor streams and rivers that drain the east and west sides of the basin.

Elevations in the northern portion of the Sacramento River Basin range from over 14,000 feet in the headwaters of the Sacramento River to approximately 1,065 feet at Shasta Lake. In this area, total annual precipitation averages between 60 and 70 inches and is as high as 95 inches in the Sierra Nevada and Cascade mountains. The floor of the Sacramento Valley is relatively flat, with elevations ranging from about 60 to 300 feet above sea level. This area is characterized by hot, dry summers and mild winters. Precipitation is relatively light, ranging from 15 to 20 inches per year as far north as Red Bluff, falling mostly as rain. The mountainous areas bordering the valley reach elevations of over 5,000 feet and receive much more precipitation, with snow prevalent at higher elevations. Areas at elevations above 5,000 feet receive an average of 42 inches of precipitation per year, and as much as 90 inches fall at Lassen Peak.

The upper portion of the Sacramento River is fed by tributary flows from numerous small creeks, primarily those draining the western slopes of the Cascade and Sierra Nevada mountains. The volume of flow increases as the river progresses southward, and is increased considerably by the contribution of flows from the Feather River and the American River watersheds. Accordingly, the Sacramento River is characterized in two sections: the upper section from its source to just above its confluence with the Feather River, and the lower section from the confluence with the Feather River to the Delta.

Upper Sacramento River

Flows in the upper Sacramento River are regulated by the CVP Shasta Dam (completed in 1945) and re-regulated approximately 15 miles downstream at Keswick Dam (completed in 1950). The portion of the river above Shasta Dam drains about 6,650 square miles and produces average annual runoff of 5.7 million acre-feet. As the Sacramento River nears Red Bluff, flows become more influenced by the inflow from major tributary streams, including Clear, Cow, Bear, Cottonwood, Battle, and Paynes creeks.

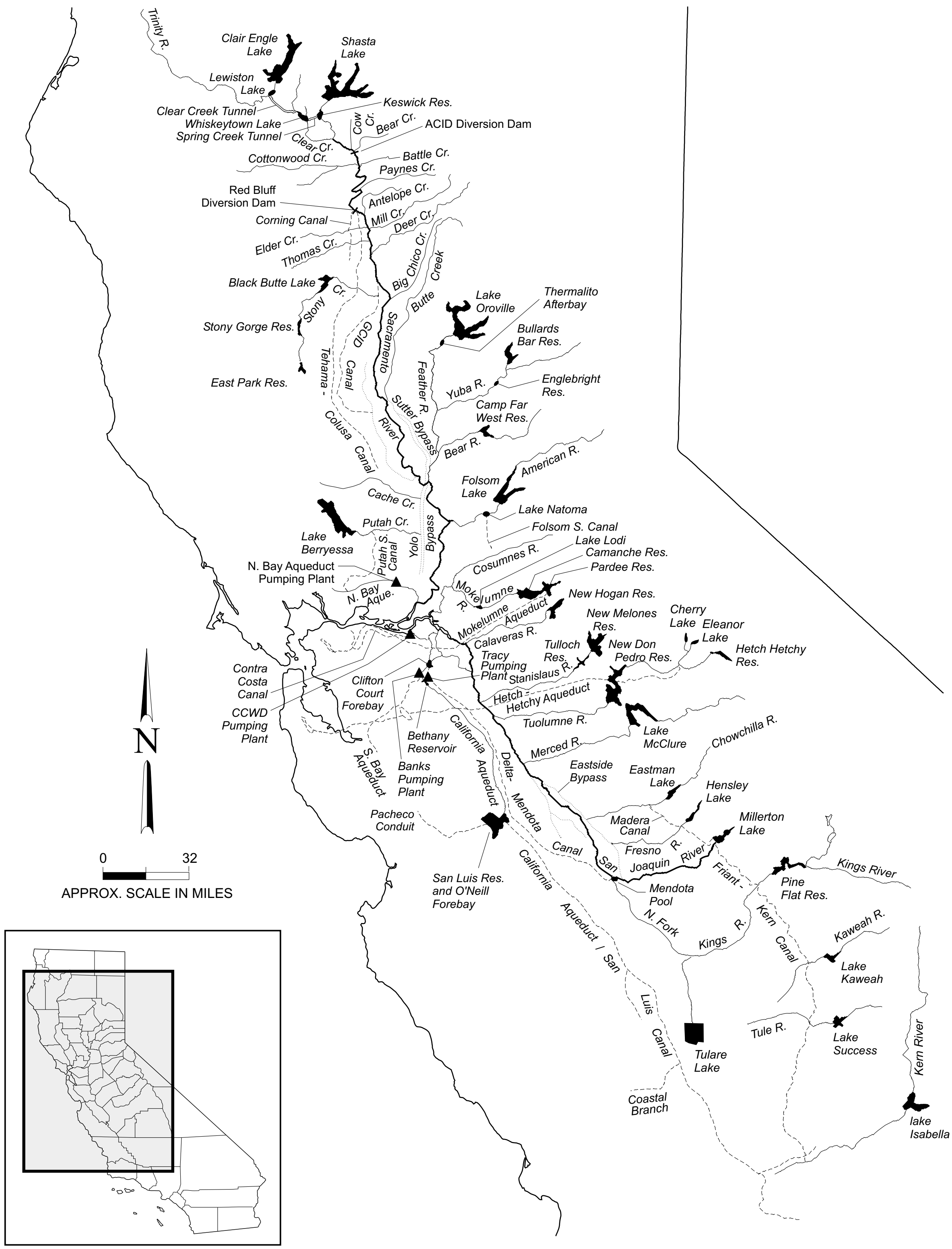


FIGURE III-1

MAJOR WATER FACILITIES IN THE CENTRAL VALLEY

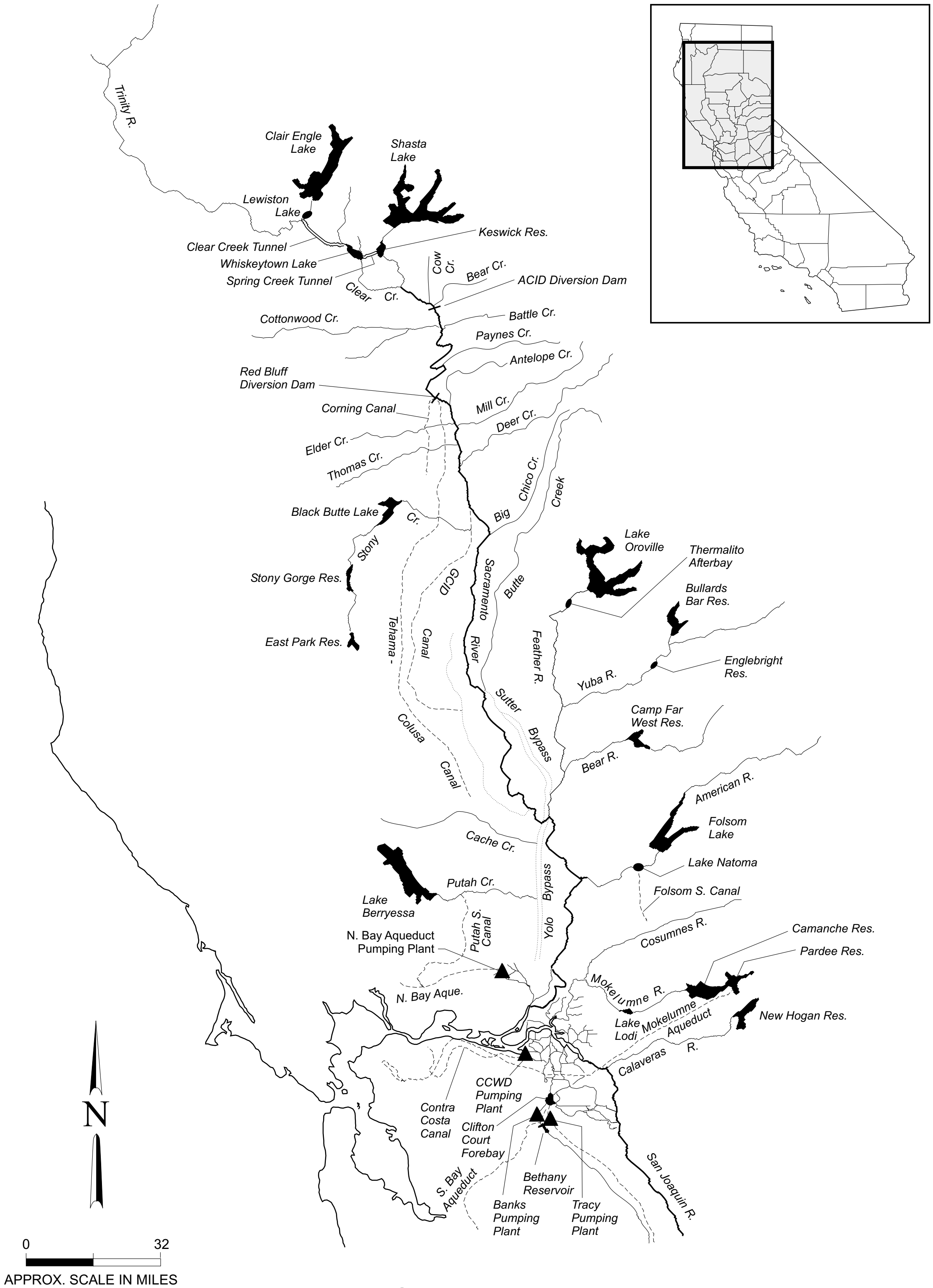


FIGURE III-2

SACRAMENTO RIVER BASIN

Prior to the construction of Shasta Dam, monthly flows in the upper Sacramento River reflected the runoff patterns associated with winter precipitation and spring snow melt. Peak flows generally occurred during the months of February, March, and April. Following the construction of Shasta Dam, average monthly flows during March and April were reduced and average flows during the summer irrigation months were increased. Since 1964, a portion of the flow from the Trinity River Basin has been exported to the Sacramento River Basin through CVP facilities.

An average of 1,269,000 acre-feet of water has been diverted from Whiskeytown Lake to Keswick Reservoir annually (1964-1992), about 17 percent of the flows in the Sacramento River measured at Keswick.

Major water diversions on the Sacramento River include the Anderson Cottonwood Irrigation District (ACID) Diversion Dam, the Glen Colusa Irrigation (GCID) District Diversion Dam, and the Red Bluff Diversion Dam (RBDD).

Lower Sacramento River and Tributaries

The lower Sacramento River is identified as the reach that extends from Knights Landing, just above the confluence with the Feather River, to Freeport, just below the point where the Sacramento River enters the Delta. The drainage area of the Sacramento River upstream of Freeport encompasses more than 24,000 square miles. The historical average annual flow on the Sacramento River at Freeport is approximately 16.7 million acre-feet, more than twice the average annual flow measured above the confluence of the Feather River over the same time period. This increase in flow in the lower Sacramento River is primarily due to the addition of the Feather and American river flows.

Feather River and Tributaries. The Feather River, with a drainage area of 3,607 square miles on the east side of the Sacramento Valley, is the largest tributary to the Sacramento River below Shasta Dam, with a median historical unimpaired runoff of 3.8 million acre-feet. This total flow is provided by the Feather River and tributaries, which include the Yuba and Bear rivers. Flows on the Feather River are regulated by Oroville Dam, the lowermost reservoir on the river, which began operation in 1967 as part of the SWP. Oroville Reservoir has a storage capacity of approximately 3.5 million acre-feet. Prior to the construction of Oroville Dam, flows in the Feather River reflected natural runoff conditions, with peak flows in the months of March, April, and May. Following the construction of Oroville Dam, the average monthly flow pattern was modified to provide reduced flows during the spring months and increased flows during summer months.

Water released from Oroville Dam is diverted approximately 5 miles downstream at the Thermalito Diversion into the Thermalito Power Canal, thence to the Thermalito Forebay, and finally into the Thermolito Afterbay. Between the Thermolito Diversion Dam and the Thermalito Afterbay, flows in the Feather River are maintained at a constant 600 cubic feet per second (cfs). This 8-mile section of the river is often referred to as the "low flow" section. The Thermolito Afterbay serves the dual purposes of an afterbay to re-regulate releases to the Feather River from the hydroelectric plants and a warming basin for irrigation water that will be diverted to rice fields. Consequently, the water temperatures in the approximately 14-mile section of the

Feather River below Thermalito Afterbay, commonly referred to as the "high flow" section, are often higher than water temperatures in the "low flow" section.

The Yuba River is a major tributary to the Feather River, historically contributing over 40 percent of the flow, on a total annual basis, as measured at Oroville. The Yuba River originates in the Sierra Nevada, drains approximately 1,339 square miles of the eastern Sacramento Valley, and flows into the Feather River near the town of Marysville.

American River. The American River originates in the mountains of the Sierra Nevada range, drains a watershed of approximately 1,895 square miles, and enters the Sacramento River at RM 60 in the City of Sacramento. The American River contributes approximately 15 percent of the total flow in the Sacramento River. The watershed ranges in elevation from 23 feet to over 10,000 feet, and receives approximately 40 percent of its flow from snowmelt runoff.

Prior to construction of Folsom Dam, monthly flows were generally highest during the months of April and May, and approached zero in the late summer. In wet years, high spring flows often resulted in downstream flooding in the Sacramento area. Since the construction of Folsom Dam, the extreme flows in wet years have been reduced, and higher flows have been provided during dry periods. This operation has resulted in improved flood protection to downstream areas.

SURFACE WATER IN THE SAN JOAQUIN RIVER BASIN

The San Joaquin River Basin, shown in Figure III-3, extends from the Delta in the north to the north fork of the Kings River in the south, encompassing about 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 8 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, drains 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 of permanent tule marshes and more than 1.5 million acres of seasonally flooded wetlands.

The three northernmost streams, the Calaveras, Mokelumne, and Cosumnes rivers, flow into the San Joaquin River within the boundaries of the Delta. Streams on the west side of the basin are intermittent, and their flows rarely reach the San Joaquin River. Natural runoff from westside sloughs is augmented with agricultural drainage.

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,

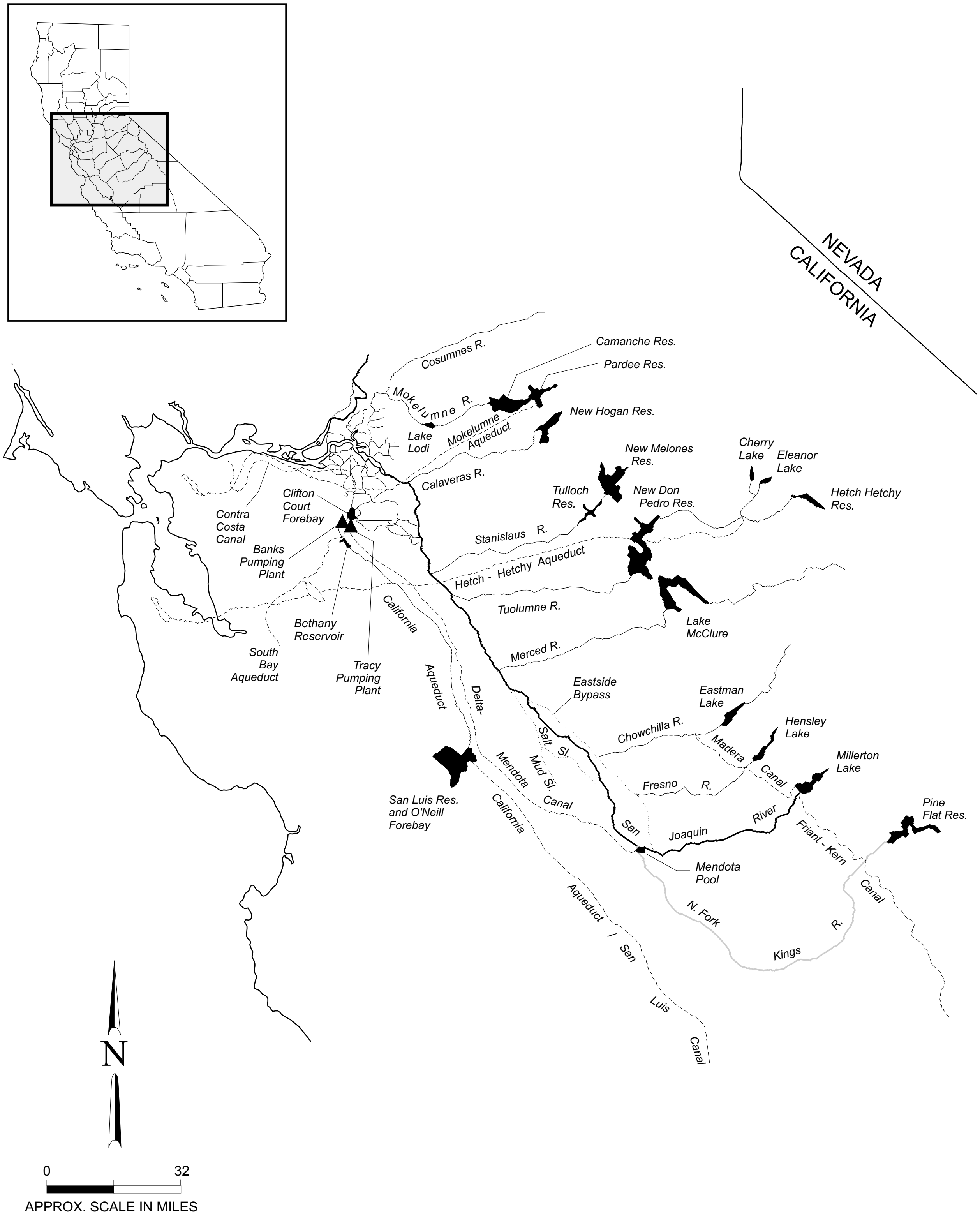


FIGURE III-3

SAN JOAQUIN RIVER BASIN

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. During the past 100 years, development in this area has resulted in groundwater overdraft conditions, and the river loses much of its flow through percolation. 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, and agricultural drainage water.

Upper San Joaquin River and Tributaries

Flows in the upper San Joaquin River are regulated by the CVP Friant Dam, which was completed in 1941 to store and divert water to the Madera and Friant-Kern canals for irrigation and municipal and industrial (M&I) 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. 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 Mammoth Pool and Shaver Lake, are primarily used for hydroelectric power generation. The operation of these reservoirs affects the inflow to Millerton Lake.

Following completion of Friant Dam in 1941, most of the annual flow has been diverted to the Friant-Kern and Madera canals. Average monthly releases from Friant Dam to the San Joaquin River since 1941 have included minimum releases to satisfy water rights above Gravelly Ford and flood control releases.

Lower San Joaquin River and Tributaries

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). 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 unimpaired runoff of approximately 1.95 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 Turlock Irrigation District (TID) and Modesto Irrigation District (MID) with participation by the City and County of San Francisco. The 2.0-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 City and County of San Francisco operate 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 0.4 million acre-feet of water in Hetch Hetchy Reservoir. The 460-square-mile drainage area is entirely within the boundaries of Yosemite National Park. Water from Hetch Hetchy is used primarily to meet the M&I water needs of the City and County of San Francisco and to provide instream flows in the Tuolumne River below O'Shaughnessy Dam. Two other storage facilities upstream of Hetch Hetchy Reservoir, Lake Eleanor and Cherry Lake, are operated for hydropower and water supply purposes. The combined capacity of these two reservoirs is about 0.4 million acre-feet. The City and County of San Francisco own 0.6 million acre-feet of storage in New Don Pedro Reservoir, which allows them to meet part of their release obligations to the districts by exchanging stored water for water diverted upstream at Hetch Hetchy.

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 1.2 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-foot, 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 in facilities on the river, average monthly flows in August and September approached zero in many years. 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 Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (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. 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.

Calaveras River. The Calaveras River originates in the Sierra Nevada Mountains, produces a median unimpaired runoff of 130,000 acre-feet, and drains an area of approximately 363 square miles. It enters the San Joaquin River near the City of Stockton. The Calaveras River watershed is almost entirely below the effective average snowfall level (5,000 feet), and receives nearly all of its flow from rainfall. As a result, nearly all of the annual flow occurs between November and April. The major water management facility on the Calaveras River is New Hogan Dam and Lake, constructed in 1963 by the U.S. Army Corp of Engineers (COE) with a storage capacity of 317,000 acre-feet, and operated by the COE and Stockton East Water District.

Mokelumne River. The Mokelumne River originates in the Sierra Nevada Mountains, drains a watershed of approximately 661 square miles, and produces a median unimpaired runoff of approximately 696,000 acre-feet. It is a major tributary to the Delta, entering the lower San Joaquin River northwest of Stockton.

Three major reservoirs influence streamflow in the Mokelumne River. The uppermost reservoir, Salt Springs Reservoir, is owned by PG&E and is located on the North Fork of the Mokelumne River. It has a storage capacity of 141,900 acre-feet and began operation in 1931. Pardee and Camanche reservoirs are located on the main stem of the Mokelumne and are both owned and operated by the East Bay Municipal Utility District (EBMUD). Pardee, completed in 1929, has design capacity of 209,900 acre-feet. Water is exported from the Mokelumne River watershed to the EBMUD service area via the Mokelumne River Aqueduct, which receives water directly from Pardee Reservoir. Camanche Reservoir, with a design capacity of 430,800 acre-feet, is located downstream of Pardee Dam. Water is released from Camanche Reservoir to maintain downstream water requirements and to provide flood protection on the Mokelumne River.

Approximately 82 diversions were identified along the Mokelumne River (DWR Bulletin 130-68). Except for the Mokelumne Aqueduct diversion, the most significant diversion in the watershed occurs at Woodbridge Dam, which diverts water into the Woodbridge Canal for irrigation of land south and west of the Town of Woodbridge.

Cosumnes River. The Cosumnes River originates in the lower elevations of the Sierra Nevada Mountains, and drains a watershed of approximately 537 square miles. It enters the Mokelumne River within the Delta near the Town of Thornton. Because of the low elevation of its headwaters, the Cosumnes River receives most of its water from rainfall. The only major water supply facilities in the Cosumnes River watershed are components of the Sly Park Unit of the CVP. The water supply provided by the Sly Park Unit is used by El Dorado Irrigation District (EID) and is not integrated into the CVP operations.

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 upstream to satisfy water rights 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 generally has higher concentrations of total dissolved solids (TDS) than water in the upper reaches of the San Joaquin River. Most of the water released from the Mendota Pool to the San Joaquin River is diverted at or above Sack Dam for agricultural uses. 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, other wastewaters, and effluent groundwater (DWR, 1965). 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). During the mid to late 1960s, San Joaquin River water quality continued to decline. In 1972, the State Water Resources Control Board (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.

SURFACE WATER IN THE SACRAMENTO-SAN JOAQUIN DELTA

The Delta, shown in Figure III-4, lies at the confluence of the Sacramento and San Joaquin rivers. It occupies the area of lowest elevation in the Central Valley, extending from the confluence of the two rivers inland as far as Sacramento and Stockton. In its original state, the Delta area included swamp and overflow lands that are some of the most fertile peat soils in the state.

Much of the land within the Delta lies below sea level and was reclaimed between 1850 and 1930 through the construction of levees around the numerous islands, creating a network of navigable river channels, sloughs, and dredger cuts. Currently, the Delta encompasses approximately 1,153 square miles, with over 700 miles of channels and sloughs and over 1,000 miles of levees. Runoff from Central Valley rivers flows through a maze of channels and waterways that surround 57 major reclaimed islands and nearly 800 unleveed islands (Water Education Foundation, 1992). On the average, about 21 million acre-feet of water, or about 42 percent of the surface water in California, reaches the Delta. Actual flow varies widely from year to year, and within the year as well. In 1977, a year of extraordinary drought, inflow to the Delta totaled 5.9 million acre-feet. In 1983, an extremely wet year, annual inflow was about 70 million acre-feet. Approximately 50,000 acres of the Delta is covered by surface water, and approximately 520,000 acres of Delta land is used for agriculture.

A significant portion of the water from California's northern streams is transported through the Delta for use in the San Joaquin River Region, the Tulare Lake Region, and in Southern California. Delta channels have been modified to allow transport of this water and to reduce the effects of pumping on the direction of flows and salinity intrusion. The conveyance of water from the Sacramento River southward through the Delta is aided by the CVP Delta Cross Channel (DCC), a man-made gated channel that conveys water from the Sacramento River to the Mokelumne River. Other water diversions in the Delta include the Contra Costa Canal, the North Bay Aqueduct, and over 1,800 agricultural diversions for in-Delta use.

The hydraulic characteristics of the Delta are influenced by inflows from tributary streams, tidal influence from the Pacific Ocean, and water diversions within the Delta. Accordingly, water quality in the Delta is highly variable. It is strongly influenced by inflows from the rivers, as well as by intrusions of seawater into the western and central portions of the Delta during periods of low outflow that may be affected by high export pumping. The concentrations of salts and other materials in the Delta are affected by river inflows, tidal flows, agricultural diversions, drainage flows, wastewater discharges, water exports, cooling water intakes and discharges, and groundwater accretions.

Delta channels are typically less than 30 feet deep, unless dredged, and vary in width from less than 100 feet to more than 1 mile. Although some channels are edged with riparian and aquatic vegetation, steep mud or riprap covered levees border most channels. To enhance flow and aid in levee maintenance, vegetation is often removed from the channel margins. The tidal currents carry large volumes of seawater back and forth through the San Francisco Bay-Delta Estuary with the tidal cycle. The mixing zone of salt and fresh water can shift 2 to 6 miles daily depending on the tides, and may reach far into the Delta during periods of low inflow.

Major CVP facilities in the Delta include the Tracy Pumping Plant, completed in 1951, which pumps water from Old River to the Delta-Mendota Canal; the Contra Costa Pumping Plant, completed in

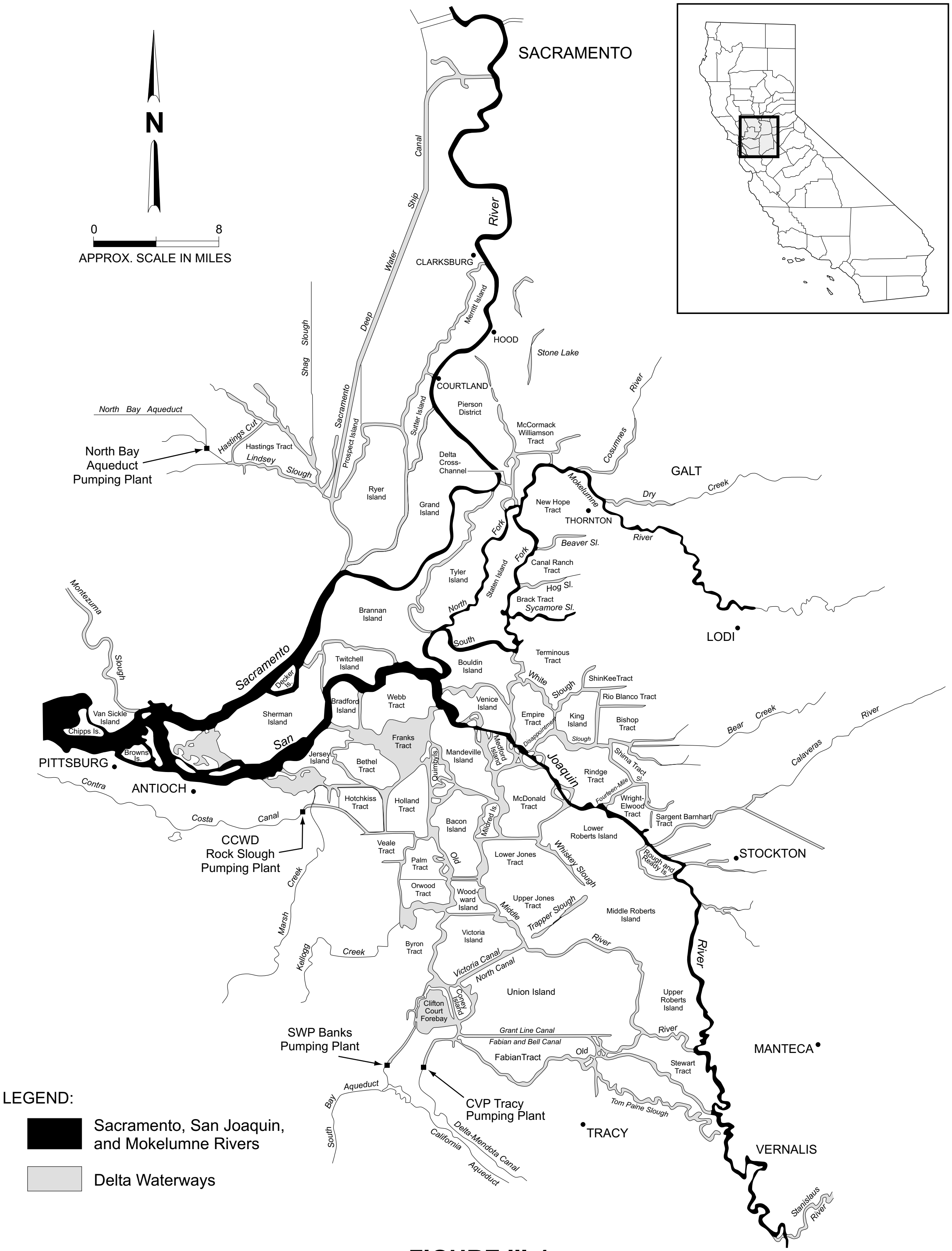


FIGURE III-4

SACRAMENTO-SAN JOAQUIN DELTA

1948, which pumps water from Rock Slough into the Contra Costa Canal; and the DCC, which was completed in 1951 and permits the diversion of water from the Sacramento River to the Mokelumne River, facilitating efficient transfer of water across the Delta to project pumps in the southern Delta. The SWP also operates and maintains facilities in the Delta. These include the Barker Slough Pumping Plant in the north Delta, which pumps water into the North Bay Aqueduct, and the Harvey O. Banks Delta Pumping Plant, which pumps water from Clifton Court Forebay in the southern Delta into the California Aqueduct.

Currently, salinity problems, which occur primarily during years of below-normal runoff, are largely associated with the high concentration of salts carried by the San Joaquin River into the Delta. Operation of the state and federal export pumping plants near Tracy draws higher quality Sacramento River water across the Delta and restricts the area of higher salinity water to the southeast portion of the Delta. Localized problems resulting from irrigation returns occur elsewhere such as in dead-end sloughs. Elevated salinity levels in the western Delta result primarily from the intrusion of saline waters from the San Francisco Bay system.

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. Figure III-5 shows the locations of CVP facilities, rivers that are controlled or affected by the operation of CVP facilities, and the CVP service area.

Historically, approximately 90 percent of the CVP water has been delivered to agricultural users, including prior water rights 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 in wet years only. 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 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. The section concludes with a discussion of CVP contract types and criteria used to determine annual water delivery levels to CVP 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.

FIGURE III-5

CENTRAL VALLEY PROJECT AND OTHER RELATED FEDERAL FACILITIES

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 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 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 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 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 1990 and 1991, SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. The orders include temperature objectives for the Sacramento River and requesting Reclamation to operate Keswick and Shasta dams and the Spring Creek powerplants to meet a daily average water temperature of 56 degrees Fahrenheit at RBDD in the Sacramento River during critical periods when higher temperature would be harmful to the anadromous fishery.

In 1993, NMFS in formal consultation issued a Long-Term Winter-Run Chinook Salmon Biological Opinion, which addresses modifications to the long-term CVP operational plan to avoid jeopardizing the continued existence of the Sacramento River winter-run chinook salmon. Also in 1993, the Service released a biological opinion and included restrictions on 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. The Draft Bay-Delta Water Control Plan, released in May 1995, superseded D-1485. The coordinated operations of the CVP and SWP continue to be based on the COA.

Operations of CVP Divisions and Facilities

The facilities included in CVP divisions north of the Delta, including the Trinity, Shasta, and Sacramento River divisions, are shown schematically in Figure III-6. These divisions are known collectively as the Northern CVP System. Facilities in CVP divisions south of the Delta are shown in Figure III-7. Of these, the Delta, West San Joaquin, and San Felipe divisions are known collectively as the Southern CVP System. Both the Eastside and 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 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.

Trinity River Division. The Trinity River Division, completed in 1964, includes facilities to collect and regulate water in the Trinity River, as well as facilities to transfer portions of the collected water to the Sacramento River Basin. Specific facilities in the Trinity River Division include Trinity Dam and Powerplant; Clair Engle Lake; Lewiston Dam, Lake, and Powerplant; Clear Creek Tunnel; Whiskeytown Dam and Lake; Spring Creek Debris Dam and Reservoir; Spring Creek Tunnel; and the Cow Creek Unit.

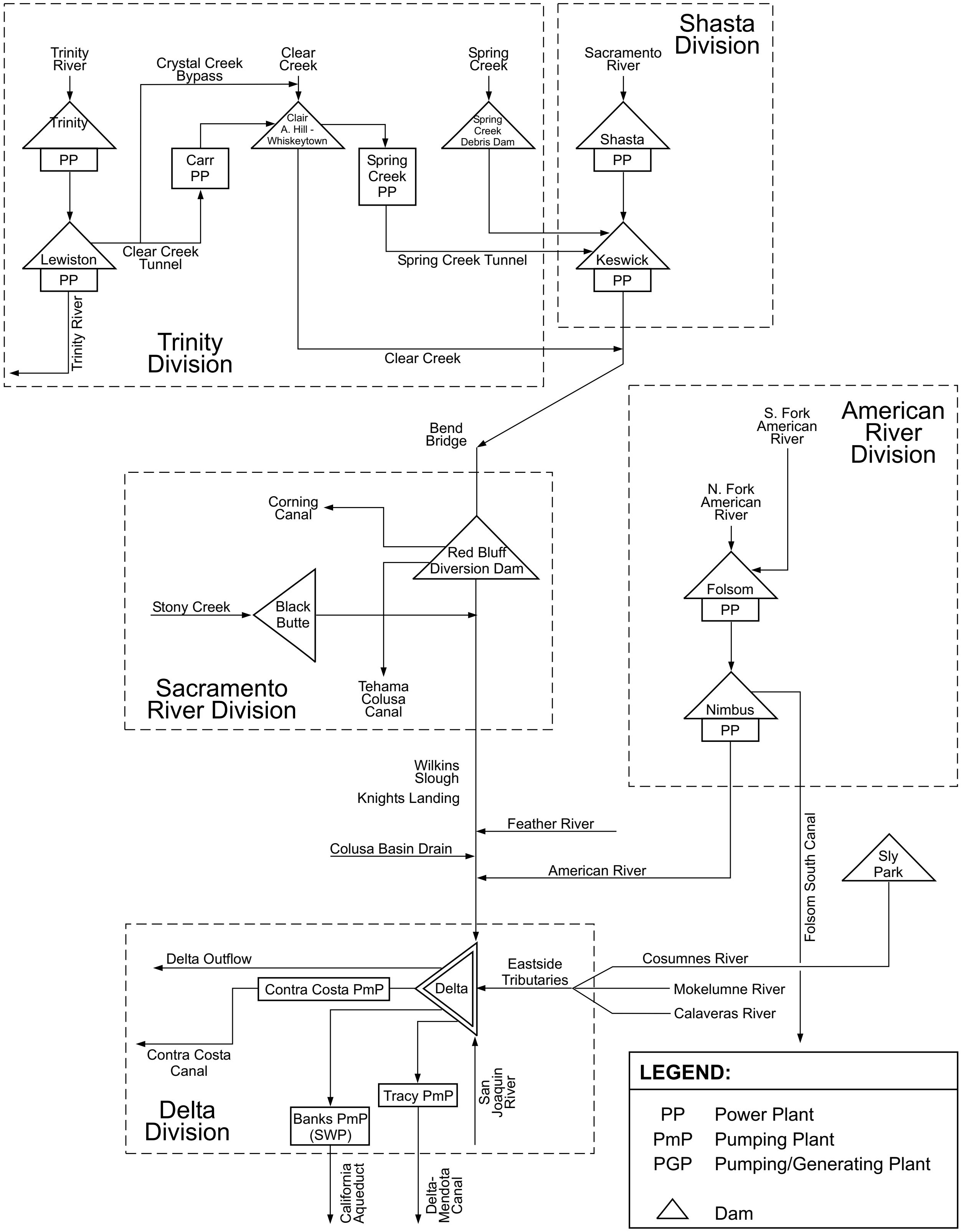


FIGURE III-6

CENTRAL VALLEY PROJECT FACILITIES NORTH OF THE DELTA

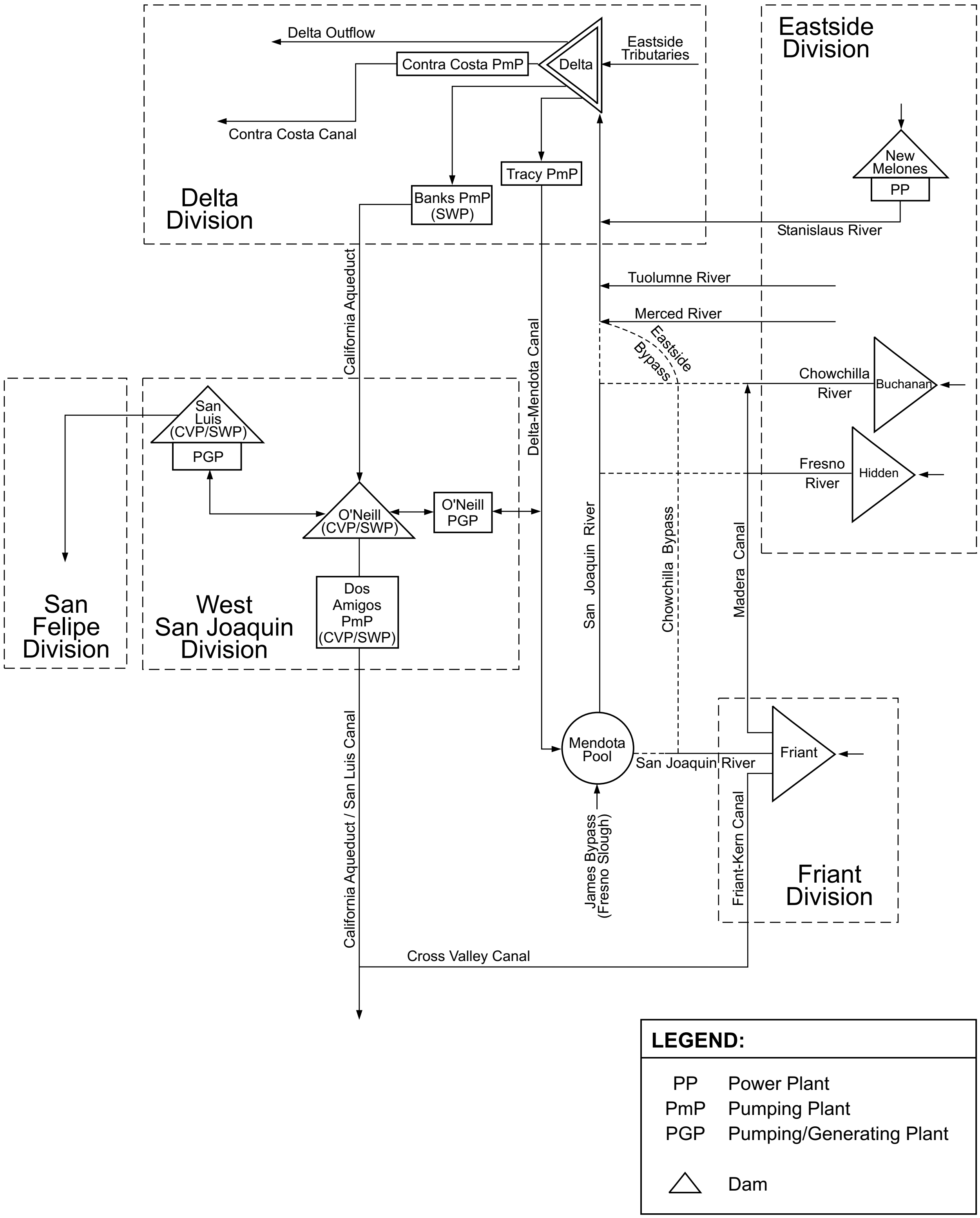


FIGURE III-7

CENTRAL VALLEY PROJECT FACILITIES SOUTH OF THE DELTA

Trinity Dam on the Trinity River was completed in 1962, forming Clair Engle Lake, with a maximum storage capacity of approximately 2.4 million acre-feet. All releases from Trinity Dam are re-regulated downstream at Lewiston Lake to meet downstream flow, in-basin diversion, and downstream temperature requirements. Lewiston Reservoir provides a forebay for the trans-basin transfer of water through the Clear Creek Tunnel and the Judge Francis Carr Powerplant into Whiskeytown Lake on Clear Creek.

Water stored in Whiskeytown Lake includes exports from the Trinity River as well as runoff from the Clear Creek drainage area. Releases from Whiskeytown Lake are either passed through the Spring Creek Powerplant and discharged into Keswick Reservoir on the Sacramento River or released to Clear Creek to meet downstream flow and diversion requirements.

The mean annual inflow to Clair Engle Lake is about 1.2 million acre-feet, a large percentage of which is diverted to the Central Valley. Clair Engle Lake is operated to satisfy required fishery releases to the Trinity River, while attempting to fill the lake by the end of June to maximize power production during the summer and fall. During the winter months, Clair Engle Lake storage is regulated within the capacity of Trinity, Lewiston, Spring Creek, Judge Francis Carr, and Keswick powerplants, as well as Reclamation's Safety of Dams criteria.

Shasta and Sacramento River Divisions. The Shasta Division of the CVP includes facilities that provide conservation of water on the Sacramento River for flood control, navigation maintenance, conservation of fish in the Sacramento River, protection of the Delta from intrusion of saline ocean water, irrigation and M&I water supplies, and hydroelectric generation. The Sacramento River Division includes facilities for the diversion and conveyance of water to CVP contractors on the west side of the Sacramento River.

Shasta Dam is located on the Sacramento River at the confluence of the Sacramento, McCloud, and Pit rivers. Keswick Reservoir serves as an afterbay for releases from Shasta Dam and for discharges from the Spring Creek Powerplant. As a condition of the Winter-Run Chinook Salmon Biological Opinion, Reclamation maintains a minimum flow of 3,250 cfs in the Sacramento River below Keswick Dam from October 1 through March 31. This minimum instream flow is to provide safe rearing and downstream passage of winter-run chinook salmon and to reduce stranding of juveniles.

The RBDD, on the Sacramento River approximately 2 miles southeast of Red Bluff, diverts water to the Corning and Tehama-Colusa canals. Completed in 1964, the dam is a gated structure with fish ladders at each abutment. The gates are lowered from May 15 to September 15 for diversion into the Tehama-Colusa Canal. When the gates are lowered, the impounded water creates Lake Red Bluff.

Flood control releases from Keswick Dam are adjusted for local runoff entering the Sacramento River between Keswick and Bend Bridge so that the flow at Bend Bridge does not exceed 100,000 cfs Releases from Keswick Dam also are regulated in the spring months to reduce adverse effects on orchards located in areas prone to seepage. During non-flood control operations, releases from Keswick are made to maintain minimum flows of 5,000 cfs at Chico Landing. This level was originally established to support navigation but has been used as a basis to set pump intakes. Therefore, even though navigation has diminished, navigation flows cannot be reduced without affecting the pumping capabilities of the water users.

American River Division. The American River Division includes facilities that provide conservation of water on the American River for flood control, fish and wildlife protection, recreation, protection of the Delta from intrusion of saline ocean water, irrigation and M&I water supplies, and hydroelectric generation. Initially authorized facilities in the American River Division are Folsom Dam, Lake, and Powerplant; Nimbus Dam and Powerplant; Lake Natoma; and the Sly Park Unit. The Sly Park unit facilities are located in the Cosumnes River basin. The Auburn-Folsom South Unit includes the Foresthill Divide subunit and the Folsom South Canal.

Delta Division. Delta Division facilities provide for the transport of water through the Sacramento-San Joaquin River and the San Francisco Bay-Delta Estuary, and the delivery of water to CVP contractors in eastern Contra Costa County and the San Joaquin Valley. The Delta Division is operated in conjunction with the SWP through the COA to meet the requirements of in-Delta riparian water rights holders and Delta water quality standards adopted by the SWRCB to protect beneficial uses of the Delta.

The DCC is a controlled diversion channel located between the Sacramento River and Snodgrass Slough, a tributary of the Mokelumne River in the Delta. The original and primary purpose of the DCC was to provide passage of Sacramento River water to the Tracy Pumping Plant. The Contra Costa Canal, one of the first CVP facilities, was completed in 1948 to serve agricultural users in eastern and central Contra Costa County. Since that time, urban growth and municipal demands have replaced nearly all of the original agricultural uses.

The Tracy Pumping Plant and Delta-Mendota Canal convey water to the Mendota Pool on the San Joaquin River west of Fresno, and deliver water to San Joaquin River Exchange Contractors and CVP water service contractors in the San Joaquin Valley. A portion of the water conveyed through the Delta-Mendota Canal is pumped into the O'Neill Forebay and then into the joint Federal-State San Luis Reservoir. Water stored in San Luis Reservoir meets contract requirements for agricultural irrigation on the west side of the San Joaquin Valley through the San Luis Canal and to deliver water to urban contractors in the Santa Clara Valley and Hollister Unit of the San Felipe Project.

Beneficial uses in the Delta are protected by the SWRCB May 1995 draft Water Quality Control Plan and the DCC gate operations specified in the NMFS 1993 Long-Term Winter-Run Chinook Salmon Biological Opinion. To accomplish these objectives, CVP and SWP operators must consider the current water supply and hydrologic conditions; current water quality conditions; and potential impacts to fisheries, recreation, and power.

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 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. 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. Water from San Luis Reservoir is 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 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 1980, 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 draft Water Quality Control Plan. 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 draft Water Quality Control Plan.

Friant Division. The Friant Division includes facilities to collect and convey water from the San Joaquin River 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 rights holders, who entered into exchange contracts 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 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

During development of the CVP, the United States entered into long-term contracts with many of the major water rights holders 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 was authorized to build the CVP, those water rights were transferred to Reclamation, which made applications for the additional water rights needed for the CVP. In granting water rights, the SWRCB sets certain conditions within the permits to protect prior water rights, fish and wildlife needs, and other prerequisites it deems in the public interest.

Sacramento River Water Rights Contractors. Sacramento River Water Rights Contractors are contractors who for the most part claim water rights on the Sacramento River. With the control of the Sacramento River by Shasta Dam, these water right claimants entered into contracts with Reclamation. Most of the agreements established the quantity of water the contractors are allowed to divert from April through October without payment to Reclamation, and are provided a supplemental CVP supply allocated by Reclamation.

San Joaquin River Exchange Contractors. San Joaquin River Exchange Contractors are contractors who receive CVP water from the Delta at the Mendota Pool. Under the Exchange Contracts, the parties agreed to not exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. These exchanges allowed for water to be diverted from the San Joaquin River at Friant Dam under the water rights of the United States for storage at Millerton Lake.

The purchase contract dealt primarily with riparian water rights. When the United States purchased these rights, they were “extinguished” and thereby made water available for storage and diversion at Friant. Under the exchange contract, the parties agreed not to exercise their rights in exchange for a substitute water supply from the Delta. This also made water available for storage and diversion at Friant. However, under the exchange contract, no transfer of water rights occurred, and Reclamation is responsible for delivering water to these contractors in accordance with these agreements.

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 agreements 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 supply of CVP water to be applied for beneficial use. In addition to CVP water supply, a water service contract can include a supply of water that recognizes a previous water right. The purposes of a water service contract are to stipulate 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 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

The criteria for deliveries to CVP contractors consider available water supplies and superior obligations on the use of the available water. Decision-making criteria are similar in most units and divisions of the CVP. The criteria applicable to CVP 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 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.

Shasta Criteria. Shortage conditions for providing water to the Sacramento River Water Rights Contractors and the San Joaquin River Exchange Contractors are based on the “Shasta Criteria.” The Shasta Criteria is used to establish when a water year is considered critical, based on inflow to Shasta Lake.

As defined by the Shasta Criteria, when inflows to Shasta Lake fall below the defined thresholds, the water year is defined as critical, and water deliveries to the contractors may be reduced. A year is critical when the full natural inflow to Shasta Lake for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) is equal to or less than 3.2 million acre-feet. This is considered a single-year deficit. A year is also critical when the accumulated difference (deficiency) between 4 million acre-feet and the full natural inflow to Shasta Lake for successive previous years, plus the forecasted deficiency for the current water year, exceeds 800,000 acre-feet.

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 the Sacramento River Water Rights Contractors is based on the Shasta Criteria which, as described above, reduce deliveries to 75 percent of the contract amount during critical years. Water availability for delivery to San Joaquin River Exchange Contractors and to Medota Pool Contractors is approximately based on the Shasta Criteria. 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 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.

SWP FACILITIES AND OPERATIONS

SWP facilities capture and store water on the Feather River, 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, 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.

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, 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 is 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.

SWP Water Users

Currently, the SWP has contracted a total of 4.23 million af for delivery in the 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 are 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.

Feather River Settlement Contractors. The Feather River Settlement Contractors are water users who hold riparian and senior appropriative rights on the Feather River. As the SWP was built, the State entered into contractual agreements with these existing water rights holders (e.g., water rights settlements). In general, agreements established the quantity of water the contractor is permitted to divert under independent senior water rights on a monthly basis and outlined supplemental SWP supply allocated by the State. Contract shortages are applied based on hydrologic conditions and storage in Lake Oroville.

SWP Contract Entitlements. 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, specified in "Table A " in DWR Bulletin 132, reflect each contractor's projected annual water needs at the time the contracts were signed. SWP delivers water to agricultural and M&I water contractors based on the criteria established in the 1996 Monterey Agreement, which applies equal deficiency levels to all contractors.

GROUNDWATER

For over 100 years, groundwater has been used to support agricultural and municipal demands throughout California. In the Central Valley, groundwater development has been used extensively for agricultural supply, and in some area remains the sole water supply. The Friant Division, one of the initial features of the CVP, was developed specifically to supplement groundwater resources in the eastern portion of the San Joaquin Valley with surface water from the San Joaquin River.

The Central Valley regional aquifer system of California is a 400-mile long, northwest-trending asymmetric trough averaging 50 miles in width, as shown in Figure III-8. Historically, groundwater resources have been extensively developed in the Sacramento, San Joaquin, and Tulare Lake regions. Prior to development of the CVP, overdraft conditions had occurred as a result of extensive groundwater development and the reliance on groundwater during drought years because of limited surface water supplies. In some areas of the Central Valley, regional groundwater levels declined by more than 300 feet during the 1940s and 1950s. The development of surface water supplies in the 1950s and 1960s reduced reliance on groundwater and helped control the rapid rate of groundwater level decline. However, the long-term effects of groundwater use have resulted in regional land subsidence.

The largest occurrence of land subsidence in the world induced by human activity occurs in the Central Valley of California (Bertoldi et al., 1991). The areal extent of land subsidence, shown in Figure III-9, generally coincides with areas where groundwater levels have declined significantly as a result of historical overdraft conditions. Overdraft conditions occur when groundwater pumping exceeds perennial yield on a sustained basis. The perennial yield of an aquifer, as defined by DWR, is the amount of groundwater that can be extracted without lowering groundwater levels over the long term, assuming a specific level of water management activity. If water management activities change, groundwater recharge will be altered, which will alter the estimate of perennial yield.

The extensive agricultural development in the Central Valley has resulted in areas where groundwater has become degraded from salts, pesticides, or fertilizer. Areas of poor shallow groundwater drainage are often associated with high concentrations of salts. Areas near rivers that are subject to seepage commonly are waterlogged during high flows.

SACRAMENTO RIVER BASIN

The northern third of the Central Valley regional aquifer system is located in the Sacramento River Region. This region extends from north of Redding to the Delta in the south. DWR identifies this portion of the Central Valley Aquifer as the Sacramento Valley and Redding basins, which cover over 5,500 square miles. This discussion refers to these basins collectively as the Sacramento Valley Basin.

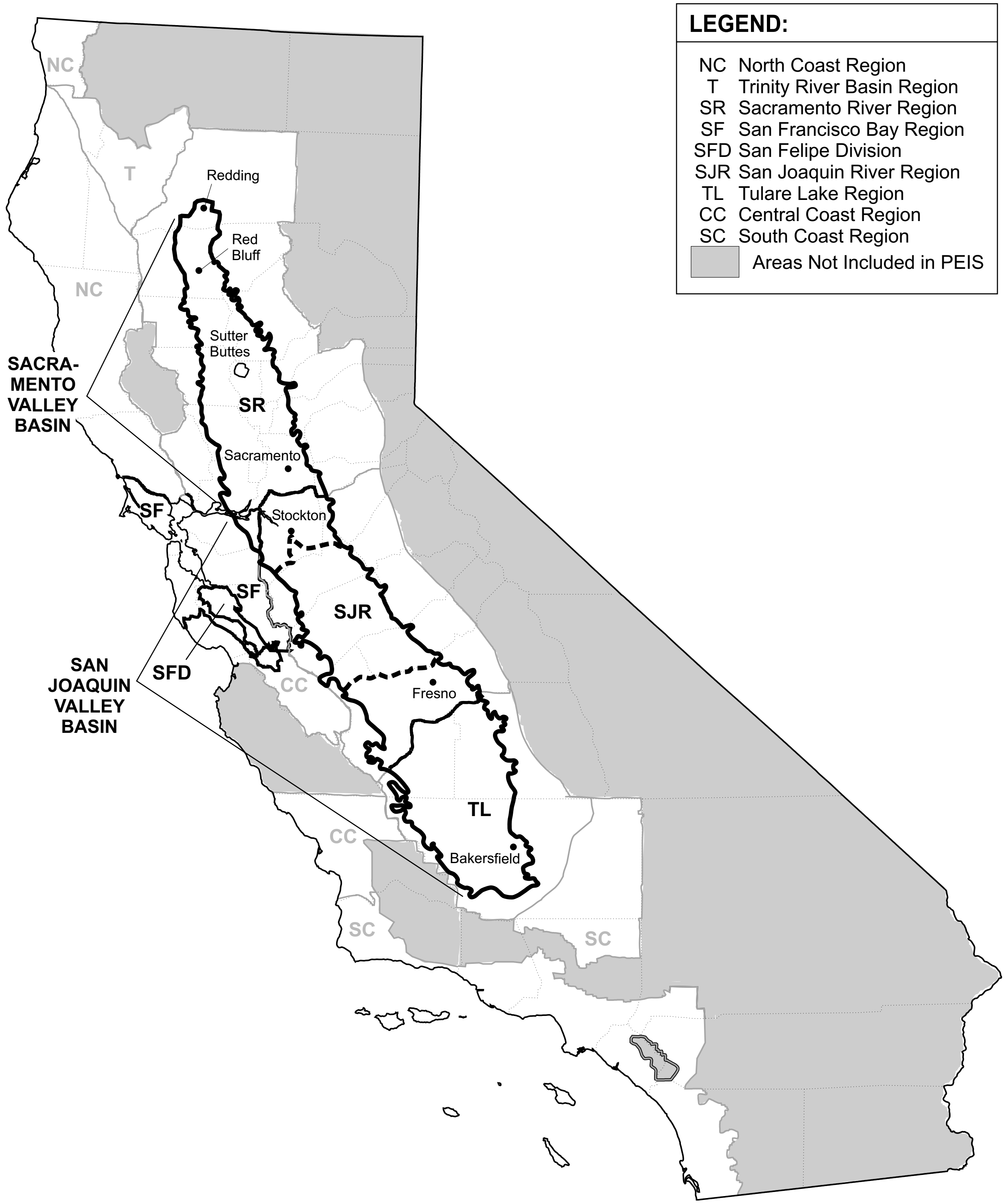
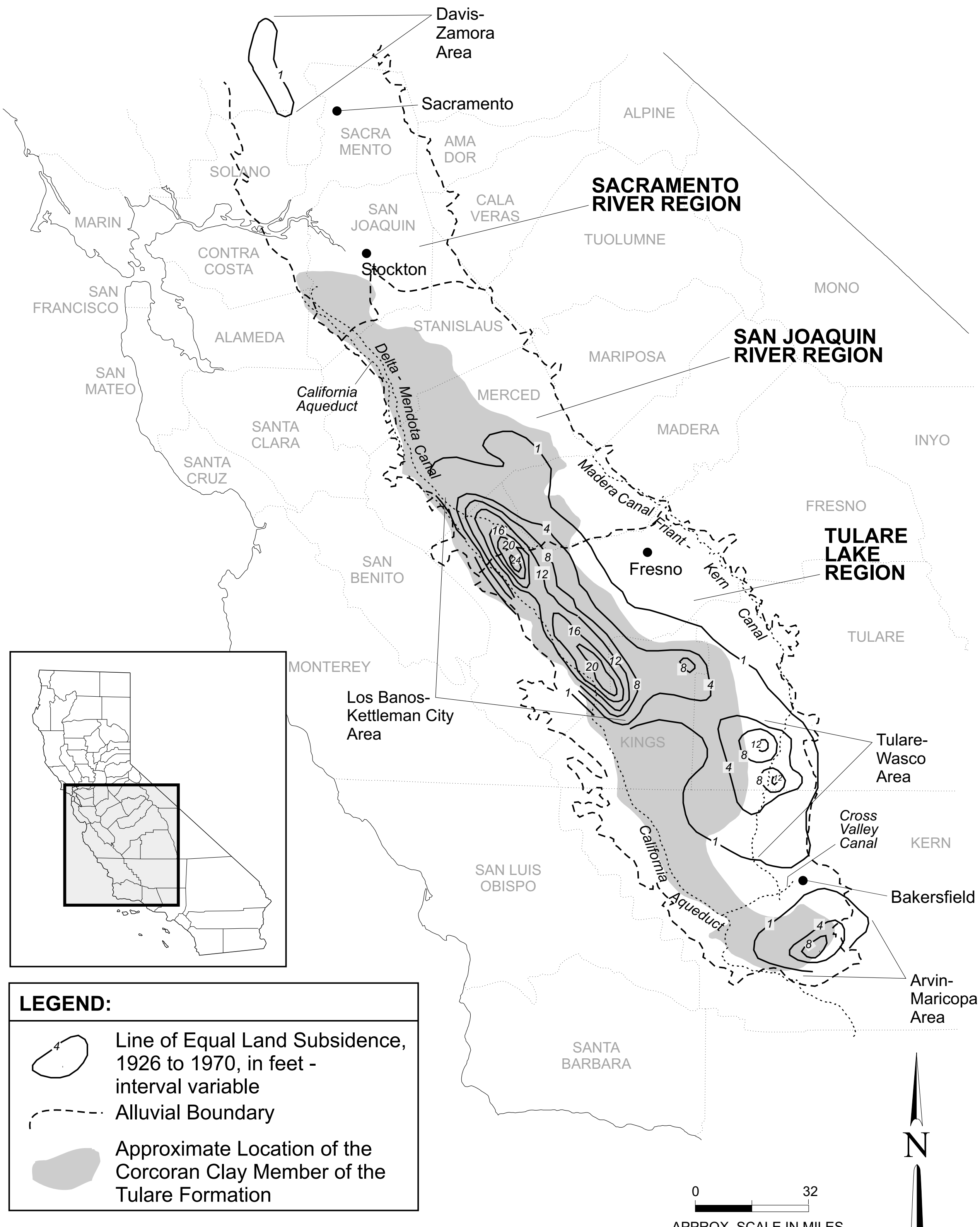


FIGURE III-8
GROUNDWATER STUDY AREA



Source: Adapted from Williamson et al., 1989.

FIGURE III-9

AREAL EXTENT OF LAND SUBSIDENCE IN THE CENTRAL VALLEY DUE TO GROUNDWATER LEVEL DECLINE

In the Sacramento Valley Basin, a long-term dynamic link between the groundwater and surface water system has been maintained on a regional basis. The greatest gains to streams from groundwater occurred during the 1940s when groundwater storage was highest in the Sacramento Valley basin. Discharge to streams was lowest during and immediately following the 1976 to 1977 drought and during the 1987 to 1992 drought periods. In some areas of the southern portion of the Sacramento Valley Region where groundwater levels have continued to decline, such as in Sacramento County, streams that formerly gained flow from the subsurface now lose flow through seepage to adjacent groundwater systems.

Aquifer recharge to the Sacramento Valley Basin has historically occurred from deep percolation of rainfall, the infiltration from stream beds, and subsurface inflow along basin boundaries. Most of the recharge for the Central Valley occurs in the north and east sides of the valley where the precipitation is the greatest. With the introduction of agriculture to the region, aquifer recharge was augmented by deep percolation of applied agricultural water and seepage from irrigation distribution and drainage canals. The basin has an estimated perennial yield of 2.4 million acre-feet, and recent groundwater pumping in the Sacramento Valley basin was estimated to be near this perennial yield, suggesting that regional overdraft conditions are not prevalent (DWR, 1994). One exception is the southwestern portion of the region in the Sacramento County area, where overdraft conditions have occurred in recent years.

Land subsidence due to groundwater level declines has been identified in the southwestern part of the Sacramento River Region, near Davis and Zamora. By 1973 land subsidence in this area had exceeded approximately 1 foot, and was reported to be approximately 2 feet east of Zamora and west of Arbuckle (Lofgren and Ireland, 1973). Land subsidence monitoring has continued since 1973, and some localized land subsidence was reported in the Davis-Zamora area during the 1988-1992 drought period (Dudley, 1995). Groundwater quality is generally excellent; however, areas of local groundwater contamination or pollution exist.

High water tables contribute to subsurface drainage problems in several areas of the Sacramento Valley Basin. High water tables in portions of Colusa County, particularly along the Sacramento River, periodically impair subsurface drainage functions of the Colusa Basin Drain and other local drainage facilities. In many reaches of the Sacramento River, flows are confined to a broad, shallow man-made channel with stream bottom elevations higher than adjacent ground surface elevations. During extended periods of high streamflows, seepage-induced water logging can occur on adjoining farmlands, particularly in areas where local groundwater is in contact with the river.

SAN JOAQUIN RIVER REGION

The southern two-thirds of the Central Valley regional aquifer system, which covers over 13,500 square miles extending from just south of the Delta to just south of Bakersfield, is referred to as the San Joaquin Valley Basin. For purposes of the PEIS analysis, this basin is divided into the San Joaquin River Region and the Tulare Lake Region. Much of the western portion of this area is underlain by the Corcoran Clay Member that divides the groundwater system into two major aquifers: a confined aquifer below the clay and a semi-confined aquifer above the clay.

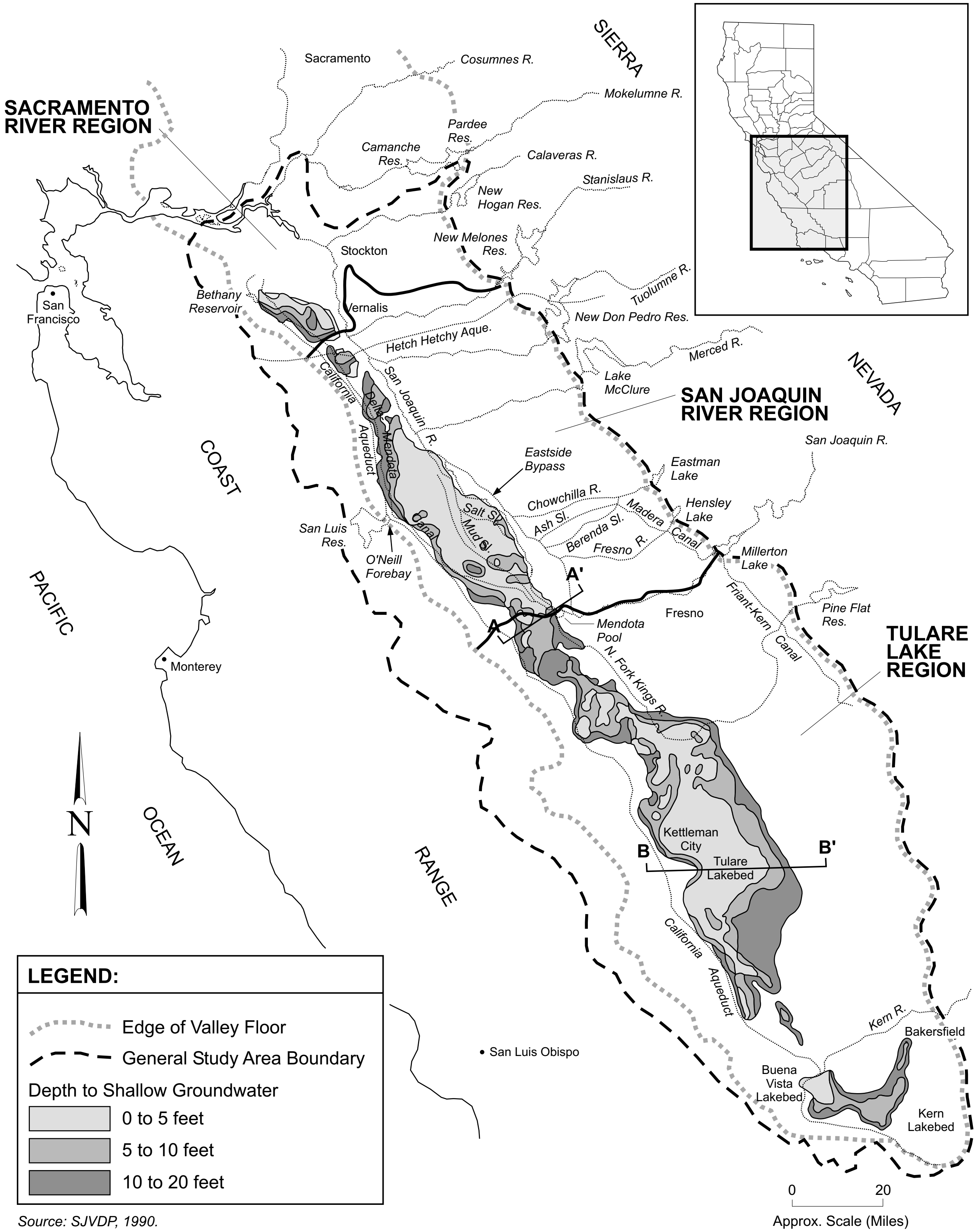
Aquifer recharge to the semi-confined upper aquifer historically occurred from stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. With the introduction of irrigated agriculture into the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems. Recharge of the lower confined aquifer results from 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 occurs through the confining layer.

The interaction of groundwater and surface water in the San Joaquin River Region has historically resulted in net gains to the streams. This condition existed on a regional basis until the mid-1950s. Since that time, groundwater level declines have resulted in some stream reaches losing flow through seepage to the groundwater systems below. Where the hydraulic connections have been maintained, the amount of seepage has varied as groundwater levels and streamflows have fluctuated. These dynamics have changed on a regional basis in eastern San Joaquin and Merced counties and in western Madera County. Other localized areas have also undergone similar changes.

Annual groundwater pumping in the San Joaquin River Region exceeds recent estimates of perennial yield by approximately 200,000 acre-feet (DWR, 1994). This overdraft condition exists, in part, in all the subbasins of the region. Historically, land subsidence resulting primarily from groundwater level declines has been a significant problem in the southern half of the San Joaquin Valley. From 1920 to 1970, approximately 5,200 square miles of irrigated land in the valley registered at least 1 foot of land subsidence (Ireland, 1986). Most of the vast acreage affected by land subsidence lies in the Tulare Lake Region discussed below. By the mid-1970s the use of imported surface water in the western and southern portions of San Joaquin Valley essentially halted the progression of land subsidence. During the 1976-1977 and 1987-1992 droughts, however, land subsidence was again observed in areas previously affected because of renewed high groundwater pumping rates.

Groundwater zones commonly used along portions of the western margin of the valley have high concentrations of TDS, ranging from 500 mg/l to greater than 2,000 mg/l (Bertoldi et al., 1991). The concentrations in excess of 2,000 mg/l commonly occur above the Corcoran Clay layer. These high levels have impaired groundwater for irrigation and municipal uses in the western portion of San Joaquin County.

Inadequate drainage and accumulating salts have been persistent problems 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 occur on the west side of the San Joaquin River and Tulare Lake regions, as shown in Figure III-10. In some portions of the San Joaquin River Region, natural drainage conditions are inadequate to remove the deep percolation to the water table. This occurs because vertical conductivity is low and, therefore, limits downward drainage of infiltrated water. In addition, horizontal hydraulic conductivity is low and inhibits downslope subsurface drainage. Shallow groundwater levels often rise into the root zone, and subsurface drainage must be supplemented by constructed facilities for irrigation to be sustained.



Source: SJVDP, 1990.

FIGURE III-10

AREAS OF SHALLOW GROUNDWATER, 1987

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 to low-lying farmland. In the western portion of the Stanislaus River watershed, groundwater pumping has historically been used for control of high groundwater and seepage conditions. Along the San Joaquin River from the confluence with the Tuolumne River through the southern portion of the Delta, seepage-induced waterlogging damage to low-lying farmland occurs during periods of high flows, such as during flood control operations in the spring. The seepage-induced waterlogging prevents cultivation of the land until the summer months and can affect annual crop production levels.

TULARE LAKE REGION

The southern part of the San Joaquin Valley Basin, referred to here as the Tulare Lake Region, is a basin of interior drainage. Much of the western portion of this area is underlain by the Corcoran Clay Member that divides the groundwater system into two major aquifers: a confined aquifer below the clay and a semi-confined aquifer above the clay.

Groundwater quality conditions in the Tulare Lake Region are similar to those of the San Joaquin River Region. The subsurface drainage problems associated with the west side of the San Joaquin Valley extend from north to south in the Tulare Lake Region. The conditions of high groundwater levels in the shallow groundwater zone are similar to those discussed for the San Joaquin River Region, except that no regional seepage problems are associated with high groundwater tables in the Tulare Lake Region.

SAN FRANCISCO BAY REGION

Imported surface water from the CVP San Felipe Division is provided to areas in Santa Clara and San Benito counties to supplement available supplies. Historically, these areas have been subject to groundwater mining, resulting in a decline in groundwater levels that led to land subsidence and seawater intrusion. The delivery of CVP surface water supplies to the San Felipe Division is intended to reduce the use of groundwater.

Groundwater resources in parts of Alameda and Contra Costa counties are limited by availability of supply and poor water quality. In areas of limited groundwater supply, this has resulted in reliability problems, excessive groundwater level declines and land subsidence, increased pumping costs, and further degradation of water quality conditions. The introduction of imported CVP surface water has supplemented the limited groundwater supplies.

FISHERY RESOURCES

Anadromous species addressed by the CVPIA include chinook salmon, steelhead trout, white and green sturgeon, striped bass, and American shad. Although striped bass and American shad are introduced species, both are abundant and contribute substantially to California’s recreational fishery. These fish populate portions of Central Valley streams and rivers during freshwater stages of their life cycles. Other species selected for analysis include delta smelt, longfin smelt, Sacramento splittail, and reservoir fishes.

FACTORS THAT AFFECTED HISTORICAL FISHERY RESOURCES

Native species have declined in abundance and distribution, and several introduced species have become well established. Habitat loss and modification, species introductions, and overfishing are the major factors affecting fisheries resources within the Draft PEIS study area.

Major modifications of the aquatic ecosystem began during the first major settlement of California that followed the 1849 gold rush. Dredging and hydraulic mining for gold produced enormous quantities of sediments that were deposited downstream, altering fish habitats in streams, rivers, the Delta, and San Francisco Bay. In the late 1800s and early 1900s, agricultural development and flood control construction of over 1,000 miles of levees eliminated much of the original marshland and riparian habitat supporting the aquatic ecosystem. Debris control, flood control, and water supply projects developed by Federal, State, local, and private entities included dams that blocked fish access to the upper portions of most major rivers in the Central Valley. Water storage and diversions greatly altered natural river and Delta flow patterns, while fish entrainment at water diversions affected unknown numbers of juvenile fish.

Agricultural, grazing, mining, logging, navigation, and urban development activities degraded water quality in almost all fish habitats. Agricultural drainage increased salinity and concentrations of pesticides and other toxic substances in both the rivers and Delta. Early cities, towns, and homesteads discharged untreated sewage into rivers, sloughs, and bays, causing eutrophication and oxygen depletion. Industries discharged toxic substances into the rivers and bays. Removal of riparian vegetation increased sedimentation and water temperature in small streams used by chinook salmon and trout for spawning and rearing.

WATER SUPPLY DEVELOPMENT

Early dams and diversions built by miners and farmers prior to 1939 obstructed hundreds of miles of habitat and blocked upstream fish passage. Debris dams were constructed in the late 1800s and early 1900s on the American and Yuba rivers to block downstream transport of mining sediments; however, these dams also blocked chinook salmon and steelhead trout migrations. The Anderson Cottonwood Irrigation District (ACID) diversion dam, constructed in 1917 on the upper Sacramento River near Redding, created a seasonal barrier to migrating chinook salmon. By the 1920s, a large portion of the Central Valley chinook salmon and steelhead trout spawning areas had been cut off by dams and other human-made barriers. Many of the smaller dams were eventually fitted with fish ladders, some of which moderately increased passage.

Beginning with the Baird Hatchery in 1872, hatcheries were constructed to augment chinook salmon production. However, the hatcheries replaced only a limited portion of the production that was lost from dams and other impacts. Dams may have blocked sturgeon, striped bass, and American shad migration; however, these species were probably only marginally affected because they generally do not ascend the rivers upstream of the dam sites. In some instances, diversions, especially for irrigation, entrained and caused mortality of millions of juvenile chinook salmon, steelhead trout, and other fish species. Diversions also dewatered sections of streams preventing migrating adult chinook salmon and steelhead trout from reaching spawning habitat.

Most of the factors adversely affecting fish habitats before 1940 continue today. The principal exceptions are uncontrolled hydraulic mining, which was banned in 1884, and discontinued gill net fishing in the Delta and Bay. The CVP, SWP, and several large local water supply projects, which include some of the largest dams, diversions, and canals in the Central Valley, profoundly altered fish habitats.

The many large dams of the CVP, SWP, and local water supply agencies permanently blocked access to the best chinook salmon and steelhead trout spawning and rearing habitat in the Central Valley. Small dams had previously disrupted adult migration and spawning life stages of chinook salmon and steelhead trout on most Central Valley streams and rivers; however, several of the small dams were fitted with fish ladders and provided some passage.

Shasta and Keswick dams, built on the Sacramento River in 1944 and 1950, respectively, blocked approximately 190 miles of spawning habitat on the upper Sacramento, Pit, and McCloud river drainages. The Red Bluff Diversion Dam (RBDD), built in the mid-1960s on the Sacramento River 60 miles downstream of Keswick Dam, was fitted with fish ladders but nevertheless caused delays of at least several days to upstream migrants. The CVP Nimbus and Folsom dams blocked approximately 61 miles of spawning habitat on the American River. A like amount of spawning habitat on the Feather River was blocked by the construction of the SWP Oroville Dam. The CVP Friant Dam on the San Joaquin River blocked access to approximately 35 miles of upstream spawning habitat, and drastically reduced flows in the section of the San Joaquin River downstream to the confluence with the Merced River.

Large dams constructed by local water districts, power companies, and the COE blocked passage to spawning reaches of other major rivers in the Central Valley. The dams also blocked recruitment of spawning gravels from upstream sources to the downstream portions of rivers used for chinook salmon and steelhead trout spawning. Gravel mining also reduced available spawning habitat.

Reservoir operations also altered the temperature regime in the rivers downstream. For a period after the large dams were constructed, reservoirs were kept relatively full and, where physically possible, cold water was released from the hypolimnion providing cooler summer temperatures in the downstream reaches. Fall-run chinook salmon populations responded to the colder flows and began to spawn earlier than historical chinook salmon runs. During dry periods, the reservoirs are typically drawn down to meet water demands, resulting in warm water releases and corresponding mortalities. Winter-run chinook salmon and steelhead trout, which are either spawning or rearing during the spring and summer, are exposed to conditions that historically they would have avoided and consequently have been especially harmed by the warm water temperatures encountered during incubation and rearing life stages.

CVP and SWP export facilities in the South Delta modify fish habitat. These facilities greatly alter flow patterns in the Delta and cause entrainment and mortality of juvenile life stages of all resident and anadromous species. Additional diversions by agricultural and M&I interests in the Delta and in the Sacramento and San Joaquin rivers entrain a large number of juvenile fish annually. During spring, many emigrating juvenile chinook salmon and steelhead trout losses may occur through entrainment at improperly screened and/or unscreened irrigation diversions and pumping facilities.

COMMERCIAL AND SPORT FISHING

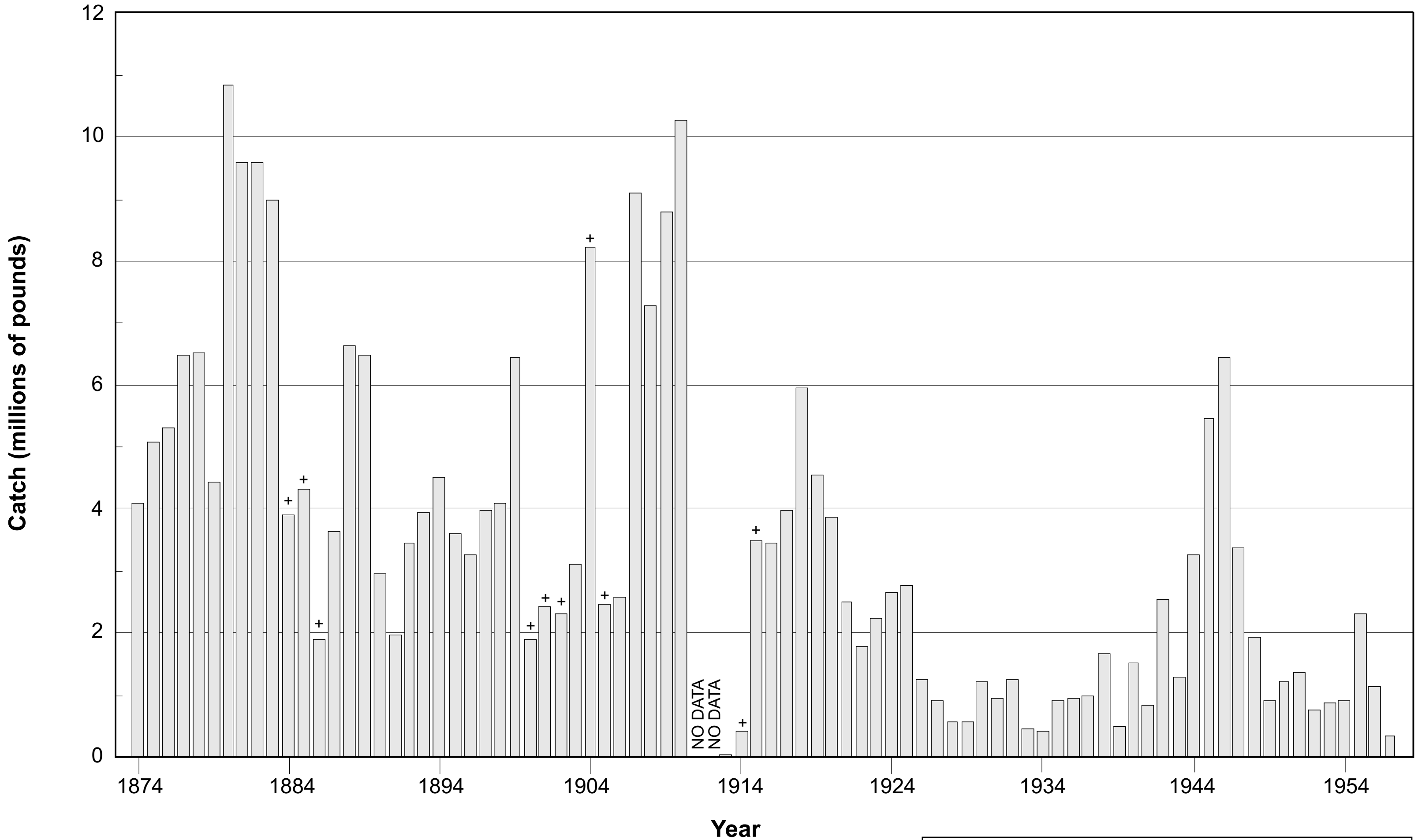
Exotic species were first introduced in the Sacramento-San Joaquin River system shortly after the gold rush. Most of those species were introduced to improve fishing or to provide forage for game species. Striped bass were brought in from the Atlantic coast in 1879 and 1882, and the population quickly multiplied to millions of adults. American shad were introduced from New York between 1871 and 1881 and were well established by 1879. Largemouth and smallmouth bass, catfishes, and sunfishes were also introduced.

The first organized commercial fishery in the Sacramento-San Joaquin River system was developed between 1848 and 1850. Chinook salmon were taken in gill nets and seines in the rivers, the Delta, and the Bay; sardines, herring, and flatfishes were captured with seines in the Bay. Following the gold rush, commercial fishing expanded rapidly and from 1873 to 1910; more than 20 canneries processed 5 million pounds of chinook salmon annually from the Sacramento and San Joaquin River system, as shown in Figure III-11. The values in Figure III-11 may reflect changes in fish population, demand for canned salmon, price fluctuations for harvested fish, and effects of labor shortages during war periods.

The ocean salmon fishery industry developed in the 1890s and early 1900s largely replaced the river fishery industry and may have further contributed to the depletion of chinook salmon stocks. Since 1970, the commercial and sport ocean harvest of chinook salmon has maintained a harvest rate index of between 50 and 80 percent, as shown in Figure III-12. During the 1980s, the availability of improved navigation and fish detection technologies, combined with the effect of increased hatchery production, dramatically increased the annual catch-per-unit-effort for California ocean salmon fisheries. Commercial and sport fisheries for striped bass also developed in the late 1800s and early 1900s, but striped bass abundance did not decline until the mid-1900s. Commercial striped bass fishing was banned in 1935.

OCEAN CONDITIONS

Variations in ocean and atmospheric conditions can affect the growth of anadromous fish species during their ocean life stage. A major ocean condition, referred to as El Nino, can significantly alter the availability of nutrients. El Nino is a disruption of the ocean-atmosphere system in the tropical Pacific. In normal, non-El Nino conditions, the trade winds blow toward the west across the tropical Pacific, and cause the accumulation of warm surface water in the western Pacific Ocean. This results in the upwelling of cold water from deeper levels in the eastern Pacific Ocean, off the coast of South America. The cold water is rich in nutrients, and supports high levels of primary productivity, diverse marine ecosystems, and major fisheries.



NOTE:
Gill net fishery discontinued by legislative action in 1957.

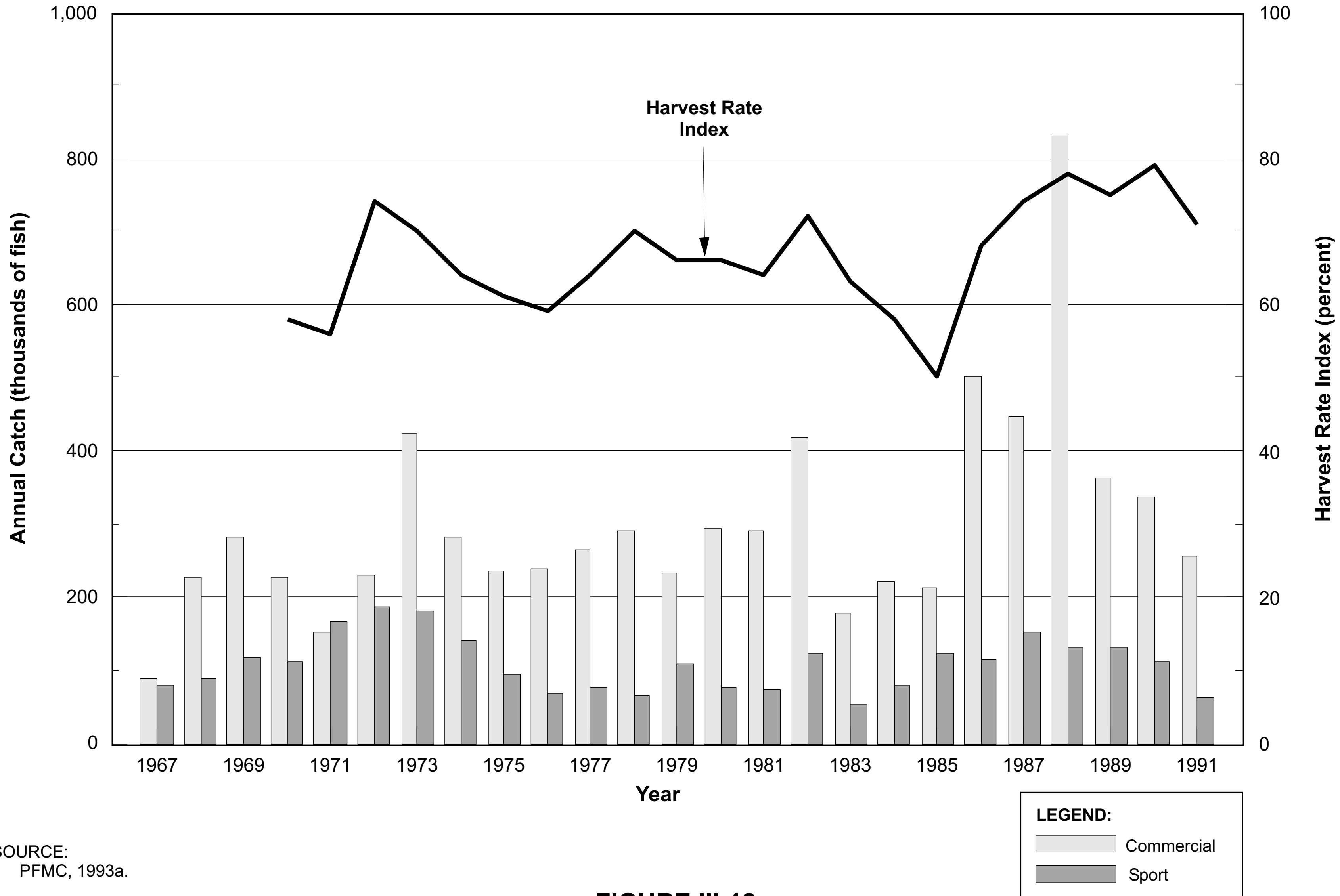
SOURCE:
Skinner, 1962.

LEGEND

+ Indicates that total pounds in that year are based on recorded pack of canned salmon only.

FIGURE III-11

SACRAMENTO-SAN JOAQUIN RIVER COMMERCIAL GILL NET SALMON LANDINGS (1874-1957)



SOURCE:
PFMC, 1993a.

FIGURE III-12

ANNUAL HARVEST RATE INDEX AND LANDINGS FOR CALIFORNIA COMMERCIAL AND SPORT OCEAN CHINOOK SALMON FISHERIES (1967-1991)

During El Nino conditions, the trade winds decrease in the central and western Pacific. This reduces the efficiency of upwelling of nutrient-rich cool water to the eutrophic zone. The result is a rise in surface water temperature and a drastic decline in primary productivity, which adversely affects higher trophic levels of the food chain, including commercial fisheries.

FISH SPECIES IN THE CENTRAL VALLEY

Chinook Salmon

Life History of Chinook Salmon. As an anadromous species, chinook salmon migrate to sea as juveniles and typically return to inland waterways as adults 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 upstream migration. While in fresh water, adult chinook salmon rarely feed as they change from an adult ocean-phase salmon to an adult spawning-phase salmon. All adult chinook salmon die after spawning.

In general, Central Valley chinook salmon appear to exhibit fall-run or spring-run behavior. A fall-run life history pattern is characterized by juveniles that migrate seaward during their first year of life after spending two to five months in fresh water. Spring-run behavior is that of chinook salmon that remain in fresh water for at least one year before emigrating to the sea.

Chinook salmon generally spend two to four years maturing in the ocean before returning to their natal streams to spawn. Some chinook salmon spend up to 6 or 7 years in the ocean. Most chinook salmon in the Sacramento and San Joaquin river systems mature at two or three years of age, although few of the two-year-old fish are able to spawn successfully. A smaller proportion of fish mature at four or more years of age.

Chinook salmon require cold, well-oxygenated freshwater streams with suitable gravel for reproduction. Female chinook salmon deposit their eggs in redds, which they excavate in the gravel bottom in areas of relatively swift water. The eggs are fertilized by one or more males.

Eggs generally hatch in approximately six to nine weeks, depending on water temperature, with newly emerged fry remaining in the gravel for another two to four weeks until the yolk is absorbed. Maximum survival of incubating eggs and larvae occurs at water temperatures between 41 and 56 degrees Fahrenheit.

After emerging, chinook salmon fry begin to feed and grow in the stream environment, seeking shallow, nearshore habitat with low water velocities, and move to progressively deeper, faster water as they grow. In streams, chinook salmon fry feed mainly on drifting terrestrial and aquatic insects, but zooplankton become more important in the lower river reaches and estuaries. Throughout this early life stage, the fry require cool, well-oxygenated water.

The upper Sacramento River and its tributaries support all freshwater life stages of chinook salmon during all months of the year, although some runs have limited stream usage. Different life stages of all four races of chinook salmon (i.e., fall-, late fall-, winter-, and spring-run) may be present at all times because of overlapping run timing, spawning periods, and early life stages unique to each run.

The San Joaquin River and its main tributaries, the Merced, Tuolumne, and Stanislaus rivers, support fall-run chinook salmon. Table III-1 summarizes the timing of chinook salmon runs and steelhead trout by life stage in the Sacramento and San Joaquin river basins, and the general timing in the Delta.

Stock Abundance and Distribution

Sacramento River. Figure III-13 illustrates the monthly proportion of each run of chinook salmon present in Delta during their migration into the Sacramento and San Joaquin river systems. The values represents month-to-month data, not continuous data. The timing of spawning, incubation, and rearing of fry and juveniles varies by run, as shown in Figure III-14. The values in Figure III-14 are from several sources. The values in Figure III-14 are represented as specific points in time when life stages occur. In the Delta, the actual presence of fish blends over a longer period of time and is not as defined as the timelines might suggest.

Annual estimates of spawning escapement (i.e., the total number of adult chinook salmon [age two and older] that "escape" the ocean fishery and return to spawn) of fall-run chinook salmon in the mainstem Sacramento River steadily declined during the 1950s and 1960s, and the decline has continued to the present. Counts of chinook salmon passing the RBDD on the Sacramento River since 1967 provide an indication of overall trends in late fall-, winter-, and spring-run chinook salmon abundance in the upper Sacramento River. The number of late fall-run chinook salmon in the mainstem Sacramento River passing the RBDD has declined from the late 1960s to the present.

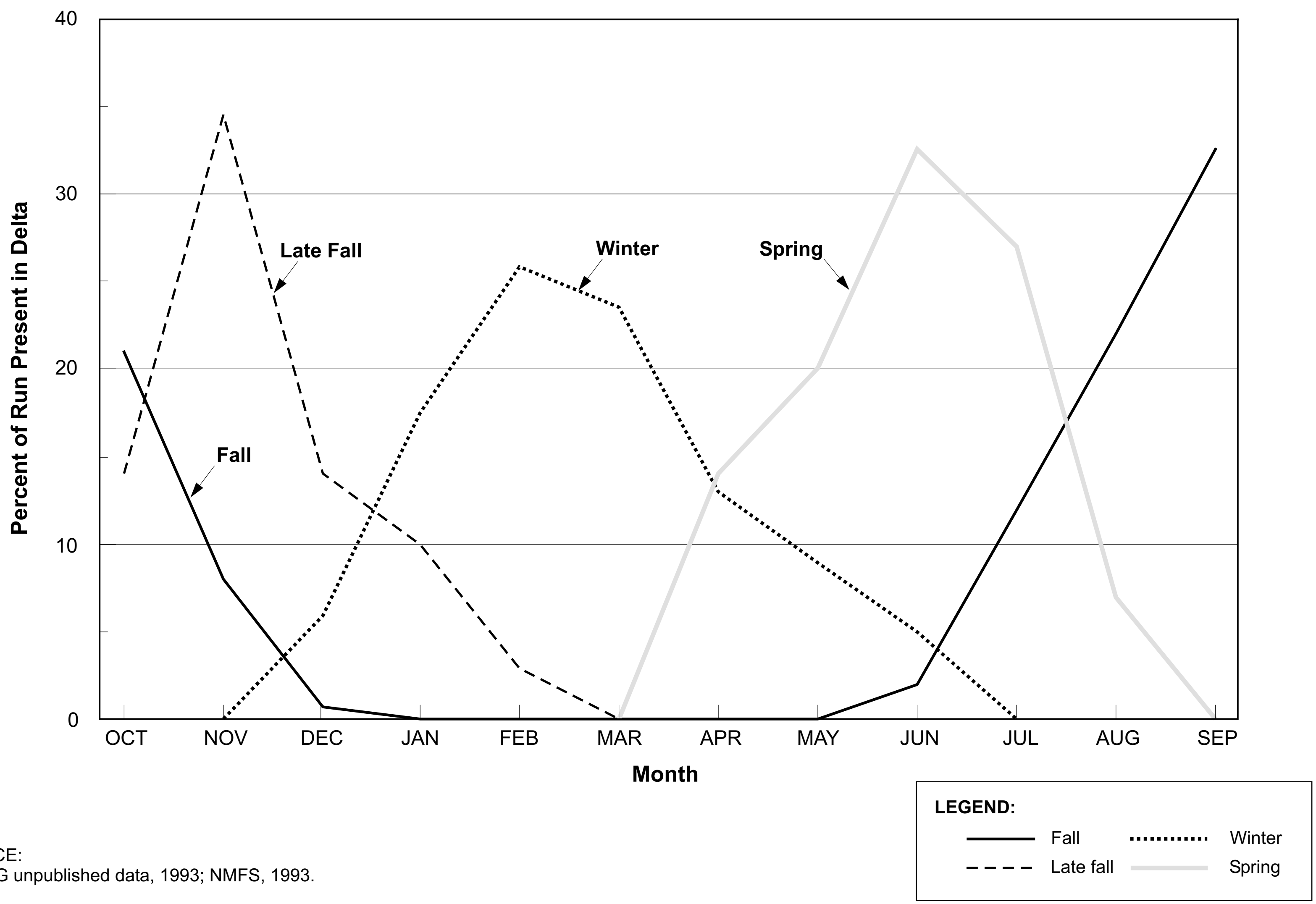
Winter-run chinook salmon spawning escapement suffered a precipitous decline from an average of approximately 70,000 to 80,000 adults in the late 1960s to estimated run sizes of approximately 500 or fewer in recent years. Estimated run sizes in 1992 and 1993 were 1,180 and 341, respectively. The low return in 1989 prompted listing of the winter-run chinook salmon as an endangered species by the State of California and as a threatened species by the Federal Government. Another record low spawning escapement in 1991 prompted review and subsequent reclassification of the winter-run chinook salmon to endangered status under the Federal Endangered Species Act (ESA).

San Joaquin River. Before extensive water development began on the San Joaquin River and its tributaries, spring-run chinook salmon were the most abundant race. The abundance of spring-run chinook salmon on the Stanislaus, Tuolumne, and Merced rivers was considerably reduced by 1930 as a result of dam construction on these rivers. Large spring runs migrating past the Merced River confluence were eliminated after 1947 following construction of Friant Dam, which blocked access to historical holding and spawning habitat and reduced flows in the San Joaquin River below the dam.

TABLE III-1

POTENTIAL OCCURRENCE OF CHINOOK SALMON AND STEELHEAD TROUT BY LIFE STAGE IN THE CENTRAL VALLEY

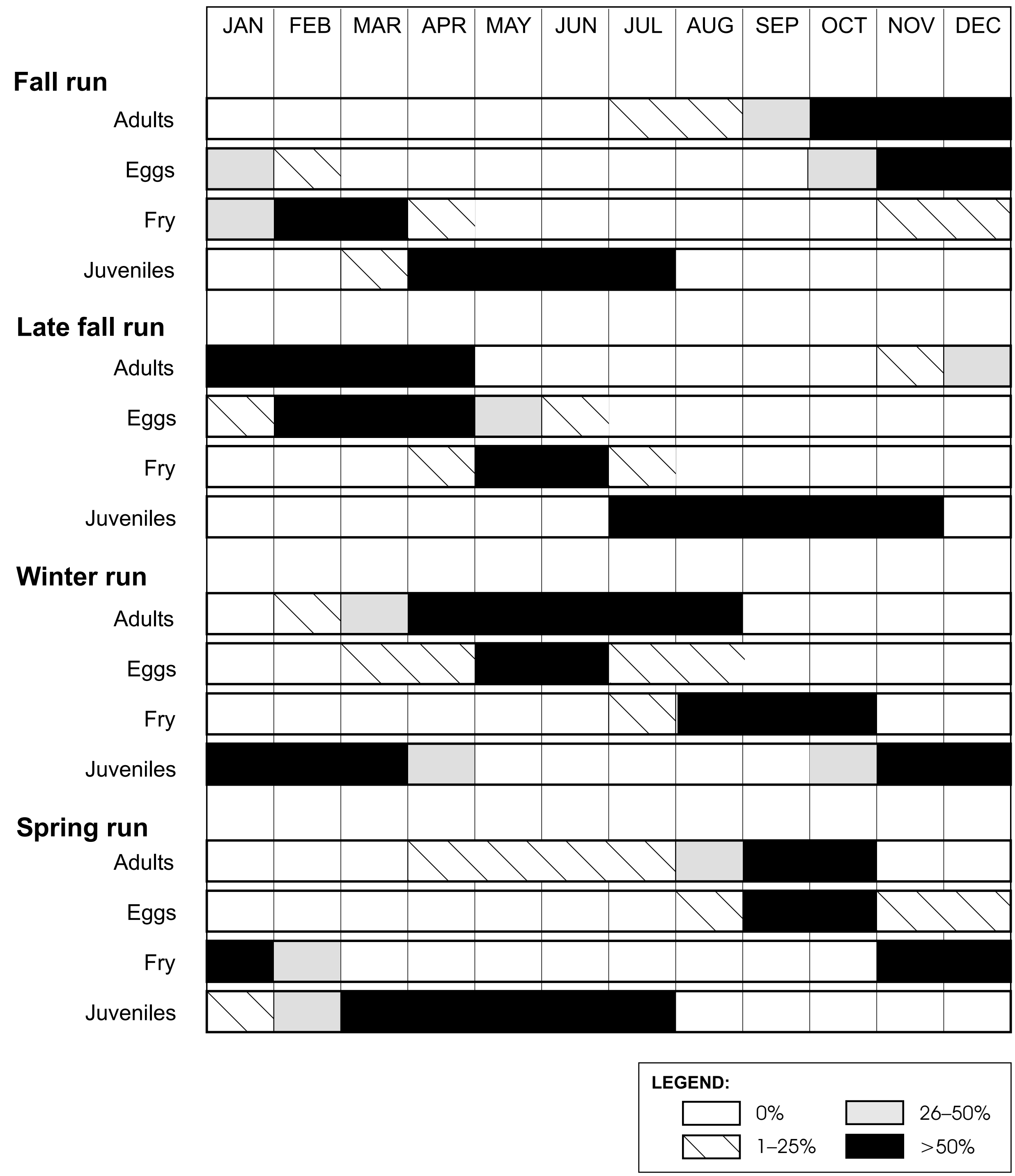
Life Stage	Sacramento River Basin	San Joaquin River Basin	Sacramento-San Joaquin Delta
Fall-run Chinook Salmon			
Adult migration	July-December	July-December	June-December
Incubation	October-February	October-February	not present
Fry / juvenile rearing	November-April	November-April	March-May
Juvenile emigration	March-June	March-June	March-July
Late Fall-run Chinook Salmon			
Adult migration	November-April	November-March	October-February
Incubation	January-June	December-May	not present
Fry / juvenile rearing	April-July	January-November	May-July
Juvenile emigration	April-December	October-December	April-December
Winter-run Chinook Salmon			
Adult migration	February-August	not present	November-June
Incubation	March-August	not present	not present
Fry / juvenile rearing	July-October	not present	October-April
Juvenile emigration	October-March	not present	January-June
Spring-run Chinook Salmon			
Adult migration	April-October	not present	March-August
Incubation	August-December	not present	not present
Fry / juvenile rearing	November-February	not present	November-May
Juvenile emigration	October-June	not present	October-June
Steelhead Trout			
Adult migration	August-March	August-March	August-March
Incubation	December-April	December-April	not present
Fry / juvenile rearing	January-December	January-December	not present
Juvenile emigration	December-May	December-May	December-May



SOURCE:
DFG unpublished data, 1993; NMFS, 1993.

FIGURE III-13

MONTHLY ABUNDANCE OF ADULT CHINOOK SALMON, BY EACH SPAWNING RUN IN THE SACRAMENTO-SAN JOAQUIN DELTA



NOTES:
Adults are in cumulative percent.
Other life stages are the percent of year's brood.

FIGURE III-14

OCCURRENCE OF CHINOOK SALMON BY LIFE STAGE IN THE SACRAMENTO RIVER BASIN

The fall-run chinook salmon population has declined since the 1940s but persists as a small but fluctuating population below major dams on the Merced, Tuolumne, and Stanislaus rivers. The fall-run had been virtually extirpated from the maintstem San Joaquin River upstream from the location of Friant Dam by local water development activities long before construction of that dam. Low returns of fall-run chinook salmon to these tributaries are attributed to low San Joaquin River flows, elevated water temperature, poor water quality, and diversions.

Spawning escapement levels of fall-run chinook salmon on the Merced, Tuolumne, and Stanislaus rivers show considerable annual variability. Peak abundance generally follows high spring runoff years, and spawning escapement is generally small following below normal or dry runoff years. The Merced River fall run has been partially sustained by production of yearling fall-run chinook salmon at the Merced River Fish Hatchery since 1970.

Hatcheries. Five hatcheries produce chinook salmon in the Central Valley. The three largest fish hatcheries (Coleman National, Feather River, and Nimbus) are located in the Sacramento River Basin; smaller hatcheries are found on the Mokelumne and Merced rivers in the San Joaquin River Basin. Most of these hatcheries were constructed between 1940 and 1970 as mitigation for specific dams or water projects. Only Nimbus and Coleman fish hatcheries had significant production prior to 1967. Total Central Valley hatchery production of chinook salmon nearly doubled from approximately 200,000 pounds to approximately 400,000 pounds during the period between 1967 and 1984.

Traditionally, Central Valley hatcheries have released fish directly into the river. To reduce downstream mortality, some of the hatcheries have trucked fish to locations nearer the ocean. Increases in survival due to this practice have depended on the timing of release, river temperature, ocean conditions, and fish size. Fish released downstream have a higher tendency to stray to other than their natal streams when they return as adults than fish released in the immediate vicinity of the hatcheries.

Factors Affecting Abundance

Upstream Migration. Higher flows and lower water temperatures in the fall stimulate upstream migration of fall-run chinook salmon. Conversely, low flows and higher water temperatures may inhibit or delay migration to spawning areas.

During upstream migration, adult chinook salmon primarily use their sense of smell to find their natal stream. The operation of water supply projects that affect flow conditions in the Delta can adversely affect upstream migration. For example, chinook salmon destined for the Sacramento River that are drawn into the central Delta may be delayed by the longer migration distance and greater number of channels that must be negotiated there. Similarly, large volumes of Sacramento River water and reverse flows in the lower San Joaquin River can inhibit or delay migration of San Joaquin River spawners.

For many years, attraction flows from the Merced River have proved inadequate during October, resulting in straying of adult chinook salmon into agricultural drainage ditches, primarily Mud and Salt sloughs. Barriers (electrical and physical) were installed across the San Joaquin River upstream of the Merced River confluence in 1992 to prevent chinook salmon migration into these sloughs and to help guide them into the Merced.

Streamflow. Adequate streamflow conditions are necessary to provide suitable rearing habitat and maintain instream water temperature. In the Merced and Tuolumne rivers, streamflow reductions after April and May result in poor survival conditions for chinook salmon juveniles that remain in these tributaries beyond these months. Mortality may occur from reduced rearing habitat, adverse water temperatures, and increased predation.

Juvenile chinook salmon and steelhead trout emigrating down the San Joaquin River and through the southern Delta frequently encounter low flows, adverse high temperatures, and high diversion rates. Recent evaluations have focused on the effectiveness of releasing short-duration, high-amplitude flows (i.e., pulsed flows) from tributary streams in conjunction with reduced Delta exports.

Water Quality. Water temperature affects the timing of chinook salmon adult migration and spawning life stages, although the migratory response to water temperature may differ among chinook salmon races. Upstream migrations of fall-run chinook salmon generally coincide with decreasing water temperatures in the fall. Water temperatures during upstream migration usually range between 51 degrees Fahrenheit and 67 degrees Fahrenheit (Bell, 1973). Hallock et al. (1970) found that chinook salmon initiated migration into the lower San Joaquin River as water temperatures declined from 72 degrees Fahrenheit to 66 degrees Fahrenheit.

Low dissolved oxygen levels (less than 5 parts per million) and adverse high water temperatures (greater than 66 degrees Fahrenheit) in the San Joaquin River near Stockton delayed or blocked the migration of adult chinook salmon during the 1960s (Hallock et al., 1970). Since 1964, fall migration problems have been reduced by improved wastewater treatment and the annual installation of a physical barrier at the head of Old River. In dry years, the barrier directs most of the San Joaquin River flow down the main channel of the San Joaquin River past Stockton. Despite these efforts, low dissolved oxygen levels recurred during the 1987-1992 drought period.

Diversion Dams. On the Sacramento River, the ACID and Red Bluff diversion dams have caused fish passage problems since their construction. The operation of these dams results in delay and blockage of winter-, spring-, and fall-run chinook salmon to upstream spawning areas. Dam operations also cause stranding of juveniles and adults and dessication of redds. A fish ladder at the ACID diversion dam, completed in 1927 and still in place today, does not effectively attract and convey upstream migrating chinook salmon (Reclamation, 1983a). An additional fishway was recently constructed at the ACID diversion dam, but its passage effectiveness has not yet been evaluated.

Delta Diversions. Annual losses of chinook salmon at the CVP and SWP Delta export facilities have ranged from 400,000 to 800,000 in recent years, assuming 75 percent mortality in Clifton Court Forebay. Salvage records from the SWP pumping plant indicate chinook salmon fry and emigrating juveniles (smolts) are entrained year-round, but levels generally peak in late winter and spring when fall-run chinook salmon pass through the Delta.

Unknown numbers of chinook salmon are also entrained in other Delta diversions, including more than 1,800 unscreened agricultural diversions, the Contra Costa Canal, the City of Vallejo diversion, and several industrial diversions in the western Delta.

Commercial and Sport Fishing. Commercial and sport fishing also affects abundance. Total commercial and sport landings ranged from 358,000 pounds in 1983 to 1,489,000 pounds in 1988 and averaged 707,000 pounds annually. Since 1988, total landings have decreased to levels near the historical minimum for the entire period of record.

Hatchery-Produced Fish. Concern is growing that the release of large numbers of hatchery fish can threaten wild fish populations. Potential impacts include direct competition between wild and hatchery fish for food and other resources, genetic dilution of wild fish stocks by hatchery fish spawning with wild fish, and increased fishing pressure on wild stocks due to hatchery production. Because of increased survival from eggs to smolts under hatchery conditions, fewer adults are needed to maintain a hatchery run. Consequently, a harvest rate based on hatchery fish will tend to overharvest wild fish in a mixed fishery of wild and hatchery stocks (Hilborn, 1992). Current harvest rates of Central Valley chinook salmon are high enough to adversely affect the natural production in some rivers.

Accurate estimates of the Central Valley hatchery contribution to ocean chinook salmon landing have not been developed because of the lack of a consistent hatchery marking program in California. The U.S. Fish and Wildlife Service (Service) (1988) estimated that 21 percent of the smolts passing Chipps Island in 1988 were of hatchery origin. Cramer et al. (1990) estimated that hatchery fish composed approximately one-third of the spawning escapement to the American and Feather rivers. This fraction is significantly lower than previous estimates developed by Dettman and Kelley (1987).

Steelhead Trout

Historically, steelhead trout (*Oncorhynchus mykiss*) spawned and reared in the most upstream portions of the upper Sacramento River and most of its perennial tributaries. Throughout the Central Valley, water and land development has led to a 95 percent reduction (from 6,000 to 300 river miles) in spawning and rearing habitat (Reynolds et al., 1993). Because of modified and unnatural flow and temperature regimes throughout the basin, steelhead trout can be found as adults in fresh water in every month of the year.

As an anadromous species, steelhead trout migrate to sea as juveniles and typically return to inland waterways as two- to four-year-old adults to spawn. Upstream migration occurs in August through March. Adult steelhead trout rarely feed while they are in fresh water. Unlike chinook and other Pacific salmon, all steelhead trout do not die after spawning, and a small portion survive to become repeat spawners.

Natural spawning of steelhead trout in the Sacramento River system has been greatly reduced by dams and other barriers to their historical spawning grounds. As a result, steelhead trout are highly dependent on hatchery production to maintain their populations. Spawning in the

Sacramento River Basin takes place primarily in December through April, with most spawning from January through March.

The timing of upstream steelhead trout migration coincides with the timing of upstream migration of fall-, late fall-, and winter-run chinook salmon. Consequently, flow, water temperature, and passage-related factors affecting upstream migration of adult steelhead trout in the Sacramento River system are similar to those affecting chinook salmon.

White Sturgeon

The white sturgeon is the largest freshwater or anadromous fish species in North America. With a life span of up to 100 years, sturgeon can grow to over 1,300 pounds. Historically, white sturgeon populations ranged from Alaska to central California (Scott and Crossman, 1973); however, the major spawning populations are now limited to the Fraser River (British Columbia, Canada), the Columbia River (Washington), and the Sacramento-San Joaquin River system. Compared to chinook salmon and steelhead trout, little is known of white sturgeon life history.

In the Sacramento-San Joaquin system, some of the mature adult sturgeon move upstream to freshwater environments to spawn during late winter and early spring. After hatching, juvenile sturgeon rear in fresh or slightly brackish waters, dispersing downstream with the river currents. Subadults commonly rear in river sloughs, estuaries, or bays during summer and may move into deeper freshwater areas upstream, into the marine environment, or remain in the estuary in fall and winter.

Only a fraction of the adult sturgeon population migrates upstream to spawn each year. The timing and extent of upstream migration are probably triggered by both biotic (i.e., sexual maturation) and abiotic (i.e., temperature, flow, and photoperiod) factors.

Green Sturgeon

The biology of the green sturgeon (*Acipenser medirostris*) is even less understood than that of the while sturgeon. Little is known about abundance and distribution, life history, or factors affecting abundance. Green sturgeon are a minor component of the sturgeon populations in the Central Valley; ratios of adult green sturgeon to white sturgeon during tagging studies in the Delta have ranged from 1:39 to 1:164 (Mills and Fisher, 1993). Green sturgeon spend less time in estuaries and fresh water than do white sturgeon, but make extensive ocean migrations. Juvenile fish have been collected in the Sacramento River near Hamilton City, and in the Delta and San Francisco Bay. Adults and juveniles have been observed near RBDD in late winter and early spring. Juveniles inhabit the Bay-Delta estuary until they are approximately four to six years old, when they migrate to the ocean (Kohlhorst et al., 1991).

Striped Bass

Striped bass (*Morone saxatilis*) are native to the east coast of the United States. Several hundred juvenile striped bass were taken from rivers in New Jersey and introduced to California waters between 1879 and 1882, and the population quickly multiplied to several million adult bass.

Striped bass inhabit fresh and ocean waters. They require tidal or riverine habitat for spawning, with turbulence and currents sufficient to keep the eggs suspended off the bottom. Estuarine habitat with high invertebrate population densities is needed to support larval and early juvenile life stages of bass. Adult bass thrive in water bodies supporting large populations of forage fishes.

When striped bass inhabit rivers, juvenile chinook salmon and carp are key prey species. In the Delta, adult bass prey primarily on threadfin shad, American shad, and young striped bass. Anchovies, chinook salmon, delta smelt, and shrimp are seasonal prey items in the lower Delta and Suisun Bay. In San Pablo and San Francisco bays, anchovies, bay shrimp, and shiner perch are the primary prey items.

Historical population data show a decline in the abundance of striped bass. The decline is a result of increased mortality and reduced reproduction. Factors that may contribute to increased mortality include: fishing, entrainment in diversions, exposure to toxic materials, habitat loss, reduced Delta inflow and outflow, altered Delta flow patterns, dredging and spoil disposal, diseases and parasites, and introduction of exotic species. Reduced reproduction results from the production of fewer fertile eggs each year, which can be attributed to a reduction in the abundance, size, and health of female striped bass.

American Shad

American shad (*Alosa sapidissima*) are also native to the east coast of the United States and were introduced to California in 1871. Currently, American shad are found on the Pacific Coast from Todos Santos Bay in Baja California northward to Alaska. In California, anadromous shad populations are found seasonally in the Sacramento, Feather, Yuba, American, Mokelumne, Stanislaus, and San Joaquin rivers, the Delta, and the Klamath, Russian, and Eel rivers.

In the Sacramento River drainage, shad migrate up the Sacramento River as far upstream as the RBDD, the Feather River as far upstream as Oroville, the Yuba River as far upstream as Daguerre Point Dam, and the American River as far upstream as Nimbus Dam. Smaller shad runs occur in the Mokelumne River, Stanislaus River, sloughs of the south Delta, and the San Joaquin River (Stevens, 1972; Moyle, 1976).

With only a few exceptions, American shad are anadromous, spending most of their lives in the ocean and returning as adults to spawn in freshwater rivers. Spawning occurs in riverine habitats, and moderate currents are needed to keep the eggs suspended above the bottom. The young may migrate downstream to the ocean soon thereafter or may rear for several months in the major rivers and Delta before moving farther downstream.

Since the early 1900s, the shad population is believed to have declined gradually. Evidence suggests that this decline is attributable primarily to human factors, such as water development. The rapid increase in American shad abundance and distribution shortly after their introduction indicates that habitat and environmental conditions historically were ideal for shad. The rivers and Delta were largely modified soon after the introduction of shad. Population data are based on several surveys that could underrepresent the actual shad abundance.

Delta Smelt

Delta smelt (*Hypomesus transpacificus*) are small (usually less than 3.5 inches long), plankton-feeding fish that live for only one year and are found only in the Sacramento-San Joaquin estuary. Except for spawning adults and recently hatched larvae and juveniles, delta smelt primarily inhabit the region of the estuary with salinities between approximately 0.45 and 4.4 parts per thousand. The location of this region varies from year to year depending on the volume of freshwater outflows, but it is generally in the western Delta and Suisun Bay. The critical habitat for delta smelt as proposed by the Service includes all of Suisun Bay and the Delta. Apparent declines in delta smelt abundance led to listing the species as threatened in 1993 under the Federal Endangered Species Act (ESA) (*Federal Register, 58*:12854-12862, March 5, 1993).

Delta smelt have no direct commercial value. Delta smelt abundance appears to be affected by Delta flow patterns (DFG, 1992), habitat loss and modification, entrainment in diversions, and possible competition from introduced species.

Longfin Smelt

The largest population of longfin smelt (*Spirinchus thaleichthys*) in estuaries on the Pacific Coast inhabits the Sacramento-San Joaquin River/San Francisco Bay-Delta estuary. Apparent declines in longfin smelt abundance in the estuary led to a petition to list the longfin smelt under the Federal ESA; however, the Service determined that listing is not warranted at this time (*Federal Register, 59*,:4, January 6, 1994).

Spawning adults are found seasonally as far upstream in the Delta as Rio Vista, Medford Island, and the CVP and SWP pumps. Except when spawning, longfin smelt are most abundant in Suisun and San Pablo bays, where salinity generally ranges between 2 and 20 parts per thousand (Natural Heritage Institute, 1992). Delta outflow appears to be the primary factor influencing the abundance of longfin smelt. In high outflow years, adult longfin smelt are most abundant in San Francisco, San Pablo, and Suisun bays, but in low outflow years they are concentrated in the Delta and Suisun Bay where they migrate to reach conditions suitable for spawning.

Sacramento Splittail

Sacramento splittail (*Pogonichthys macrolepidotus*) are large cyprinids (minnow family) endemic to the lakes and rivers of the Central Valley of California (Moyle et al., 1989). Historically, they were collected from the Sacramento River as far north as Redding, from the San Joaquin River as far south as Fresno, and from the Delta. Commercial harvests occurred from 1916 to 1947 (California Bureau of Marine Fisheries, 1949).

Habitat loss and modification, annual flow variation, and entrainment in diversions from the Delta are major factors potentially affecting abundance of splittail populations in the Delta.

Reservoir Fisheries Communities

Reservoir construction in California has greatly increased game fish production; however, large self-sustaining game fish populations are uncommon. Most reservoirs are relatively artificial ecosystems that rarely meet all the needs of the species present.

The exact species composition in each reservoir is related to the history of introductions, but some species are common: bluegill, largemouth bass, carp, golden shiner, black crappie, brown bullhead, mosquitofish, and rainbow trout (hatchery strains). Native species that are permanently established in a number of Central Valley reservoirs include prickly sculpin, Sacramento sucker, hitch, and tui chub. Water-level fluctuation is the most frequently cited factor adversely affecting reservoir fishery production. Habitat quantity and quality are primarily determined by water-level fluctuation in reservoirs.

FISH SPECIES IN THE TRINITY RIVER BASIN

The Trinity River supports a variety of fishery resources. Anadromous salmonids include the spring-run and fall-run chinook salmon, coho salmon, and steelhead trout. In addition to natural production, the Trinity River Hatchery, located at the base of Lewiston Dam and built to mitigate for lost habitat, propagates and supplements basin production of chinook salmon, coho salmon, and steelhead trout. Other native and nonnative species present in the Trinity River Basin include the green sturgeon, Pacific lamprey, Klamath smallscale sucker, speckled dace, American shad, and brown trout. Factors affecting the abundance of anadromous fish produced in the Trinity River system include those factors affecting anadromous fish produced in Central Valley streams, as described previously, and historic changes in habitat on the Trinity River system.

The times at which the majority of chinook salmon and steelhead trout smolts emigrate overlaps, although some differences are apparent. Summer- and winter-run steelhead trout smolts emigrate from the Trinity River from April to early June. Coho salmon smolts emigrate from later April to mid-June. Chinook salmon smolts are the latest to leave the Trinity system. This species generally emigrates from mid-May to early July. Adult spring-run chinook salmon generally enter the Trinity River beginning in early April; peak migration in the lower river occurs in mid-June, and peak abundance in the upper river occurs in July or August.

AGRICULTURAL AND ECONOMICS LAND USE

The Central Valley is an important agricultural region for both California and the United States. It contains almost 80 percent of the irrigated land in California. In 1993, the 19 Central Valley counties contributed more than 60 percent, by value, of California's agricultural production and included 6 of the top 10 agricultural counties in California (Table III-2). Agriculture in the Central Valley is an important employer and affects the regional economy through farm expenditures, as well as production of many crops that require processing or transportation after harvest.

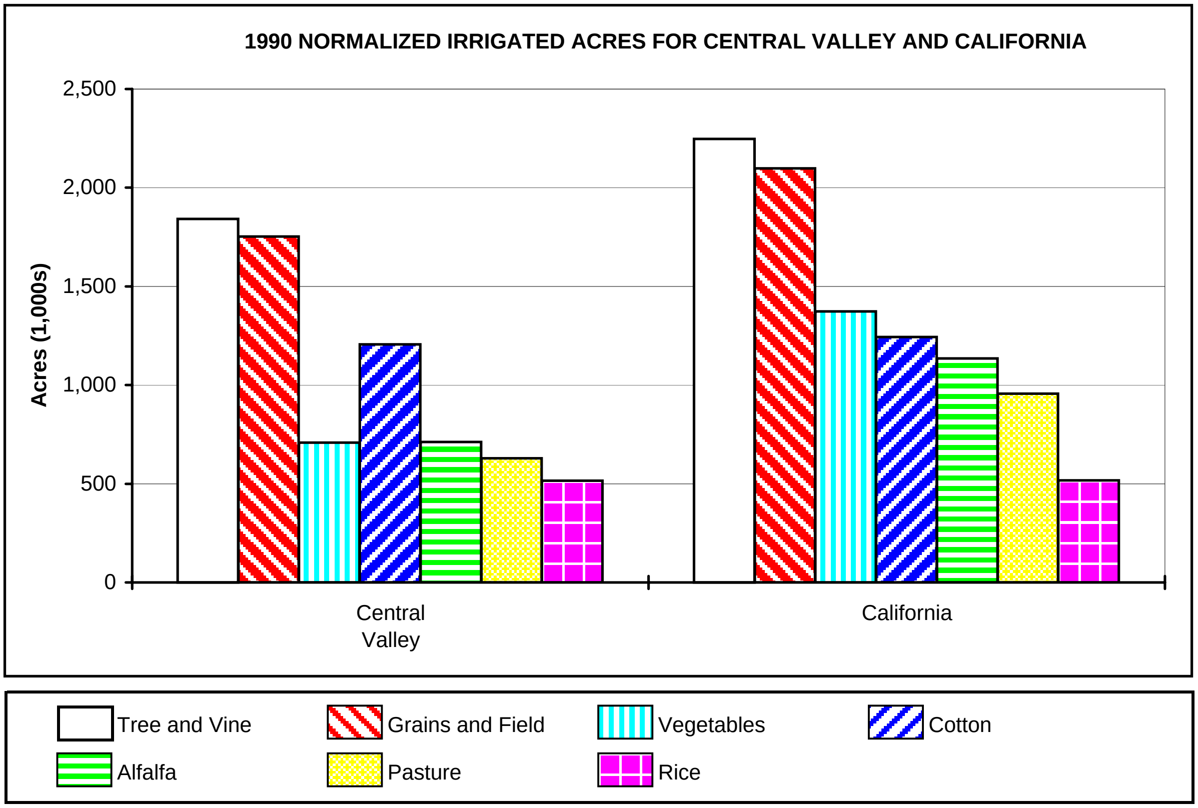
TABLE III-2

RANKING OF CENTRAL VALLEY COUNTIES BY TOTAL VALUE OF PRODUCTION IN 1993

1993 CA Rank	County	1993 Production ($1,000)	Percent of Total CA Value	Cumulative Percent	Leading Crops
1	Fresno	3,014,412	13.1	13.1	Grapes, cotton, tomatoes, milk, cattle & calves
2	Tulare	2,359,551	10.2	23.3	Milk, grapes, oranges, cattle & calves, cotton & seed
3	Kern	1,884,749	8.2	31.5	Grapes, cotton & seed, almonds, citrus, carrots
5	Merced	1,201,025	5.2	36.7	Milk, almonds, chickens, cotton, alfalfa
6	Stanislaus	1,147,126	5.0	41.7	Milk, almonds, chickens, walnuts, cattle & calves
7	San Joaquin	1,053,364	4.6	46.3	Milk, grapes, almonds, tomatoes, walnuts
12	Kings	836,860	3.6	49.9	Cotton lint, milk, cattle & calves, cottonseed, turkeys
13	Madera	615,047	2.7	52.6	Grapes, almonds, cotton lint, milk, pistachios
18	Sutter	292,108	1.3	53.9	Rice & seed, walnuts, peaches, prunes, tomatoes & seed
19	Butte	278,030	1.2	55.1	Almonds rice, walnuts, prunes, kiwifruit
20	Colusa	273,518	1.2	56.3	Rice, almonds, processing tomatoes, wheat, rice seed
21	Glenn	249,134	1.1	57.4	Rice, almonds, dairy products, prunes, cattle & calves
23	Yolo	235,805	1.0	58.4	Tomatoes, alfalfa hay, rice, safflower, wheat
24	Sacramento	228,651	1.0	59.4	Milk, pears, cattle & calves, wine grapes, ornamental nursery stock
28	Solano	177,705	0.8	60.2	Processing tomatoes, sugar beets, cattle & calves, nursery stock, alfalfa hay
32	Yuba	117,452	0.5	60.7	Rice, peaches, prunes, walnuts, cattle & calves
34	Tehama	100,365	0.4	61.1	Walnuts, prunes, almonds, cattle & calves, pasture & range
Total Central Valley		**$14,064,902**			
Total California		**$23,094,133**			

SOURCE:
California Department of Food and Agriculture (DFA), 1994.

Central Valley agriculture receives irrigation water from the CVP, the SWP, local water districts, individual water rights holders, and groundwater. Most of this water is delivered to farmers through irrigation districts and other water agencies. Figure III-15 shows irrigation water deliveries by source for the years 1985-1992. Deliveries average about 22.5 million acre-feet per year, with the SWP providing about 10 percent, local surface water rights about 30 percent, and groundwater about 35 percent. The CVP normally supplies about 25 percent of Central Valley water to approximately 200 water districts, individuals, and companies through water service contracts and water rights and exchange contracts.



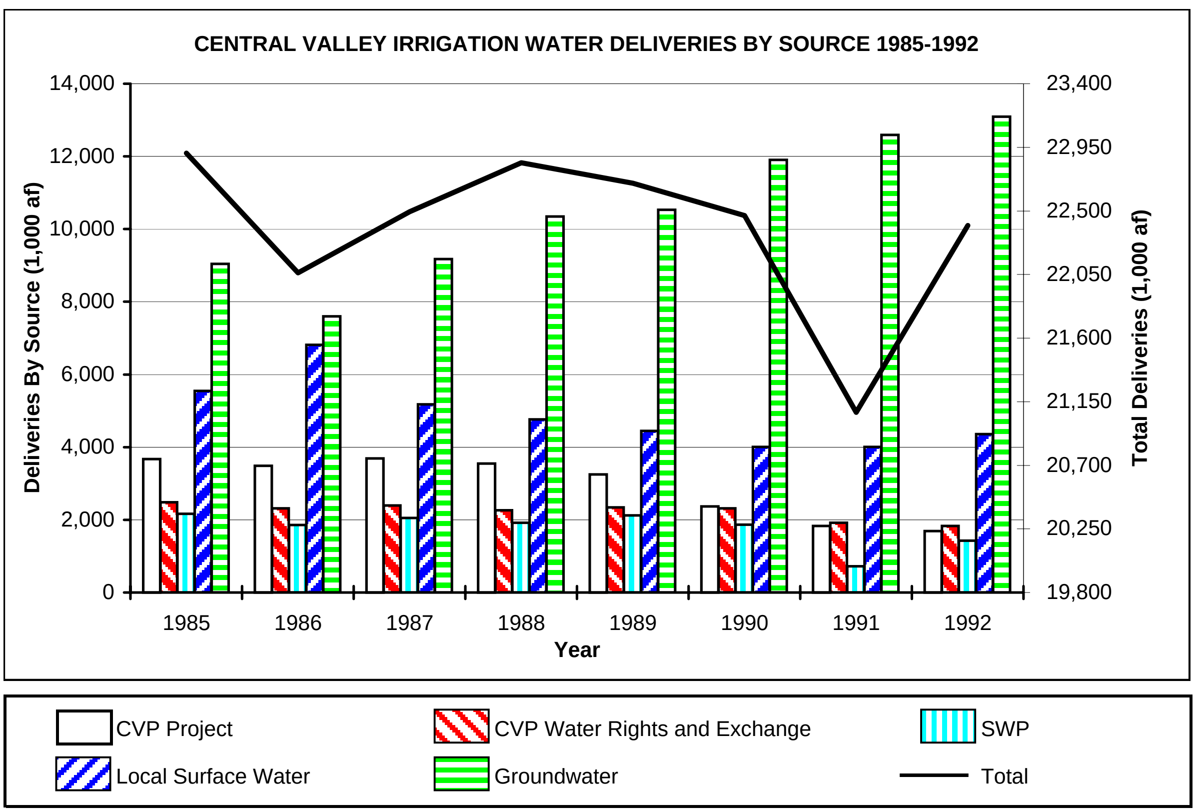


FIGURE III-15
1990 NORMALIZED IRRIGATED ACRES AND CENTRAL VALLEY IRRIGATION WATER DELIVERIES BY SOURCE FROM 1985-1992

Table III-3 shows 1989 project water supply and irrigated acreage by type of service and CVP division.

TABLE III-3

1989 CVP ACREAGE AND IRRIGATION WATER SUPPLY

CVP Division and Type of Service	Irrigable Acres for Service	Irrigated Acres	Percent Irrigated	Net CVP Supply Delivered to Farm (acre-feet)	CVP Delivery Per Acre Irrigated (acre-feet)
Lands Served Solely with CVP Water					
Delta Division	45,648	41,299	90	131,907	3.19
Sacramento River Division	32,253	23,834	74	72,052	3.02
Trinity Division	4,729	3,009	64	5,772	1.92
Total Full Service	82,630	68,142	82	209,731	3.08
Lands Served with CVP Water and Other Water Supplies					
American River Division	51,826	7,580	15	19,642	2.59
Delta Division	167,518	138,533	83	280,657	2.02
Friant Division	999,808	813,885	81	856,481	1.05
Sacramento River Division	98,411	74,679	76	208,801	2.80
San Felipe Division	37,430	23,730	63	19,827	0.84
Shasta and Trinity Divisions	471,730	358,524	76	612,631	1.71
West San Joaquin Division	618,972	550,227	89	1,261,062	2.29
Total Supplemental Service	2,445,695	1,967,158	80	3,833,093	1.95
Short-term Annual Water Service Contracts					
Delta Division	140,174	130,793	93	577,668	4.42
Friant Division	33,227	29,542	89	13,690	0.46
Sacramento River Division	4,262	1,506	35	2,862	1.90
Shasta Division	10,711	10,283	96	18,309	1.78
Total Temporary Service	188,374	172,124	91	38,537	3.56
Total/Average	**2,716,699**	**2,207,751**	**81**	**4,081,361**	**1.85**

SOURCE:
Reclamation, 1989. Does not include water rights contracts and some exchange contract water. Does not include COE projects.

Through contracts with 29 water agencies, the SWP provides water within the Central Valley to Butte, Solano, Kings, and Kern counties and outside the Central Valley to several Southern California counties, to Alameda and Santa Clara counties in the South Bay Area, and to Napa and Solano counties in the North Bay Area. Average SWP water supplies to the Central Valley from 1985 until 1992 were about 1.7 million acre-feet per year. In addition, the SWP provides water rights deliveries to water rights holders along the Feather River. Local surface water supplies (those not delivered by either project) averaged about 6.3 million acre-feet per year between 1985 and 1992, about 30 percent of all water supplies in the Central Valley.

Groundwater provides a significant supply in normal years and is often used to reduce or eliminate shortages of surface water supplies during drought. Declining groundwater tables, land subsidence, and loss of aquifer storage continue to be costly problems, particularly in the western and southern parts of the San Joaquin River Region where less surface water is available. Declining groundwater tables increase pumping costs. The costs of subsidence include damage to structures, failure of well casings, and frequent surveying. Water from the CVP and SWP had replaced some of the groundwater pumping, and withdrawals were about equal to estimated recharge (Bertoldi et al., 1991). However, the recent drought reduced surface water supplies and renewed the past trend of groundwater depletion in many parts of the valley.

REGIONAL DESCRIPTIONS

Sacramento River Region climate and soils cause a wide variation in crop mix. The uplands are suitable for a variety of crops, but the fine-textured soils adjacent to the Sacramento River are most suited to rice production. Grains and field crops; rice; and hay, pasture, and alfalfa are the major crops in the Sacramento River Region (72 percent of irrigated acres).

Irrigated acreage within the San Joaquin River Region is also very diversified. Almost half of the 1992 acreage was planted with grains, hay, and pasture. Orchards were planted on about 30 percent of the irrigated acres, and cotton and vegetables were each planted on about 10 percent. The region is the leading California area for production of grapes, almonds, walnuts, tomatoes, melons, and many other crops. Vegetables and cotton are grown on the west side, and grapes, fruits, nuts, and cotton are grown on the east side. Most of the west side depends on CVP water delivery.

The warm climate of the Tulare Lake Region provides ideal conditions for many crops. Cotton leads irrigated acres (32 percent), followed by fruits and nuts (28 percent), grains and field crops (17 percent), hay and pasture (12 percent), and vegetables (10 percent). The region has benefitted from supplemental water supply provided by the SWP for areas within Kern and Kings counties and from deliveries by the Friant-Kern Canal. Tulare County is the leading milk-producing county in the United States.

WATER PRICING

Water costs vary substantially throughout the valley depending on location and source of water. Average surface water prices are lowest in the Sacramento River Region at $11.35 per acre-foot and highest in the Tulare Lake Region at $42.50, reflecting higher SWP costs. Groundwater cost largely depends on the depth to water. Estimated groundwater pumping costs range from about $20 per acre-foot in parts of the San Joaquin River Region to more than $75 in parts of the Tulare Lake Region.

CROPPING PATTERNS AND IRRIGATED ACRES

Normalized 1990 irrigated acres for the Central Valley in DWR's three Central Valley hydrologic basins are shown in Figure III-15. Virtually all of California's rice and cotton acreage, almost half of its vegetable acreage, and 80 percent of its orchard land are in the Central Valley. The Central Valley also contains almost 60 percent of California's irrigated hay acreage.

From 1984 to 1993 vegetables and truck crops as a group increased by about 160,000 acres in the Central Valley. Orchard acreage increased by over 200,000. Acreage of grains, pasture, sugar beets, and cotton declined during this period. Acreage of program crops including cotton, rice, and grains have been strongly influenced by farm commodity programs.

AGRICULTURAL PRODUCTION COSTS AND REVENUES

Central Valley farms accounted for more than $8.5 billion in agricultural sales in 1987 and $10 billion in 1992, according to Census Bureau estimates. About two-thirds of these sales were receipts for crops. The remainder of the sales were mostly livestock products. Revenues in 1992 were probably less than normal because of the influence of drought. Farmers received an additional $329 million in government payments and $171 million from direct sales, custom work, and other farm services for a total income of $10.5 billion in 1992. Production expenses were about $8.2 billion, leaving a net cash return of $2.4 billion. Net cash return includes the payment for family labor, management, returns to land and water, risk, and some other uncounted costs of farming.

The market value of Sacramento River Region crops sold reached $1.7 billion in 1992; rice, tomatoes, almonds, and walnuts were the most valuable crops. In the San Joaquin River Region, fruits and nuts accounted for approximately half of the total value of crop production ($4.7 billion). Vegetables and cotton accounted for approximately 20 and 10 percent of the San Joaquin River Region's value of crop production. In the Tulare Lake Region, grapes were the highest value crop, followed by cotton and oranges. All fruits and nuts accounted for almost 60 percent of the total value of crop production (about $3.8 billion) in the Tulare Lake Region

Crop revenues, estimated by County Agricultural Commissioners as crop yield (in units of production per acre) multiplied by acres and by price, are shown in Table III-4.

AGRICULTURAL WATER CONSERVATION

On-farm application efficiency depends on many factors including crop type, terrain, climate, irrigation system, and management of the system. Application efficiencies in the Central Valley range from below 50 to above 80 percent. Lowest efficiencies tend to occur in the Sacramento Valley, where water is more abundant and less expensive. Rice cultivation here generates much more irrigation tailwater than other crops, but this tailwater normally returns to the hydrologic system. Higher efficiencies are found in the San Joaquin River and Tulare Lake regions for the opposite reasons.

District and project efficiencies incorporate the efficiency of the district conveyance systems as well as the on-farm application. Districts with improved conveyance, especially lined canals and laterals, tend to have higher district conveyance efficiencies. Again, the southern Central Valley tends to be more efficient at the district and project level because of greater use of lining and piping. Some Sacramento Valley districts, most notably those in the Tehama-Colusa area, have entirely piped or lined conveyance systems.

TABLE III-4

1985 THROUGH 1992 AVERAGE CROP ACREAGE, YIELDS, PRODUCTION, AND VALUE

Crop	Harvested Irrigated (1,000 Acres)	Average Yield (Tons/Acre) (1)	Product (1,000 Tons)	Average Price Per Unit	Average Revenue Per Acre	Value of Production ($ millions)
Wheat	371.8	3.03	1,127	107	325	121
Misc. Grain	151.9	2.30	350	106	244	37
Rice	415.9	3.85	1,600	151	581	242
Cotton (Bales)	1167.3	2.47	2,885	409	1,010	1,179
Sugar Beets	147.3	25.12	3,699	36	909	134
Corn	364.9	4.45	1,625	105	468	171
Misc. Hay	211.1	3.33	704	63	211	45
Dry Beans	167.9	1.11	186	555	616	103
Oil Seed	66.1	1.57	103	265	415	27
Alfalfa Seed	192.2	0.27	52	2,351	642	123
Alfalfa	579.7	7.60	4,480	88	671	389
Pasture (AUMs)	481.9	13.60	6,555	12	163	79
Process Tomatoes	232.1	31.41	7,291	51	1,609	374
Fresh Tomatoes	24.1	13.73	330	416	5,719	138
Melons	74.0	9.04	669	208	1,884	139
Onions	41.9	19.09	799	117	2,227	93
Potatoes	23.9	18.59	445	179	3,319	79
Misc. Vegetables	199.0	26.60	5,295	170	4,519	899
Almonds	459.0	0.68	310	2,357	1,592	731
Walnuts	160.0	1.37	219	1,022	1,401	224
Prunes	128.6	2.63	338	787	2,071	266
Peaches	134.0	12.69	1,701	368	4,676	627
Citrus	150.6	11.33	1,707	329	3,724	561
Olives	60.3	3.47	209	545	1,893	114
Raisin Grapes	347.9	7.97	2,773	345	2,753	958
Wine Grapes	189.8	8.50	1,614	193	1,644	312
Total	**6543.2**					**8,165**

NOTE:
(1) Tons per acre unless otherwise noted next to crop name. Cotton price includes value of cottonseed.

SOURCES:
CAC, 1985, 1992.

AGRICULTURAL WATER MEASUREMENT

Practically all agricultural districts in the Central Valley currently have some type of measurement capability at the district level, and most can measure water delivered to individual users. In some cases, control structures that are already in place could facilitate water measurement. These control structures are usually gates or weirs that, when lowered or opened, allow water to flow to the users. In some other cases, water is physically pumped out of a canal or ditch by the user.

LAND VALUES

Average values of irrigated land used for the same purpose are typically highest in the Central Coast Region, lower in the San Joaquin River Region, and lowest in the Sacramento River Region. Land values in the Sacramento River Region generally declined during the five-year period from 1985 to 1990, but prices generally increased in the San Joaquin River and Central Coast regions. Irrigated land value for field crops, rice, cotton, and pasture ranged from $1,800 to

$5,000 per acre in the Central Valley and Central Coast regions. Land values have held generally steady since 1990 with some notable movements in both directions. Throughout the region, reliable water supplies and suitability for permanent crops are two factors that enhance land value.

There is normally a large range in land values, reflecting local variations in climate, soils, and water supply and cost. Values tend to be lower in areas with high soil salinity, drainage problems, and unreliable water supply.

CENTRAL VALLEY AGRICULTURE IN NATIONAL AND INTERNATIONAL MARKETS

California leads all other states in value of agricultural production, and the Central Valley provides most of this production. The Central Valley accounts for almost 10 percent of the total U.S. market value of agricultural crops sold. More than half of this value comes from fruits and nuts. The Central Valley accounts for almost 40 percent of U.S. fruit and nut production.

California's 20 percent share of the U.S. cotton market value is produced on less than 10 percent of total U.S.-harvested cotton acres (including non-irrigated acres) because of the Central Valley's higher yields and the higher quality of its cotton. Central Valley hay and vegetables also account for disproportionately large value shares of the national market. In general, the Central Valley's climate and larger proportion of irrigated acreage allow yields and the share of vegetables, fruits, and nuts to exceed national averages.

In addition to its importance in national markets, Central Valley agriculture plays an important role in international markets. California produces about 10 percent of total U.S. agricultural exports. These exports represent almost 25 percent of the gross farm income of the State (Carter and Goldman, 1992). Leading California export commodities and the percent of each grown in the Central Valley include cotton (99 percent), almonds (100 percent), grapes (73 percent), oranges (77 percent), walnuts (96 percent), tomatoes (83 percent), and rice (100 percent).

FARM PROGRAMS

Commodity programs were designed to increase and stabilize incomes of growers of certain commodities. Rice, cotton, wheat, and corn are important program commodities in California. Almost 4 million acres of California cropland were eligible to participate in commodity programs in 1991 and 1992, and an average of 2.6 million acres were in compliance with the programs of the U.S. Department of Agriculture ([USDA], 1990-1992). The income provided by government payments is not an important share of all Central Valley agricultural income (roughly 3 percent), but farm programs have had important effects on commodity crop economics, especially rice and cotton. A large share of eligible rice and cotton acreage participates and, until 1996, a substantial share of net income was attributable to farm programs. As a condition for participating in the program, growers were required to set aside a percentage of eligible land each year, called the Acreage Reduction Percentage (ARP).

The Federal Agriculture Improvement and Reform Act of 1996 made several substantial changes to past farm programs. Participating commodity base acreage will receive fixed payments per acre regardless of what crop is grown on the base acreage. Any crop except for fruits or vegetables may be grown while payments are received, and acreage reduction requirements are no longer authorized. Non-recourse loan provisions are retained.

WATER TRANSFER

Water transfers are voluntary trades or sales of water between water users. Agricultural water users participate in water transfers as buyers and sellers. Water transfers between individual water users within a water district are common in dry conditions and are becoming more common even in average conditions. Water transfers between users within a district do not normally require approval from the SWRCB because such users are covered by the same water right permit. Water transfers between CVP water service contractors do not require approval from the SWRCB.

Voluntary water transfers out of a district or region were not common in California until the 1987-1992 drought period. Early in the drought, agricultural water users transferred some water to municipal and other uses privately. The State Drought Water Bank was established in 1991 to acquire and transfer water to meet critical needs. DWR paid $125 per acre-foot and sold water for $175 an acre-foot. About 820,000 acre-feet were made available by fallowing land, by groundwater substitution, and from storage. Less was delivered to buyers due to losses, especially in the Delta. The Bank offered only $50 in 1992, and even though land fallowing to provide water was not allowed, 193,000 acre-feet were obtained.

Water transfers have raised a number of concerns involving third-party impacts. Land fallowing affects regional economies and local governments, and transfers may affect hydrology and cause unintentional harm to other water users.

MUNICIPAL AND INDUSTRIAL LAND USE AND DEMOGRAPHICS

M&I land uses include residential, industrial, commercial, construction, institutional, and public administration purposes, as well as railroad yards, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures, and other developments. Highways, railroads, and other transportation facilities are also included as M&I land use if they are located in an M&I region.

Until recently, most of the M&I land use in California was concentrated in or near the coastal areas. During the last decade, this trend has begun to shift, as the rate of new development in coastal areas has declined in response to the decreasing availability of developable land and the increasing prices of remaining available land. This trend is evident in the relationship between the San Francisco Bay Region and the areas of Sacramento and San Joaquin counties. During the 1980s, communities in the Sacramento, Tracy, and Stockton areas have grown, and now include residents who commute to Livermore, Walnut Creek, and other areas of the San Francisco Bay Region.

California had an estimated population of 29,760,000 in 1990. Approximately 36 percent, or 10,604,000, of these people are located within the four regions evaluated in detail for changes in land use in the PEIS. These four regions are discussed below. Trinity River Region would experience the same impacts in all alternatives as compared to the No-Action Alternative. These impacts are being evaluated in a separate environmental document, and therefore are not described in this PEIS. Land use and demographics also are not evaluated in detail in the PEIS and will be evaluated in future environmental documents concerning water transfers.

SACRAMENTO RIVER REGION

M&I land use in the Sacramento River Region increased after 1950, in part as a result of the post-World War II baby boom and strong economic conditions. Between 1950 and 1980, corridors of M&I development became established along Interstate 80 from Fairfield to Auburn and along Highway 50.

During the 1980s, the Auburn and Sacramento areas were among the fastest growing areas in California. Rapid growth in Sacramento County and surrounding areas has occurred as previously undeveloped or agricultural lands have been developed for the construction of single and multi-family housing. Irrigated agricultural acreage in the region peaked during the 1980s and has since declined with their conversion to M&I land uses.

The population in the Sacramento River Region increased by approximately 2.2 million between 1920 and 1990. This increase represents the largest percent change of the four regions and was similar to the rate of population growth for the State as a whole.

SAN JOAQUIN RIVER REGION

Between 1980 and 1990, M&I land acreage within the San Joaquin River Region increased from approximately 71,000 acres to 110,000 acres. This change in M&I land area represents the smallest change of the four regions during this period. Major M&I centers include the cities of Fresno, Stockton, Tracy, Modesto, and Merced, which are industrial hubs for food and grain processing. The cities of Tracy and Stockton have grown recently, fed by the San Francisco Bay Region growth trends. The City of Fresno is the major M&I center for the San Joaquin Valley.

The population of the San Joaquin River Region increased by approximately 1.6 million people between 1920 and 1990. This increase exceeded the State's population growth rate for that period and was the largest increase of the four regions.

TULARE LAKE REGION

Between 1950 and 1990, M&I acreage in the Tulare Lake Region approximately tripled from 96,000 acres to 294,000 acres. During the period between 1920 and 1990, M&I land use in the region increased from approximately 45,000 acres to 294,000 acres. Much of this growth was associated with the expansion of the City of Bakersfield, the largest M&I center within the region. Other municipal areas include the cities of Tulare, Hanford, and Visalia. The population in the Tulare Lake Region increased by approximately 821,000 people between 1920 and 1990.

SAN FRANCISCO BAY REGION

Between 1955 and 1970, M&I land use in the San Francisco Bay Region increased from approximately 225,000 acres to 485,000 acres, the largest increase of M&I land area in the four PEIS regions. During this period, the Santa Clara Valley developed rapidly, and by the 1980s, few areas in the immediate San Francisco Bay Area remained available for M&I land development. During the 1980s, extensive development occurred along the Highway 680 corridor. M&I land use for 1990 was 655,000 acres, a substantial increase in development for the 20-year period between 1970 and 1990. Although land development between 1950 and 1970 more than doubled, adding approximately 260,000 acres, the change from 1970 to 1990 was associated with "in-fill" developments and has resulted in greater regional population density than in previous periods. This region is extensively urbanized and includes the San Francisco, Oakland, and San Jose metropolitan areas.

Between 1920 and 1990, the population in the San Francisco Bay Region increased by approximately 4 million.

VEGETATION AND WILDLIFE RESOURCES

A wide diversity of vegetation and wildlife resources exists in the Central Valley, the Trinity River Basin, and in the San Felipe Division. Habitat types in these regions include natural terrestrial, agricultural, urban, riparian, and wetland habitats. This section describes the vegetation and wildlife resources in the CVPIA study area, with emphasis on biological communities in the Central Valley, where implementation of the CVPIA will have the greatest effect.

CENTRAL VALLEY RESOURCES

For the purposes of this assessment, the Central Valley was divided into four regions: Sacramento River Region, Sacramento-San Joaquin Delta Region, San Joaquin River Region, and Tulare Lake Region. Acreages of habitat types in these regions are listed in Table III-5.

Natural Terrestrial and Agricultural Habitats

Natural terrestrial habitats constitute large portions of the Sacramento River, San Joaquin River, and Tulare Lake regions (Table III-5), although extensive portions of these habitats also exist on the east slope of the Coast Mountains and the west slope of the Sierra Nevada. Grassland and valley foothill hardwood are the dominant natural terrestrial habitat types in the Central Valley, constituting approximately 36 percent, 58 percent, and 46 percent of these habitats in the Sacramento River, San Joaquin River, and Tulare Lake regions, respectively.

TABLE III-5

SUMMARY OF CENTRAL VALLEY HABITAT TYPES CONSIDERED IN THE ANALYSIS

Region	Habitat Type (1,000 acres)				
	Natural Terrestrial	Agricultural	Urban/Other	Riparian	Wetland
Sacramento River	8,443	1,984	1,309	14	157
Delta	0	505	107	7	25
San Joaquin River	4,347	3,140	615	15	138
Tulare Lake	3,319	2,200	707	14	32

NOTE:
Acreages are based on 1992 data.

Agricultural habitats are generally of lower quality than natural habitats. Rice and irrigated pasture provide the highest quality agricultural habitat for wildlife, followed by grain crops. The habitat value of row crops, orchards, and vineyards is less than that of the previously mentioned crops, but all these agricultural habitats provide better habitat value than cotton. The major agricultural habitats are grain, irrigated pasture, and rice in the Sacramento River Region; row crops in the Delta Region; irrigated pasture, orchards and vineyards, and cotton in the San Joaquin River Region; and cotton and irrigated pasture in the Tulare Lake Region.

Natural terrestrial and agricultural habitats support special-status species (Federally and State-listed threatened or endangered species, species proposed for Federal listing as threatened or endangered, and Federal candidate species) (Tables III-6 and III-7). Grassland and valley foothill hardwood, the dominant habitats in the Central Valley, support 40 special-status plant and 22 special-status wildlife species. Examples of species that occur in grasslands are palmate-bracted bird's beak, Chinese Camp brodiaea, San Joaquin kit fox, giant kangaroo rat, San Joaquin antelope squirrel, and blunt-nosed leopard lizard. Many of the special-status plant species are associated with rare habitats in grasslands, such as vernal pools. Examples of species that occur in valley foothill hardwoods are San Joaquin adobe starburst, Hartweg's golden sunburst, striped adobe lily, loggerhead shrike, and California mastiff bat. A more detailed list of special status species is presented in the Vegetation and Wildlife Technical Appendix.

The extent of natural terrestrial and agricultural habitat is affected by urban development. Urban and other habitats generally provide low-quality habitat for native plants and wildlife because they are small and isolated, so that only a limited number of species can use them. Additionally, these areas generally receive high levels of human use, which disturbs native species and restricts their use of the area.

TABLE III-6

NUMBERS OF SPECIAL-STATUS PLANTS BY STATUS LEVEL AND HABITAT IN EACH CENTRAL VALLEY REGION

Region/Status	Mixed Conifer Forest	Montane Hardwood	Pinyon-Juniper	Valley-Foothill Hardwood	Valley-Foothill Riparian	Inland Dunes	Montane Riparian	Chaparral	Alkali Desert Scrub	Desert Scrub	Sagebrush & Bitterbush Scrub	Grassland	Freshwater Emergent Marsh	Saline Emergent Marsh
Sacramento River														
Federally listed or proposed	1	8		7				6	1			18	1	1
State listed	2	2		2	1			2	1			3	3	1
Federal candidate		1		1				3						
Sacramento River Totals	**3**	**11**		**10**	**1**			**11**	**2**			**21**	**4**	**2**
Delta														
Federally listed or proposed						2						9		2
State listed					1							2	2	1
Federal candidate														
Delta Totals					**1**	**2**						**11**		**3**
San Joaquin River														
Federally listed or proposed		6	1	9				2	4			15		
State listed	4	4		4	2			4				2	2	1
Federal candidate	1	2		3				2				1		
San Joaquin River Totals	**5**	**12**	**1**	**16**	**2**			**8**	**4**			**18**	**2**	**1**
Tulare Lake														
Federally listed or proposed		2	3	4				1	5			12		
State listed	1	1		1						1		1		
Federal candidate		1		1								1		
Tulare Lake Totals	**1**	**4**	**3**	**6**				**1**	**5**	**1**		**14**		

NOTE:
Coastal and desert habitats that do not occur in the Central Valley are not included in this table.

TABLE III-7

NUMBERS OF SPECIAL-STATUS WILDLIFE SPECIES BY STATUS LEVEL AND HABITAT IN EACH CENTRAL VALLEY REGION

Region/Status	Mixed Conifer Forest	Montane Hardwood	Pinyon-Juniper	Valley-Foothill Hardwood	Valley-Foothill Riparian	Inland Dunes	Montane Riparian	Chaparral	Alkali Desert Scrub	Desert Scrub	Sagebrush & Bitterbush Scrub	Grassland	Freshwater Emergent Marsh	Saline Emergent Marsh	Lacustrine	Riverine	Irrigated Pasture	Row Crops	Grain Crops	Rice
Sacramento River																				
Federally listed or proposed	1				1							3	8		4	4	1		1	
State listed					1		1					1	2	1	2	1		1	1	
Federal candidate												2	1				1		1	
Sacramento River Totals	**1**				**2**		**1**					**6**	**11**	**1**	**6**	**5**	**2**	**1**	**3**	
Delta																				
Federally listed or proposed						1							8	2	3	3	1		1	
State listed					2		1						1	1		1	2	1	3	
Federal candidate					1								1		1		1		1	
Delta Totals					**3**	**1**	**1**						**10**	**3**	**4**	**4**	**4**	**1**	**5**	
San Joaquin River																				
Federally Listed or proposed	1				2				6	1		5	6		3	3	1		1	
State Listed				1	3		1					1	1		1			2	1	
Federal Candidate												2	1		1		1		1	
San Joaquin River Totals	**1**			**1**	**5**		**1**		**6**	**1**		**8**	**8**		**5**	**3**	**2**	**2**	**3**	
Tulare Lake																				
Federally listed or proposed	1				2				5			5	4		2	1				
State listed	1				3		1	1				1	1		1			2	1	
Federal candidate						1					1	2	2		1		1		1	
Tulare Lake Totals	**2**				**5**	**1**	**1**	**1**	**5**		**1**	**8**	**7**		**4**	**1**	**1**	**2**	**2**	

NOTE:
Coastal and desert habitats that do not occur in the Central Valley are not included in this table.

Riparian and Wetland Habitats

Riparian habitats are associated with the rivers and streams in each region (Table III-5). Flood-control structures and land use changes have restricted the abundance and distribution of riparian habitat in each region. Freshwater emergent wetlands in the Sacramento River and San Joaquin River regions are generally associated with rivers and seasonal wetlands, such as vernal pools and swales. Freshwater and saline emergent wetlands are found in the Delta Region. Wetland habitat is restricted in the Tulare Lake Region because of the drier climate and land use practices.

Riparian and wetland habitats in the Central Valley support numerous special-status plant and wildlife species (Tables III-6 and III-7). Examples of those special-status species that occur in riparian habitat are delta button-celery and Mason's lilaeopsis, valley elderberry longhorn beetle, yellow-billed cuckoo, and riparian brush rabbit. Examples of special-status species found in wetland habitat are Colusa grass, orcutt grasses, Suisun thistle, salt marsh harvest mouse, black rail, giant garter snake, vernal pool fairy shrimp, and vernal pool tadpole shrimp.

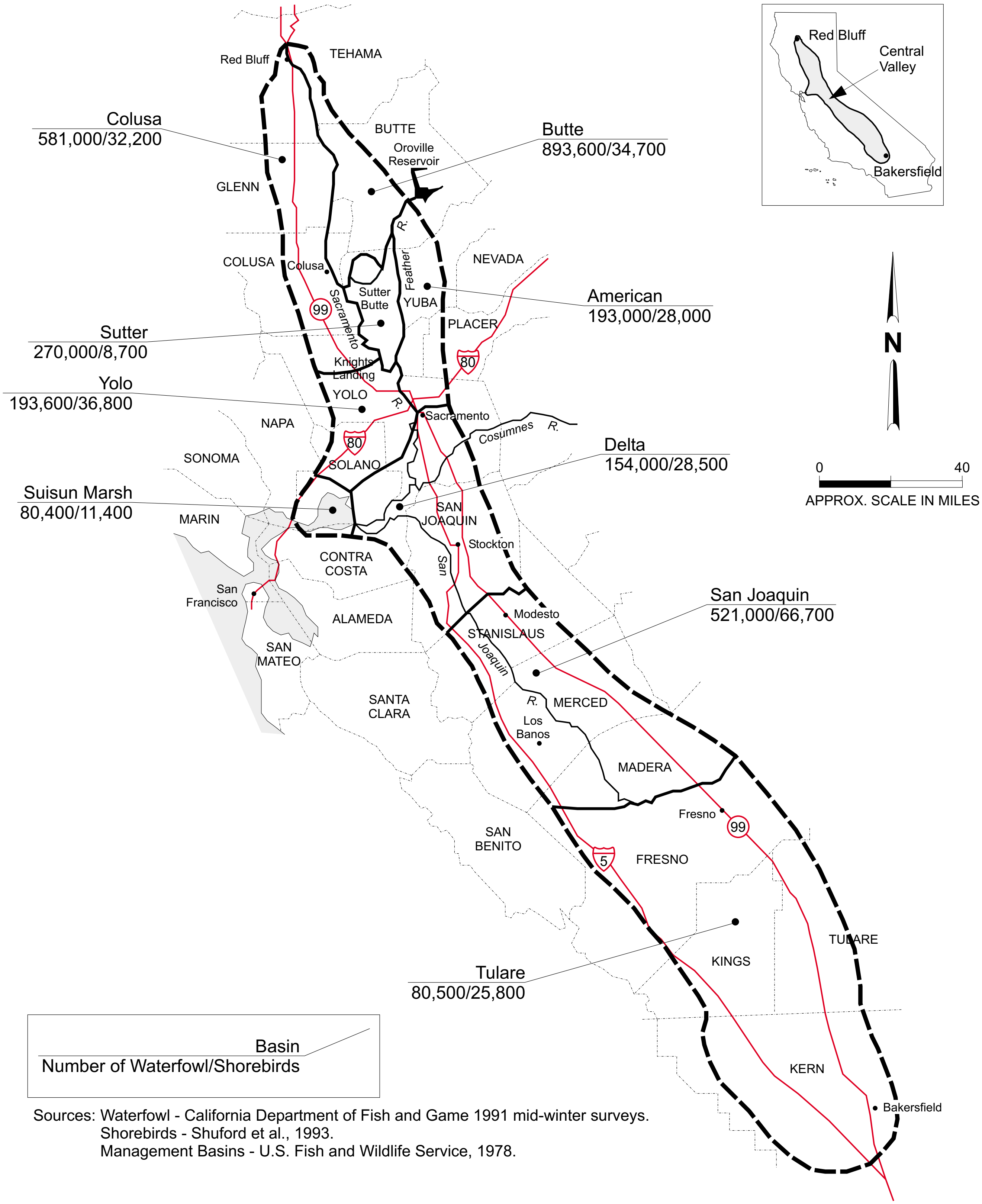
River and Reservoir Aquatic Habitats

River and reservoir aquatic habitats are those in the rivers and associated reservoirs operated by the CVP and the SWP. In the Sacramento River Region, aquatic habitats were evaluated in the Sacramento, Feather, and American rivers and Whiskeytown Lake, Shasta Lake, Lake Oroville, and Folsom Lake. Aquatic habitats evaluated in the San Joaquin River Region were the San Joaquin, Stanislaus, Tuolumne, and Merced rivers, San Luis and New Melones reservoirs, and Millerton Lake. Aquatic habitats provided by rivers and reservoirs in the Tulare Lake Region were not evaluated because they are not affected by operation of the CVP.

Special-status wildlife species associated with riverine habitat in the Central Valley include the bald eagle, bank swallow, and California red-legged frog. Reservoirs are used primarily by migratory birds that are present in the Central Valley between October and March. Shallow water habitat (less than 1 foot deep) is used by dabbling ducks, such as mallards and cinnamon teal; deep water habitat (more than 1 foot and less than 15 feet deep) is used by diving ducks, such as lesser scaup and ring-necked ducks; and open water habitat (more than 15 feet deep) is used by gulls and western grebes.

Waterfowl and Shorebirds

Natural and managed wetlands in the Central Valley provide the most important wintering area for waterfowl on the Pacific Flyway, supporting approximately 60 percent of that population and 18 percent of the entire continental wintering waterfowl population. Between 1970 and 1980, 5.5 to 7 million waterfowl wintered each year in the Central Valley; however, the population declined in recent years to approximately 3 to 4 million as a result of extended droughts in wintering and breeding ranges. The Central Valley also supports the largest concentrations of wintering shorebirds in western North America; more than 270,000 birds were counted during winter 1992-1993. Spring counts of shorebirds may be higher because many birds stop in the Central Valley before migrating to northern breeding grounds. The recent distribution of waterfowl and shorebirds in the Central Valley is shown in Figure III-16.



Sources: Waterfowl - California Department of Fish and Game 1991 mid-winter surveys.
Shorebirds - Shuford et al., 1993.
Management Basins - U.S. Fish and Wildlife Service, 1978.

FIGURE III-16

MANAGEMENT BASINS AND WINTERING WATERFOWL AND SHOREBIRD POPULATIONS IN THE CENTRAL VALLEY

Federal and State refuges and private duck clubs provide important wetland habitat for migratory waterfowl and shorebirds. Public refuges in the Sacramento River Region include Gray Lodge Wildlife Management Area (WMA), Oroville WMA, Sacramento National Wildlife Refuge (NWR), Delevan NWR, Colusa NWR, and Sutter NWR. The San Joaquin River Region supports the largest block of public refuges and private duck clubs in the Central Valley. These include Kesterson NWR, San Luis NWR, Merced NWR, North Grasslands WMA, Los Banos WMA, Volta WMA, the San Joaquin Basin Action Plan lands, and Grasslands Resource Conservation District. The Tulare Lake Region has three refuges: Mendota WMA, Kern NWR, and Pixley NWR.

TRINITY RIVER BASIN RESOURCES

The riparian zone along the Trinity River is primarily composed of blackberry, willow, and alder species. No Federally listed species are present. Since the completion of Trinity Dam and the beginning of water diversion to the Sacramento River Basin in the 1960s, flows in the Trinity River have been reduced, resulting in the exposure of gravel bars within the river channel and the establishment of vegetation on the gravel bars.

A variety of species of mammals, birds, amphibians, and reptiles inhabit the riparian and neighboring areas throughout the spring months. Although present in the Trinity River Basin, the bald eagle is primarily limited to the reservoir areas. Reclamation has previously consulted on the effects of the operation of the CVP on bald eagles and is operating under the resultant biological opinion that addresses effects of CVP operations, including reservoirs.

The willow flycatcher, which is listed as an endangered species by the State of California, has been occasionally observed in the Trinity Basin (Wilson, 1993). Wildlife species designated by the State of California and/or Federal agencies as species of special concern include the foothill yellow-legged frog and the northwestern pond turtle.

SAN FELIPE DIVISION RESOURCES

Although most of the non-urban land in the San Felipe Division is used for agricultural purposes, native trees and shrubs fringe some of the natural drainage courses. Willows, alders, cottonwood, black walnut, and sycamores, with an understory of California blackberry, sage, wild radish, and other annual plants are common among intermittent stream courses. Rare or endangered plant species in, or in the vicinity of, the San Felipe service area include the ferris ceanothus, the California balsam root, Hamilton thistle, and the glabrous popcorn flower.

Because of the varied natural and cultivated vegetation, birdlife is abundant and includes numerous non-game species in addition to upland game birds. The intense development of the valley floor, however, has eliminated many acres of marsh habitat previously used by waterfowl.

Rare, threatened, or endangered species in the San Felipe Service Area include the San Joaquin kit fox, the southern bald eagle, the red-shouldered hawk, the California least tern, the San Francisco garter snake, and the salt-marsh harvest mouse.

CENTRAL VALLEY PROJECT POWER RESOURCES

CVP facilities were constructed and are operated under Reclamation Law and the authorizing legislation for each facility. Initially, Reclamation projects were authorized solely for irrigation and reclamation purposes under the Reclamation Act of 1902. In 1906, Reclamation Law was amended to include power as a purpose of the projects if power was necessary for operation of the irrigation water supply facilities, or if power could be developed economically in conjunction with the water supply projects. The Act of 1906 also allowed for lease of surplus power. Surplus power is described as power that exceeds the capacity and energy required to operate the Reclamation facilities (Project Use Load). The Act of 1906 stipulated that surplus power would be leased with preference for municipal purposes.

The Reclamation Act of 1939 provided for surplus power to be sold with preference given to municipalities and other public corporations or agencies, and also to cooperatives and other non-profit organizations financed pursuant to the Rural Electrification Act. By Reclamation Law, the Preference Power Customers include irrigation and reclamation districts, cooperatives, public utility districts, municipalities, California educational and penal institutions, and Federal defense and other institutions.

The preference power customers include “first preference” customers which have priority over other preference contractors. The Trinity River Division Act of 1955 provides the first preference power customers in Trinity County 25% of the additional available energy from the CVP power generation facilities in the Trinity River Division. The Flood Control Act of 1962 provided up to 25% of additional available power attributed to CVP power generation facilities in the New Melones Project to first preference power customers in Calaveras and Tuolumne counties.

In 1967, Reclamation and PG&E signed an agreement (Contract No. 14-06-200-2948A, or “Contract 2948A”) allowing for the sale, interchange, and transmission of electrical power between the Federal government and PG&E. Under this agreement, power produced in excess of Project Use Load and preference customer deliveries is delivered to PG&E and is available to meet Western’s requirements during subsequent periods.

Until 1977, Reclamation operated the CVP power generation and transmission facilities and marketed the power generated by the CVP facilities. In 1977, Western Area Power Administration (Western) was established as part of the Department of Energy. Western operates, maintains, and upgrades the transmission grid that was constructed by the CVP. As part of their marketing function, Western ensures that CVP Project Use loads are met at all times by using a mix of generation resources including CVP generation and other purchased resources. Western also dispatches and markets power surplus to the CVP project needs to preference power customers and other utilities.

CENTRAL VALLEY PROJECT HYDROELECTRIC GENERATION FACILITIES

The CVP power facilities include 11 hydroelectric powerplants with 38 generators, and have a total maximum generating capacity of 2,045,000 kilowatts (kW) as schematically presented in Figure III-17. Major factors that influence powerplant operations include required downstream water releases, electric system needs, and Project Use demand. CVP powerplants have produced an average of 4,800,000 kWh per year over the last 15 years.

Revenue from CVP generation is vital to project repayment and operation and maintenance expenses. Through appropriations, revenues from the sales of surplus CVP power are applied to several types of annual expenses, including:

- Power operation and maintenance
- Administration and general expenses allocated to power
- Power equipment replacement
- Interest on power investment
- Federal power investment
- Depreciation

With the ability to support the Central and Northern California power system and the power system reliability, the CVP powerplants have a major long-term role with important implications in California and thus the Nation's security, energy self-sufficiency, quality of life, environment and economy. In addition to providing peaking and base load generation to the Central and Northern California power system, it supplies many secondary benefits to the power system including VAR (magnetic or inductive power) support, spinning reserves, and black start capabilities. The continued stream of benefits derived from the CVP power facilities is of vital importance to the CVP water and power users. Loss of CVP hydropower generation results in a reduction of electric system reliability as well as increasing electrical system costs.

POWER GENERATION

Historically, power generation from CVP hydropower facilities has fluctuated significantly in response to reservoir releases. Reservoir releases are significantly affected by droughts, minimum streamflow requirements, flow fluctuation restrictions, and water quality requirements. Figure III-18 shows monthly total CVP power generation for the period 1984 through 1993.

Recently, power generation has been affected by changes in CVP operations to meet minimum streamflow and water quality requirements. For example, Shasta Powerplant operations were affected by the SWRCB Water Rights Order 91-01 and the biological opinion issued by the NMFS in 1992 to protect winter-run chinook salmon in the Sacramento River. The SWRCB order and the biological opinion included maximum temperature requirements during specified months of the year. To meet the temperature requirements, cold water from the lower levels of Shasta Lake was released during the critical periods. Outlets in the dam that allowed the release of colder water are not connected to the Shasta Powerplant. Therefore, to meet temperature requirements, the powerplant was bypassed and annual power generation was significantly

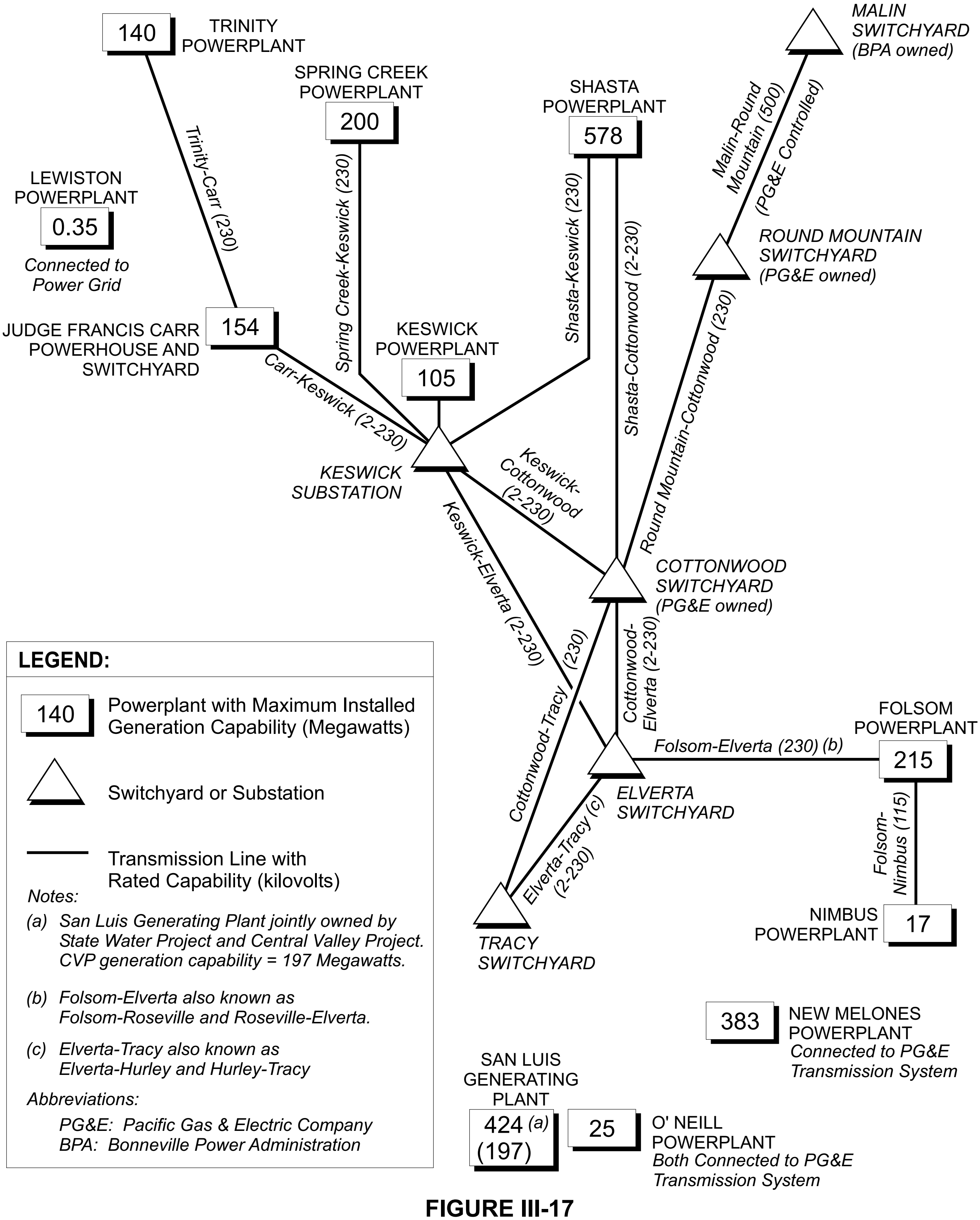
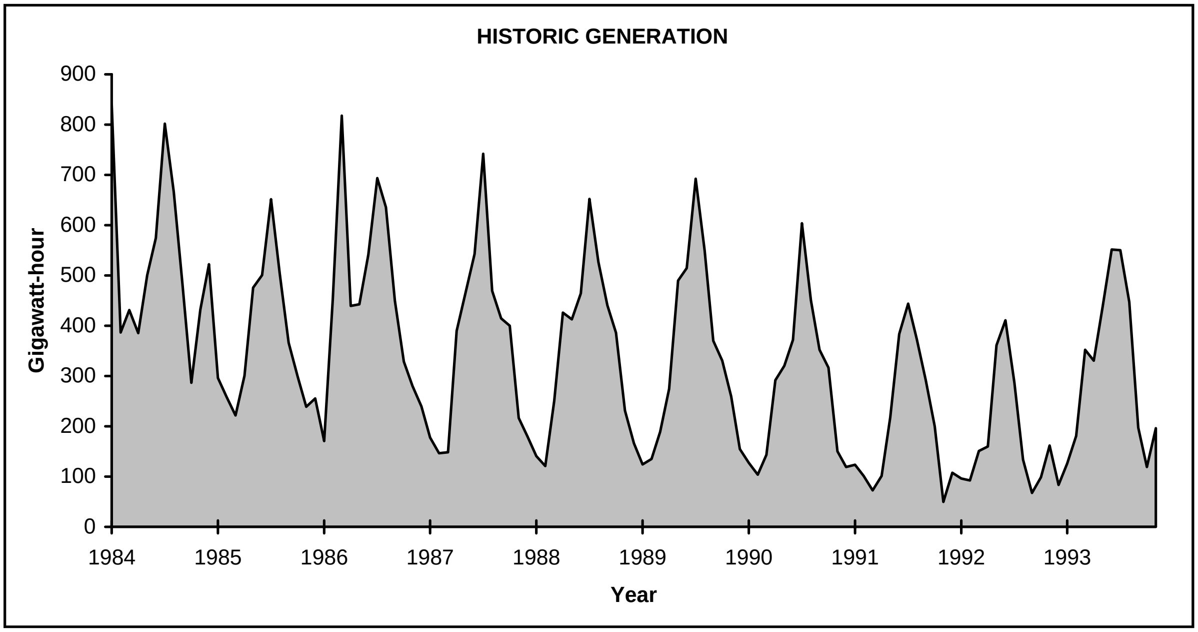
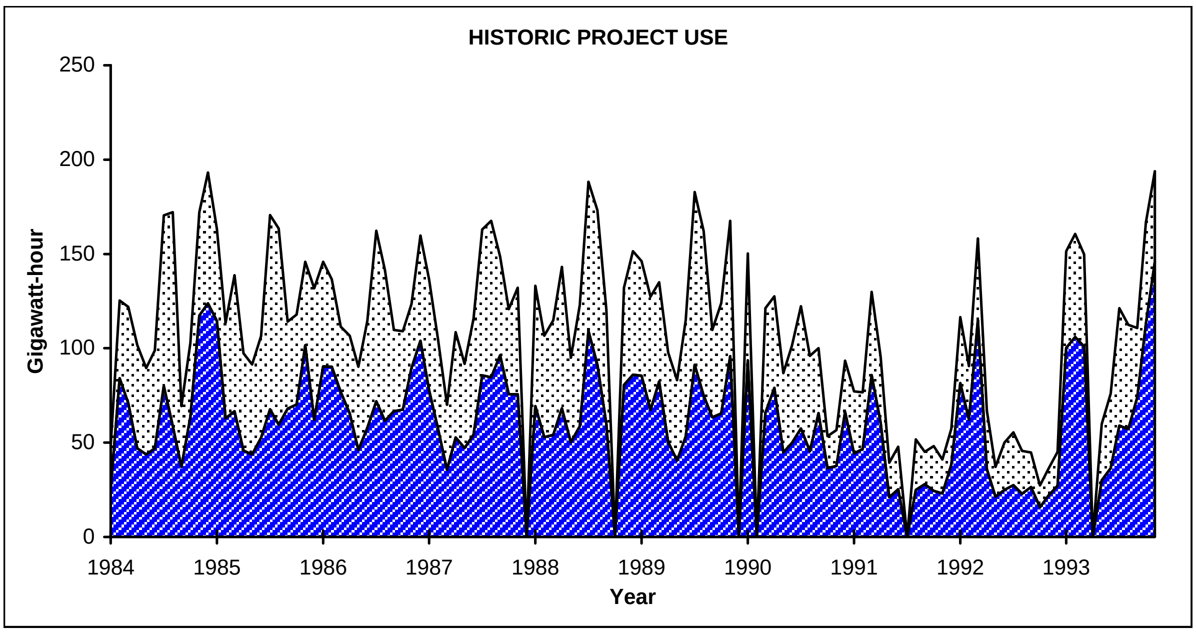


FIGURE III-17

CENTRAL VALLEY PROJECT POWER GENERATION FACILITIES AND ASSOCIATED WESTERN AREA POWER ADMINISTRATION MAJOR TRANSMISSION FACILITIES



NOTE: Includes Trinity, Shasta, American, Eastside, and West San Joaquin Divisions.



Off-Peak Portion of Total Project Use   Total Project Use

NOTE: Based on Monthly Energy Balance Sheets including San Luis Unit, Delta Division, and CVP Portion of Banks Pumping Plant.

FIGURE III-18

HISTORIC MONTHLY CVP GENERATION AND PROJECT USE

reduced. The construction of the Shasta Temperature Control Device now allows the colder water to pass through the powerplant.

Changes in CVP operations to meet water quality requirements have also impacted the monthly release patterns and resulting power generation at all CVP hydroelectric generation facilities. Historically, maximum releases from CVP facilities occurred during the summer months in periods of high irrigation water demand, which correspond to the peak power load periods in the area served by CVP generation. Recent water quality requirements have increased the need for water releases in the winter and spring months, reducing the amount of water available for release during the peak summer months. Consequently, peak generation during the summer period has been reduced and power generation in other months has been increased. Generation patterns may not coincide with power loads. Changes in power generation patterns affect coordinated operations of both PG&E and CVP facilities.

CENTRAL VALLEY PROJECT POWER CUSTOMERS

The CVP power generation facilities were initially developed based on the premise that power could be generated to meet Project Use loads. Currently, Project Use demand uses on average approximately 25 to 30 percent of the power generated by the CVP. Historic on- and off-peak Project Use summed for the major CVP pumping plants, which account for about 90 percent of total Project Use demand, is shown in Figure III-18.

The current preference power customers include 11 municipalities, 1 rural electric cooperative, 23 Federal installations, 8 State-owned installations, 10 public utility districts, 22 local water and irrigation districts, and the Bay Area Rapid Transit District.

POWER MARKETING

Hydropower generation does not always occur during times of peak loads of the CVP. Initial CVP plans included construction of fossil-fuel thermal powerplants to be located near Tracy to provide power generation in support of CVP project load. The hydropower generation with thermal generation plants were to be operated to meet CVP Project Use loads. The initial concept also included an extensive transmission grid to provide Project Use power to all CVP facilities, to provide commercial firm power to preference power customers, and to transmit power from all CVP hydropowerplants. This project was reevaluated in the late 1940s as the CVP facilities were constructed. In 1951, it was determined that it would be more cost-effective to co-utilize generation and transmission facilities constructed by PG&E wherever possible to avoid duplication of facilities.

Under the terms of Contract 2948A, the generation of CVP hydroelectric powerplants is delivered to PG&E, along with Western power purchases. In return, PG&E supports firm power deliveries to CVP Project Use needs and preference customers. Contract 2948A also includes limits on contracts for preference power customer loads to a stated maximum simultaneous peak load of 1,152,000 kW. The actual maximum contractual obligation of the power customers was calculated based upon different types of loads, timing of loads, and agreements for withdrawing power when CVP generation and Western power purchases cannot meet loads. The power accounting procedures under 2948A are based upon the assumption that all power is transmitted from the CVP generation units to the Tracy Switchyard. The power is then dispatched to the CVP preference power customers and CVP Project Use loads. Therefore, all loads and available capacity are adjusted for line losses to the "load center" at the Tracy Switchyard.

RECREATION

Recreation sites that could be affected by implementation of the CVPIA include reservoirs, rivers, and wildlife refuges located in the study area. A detailed discussion of recreation sites is provided in the Recreation Technical Appendix.

RESERVOIRS

Recreation opportunities are provided by CVP, SWP, non-CVP, and SWP reservoirs in the Trinity, Sacramento River, and San Joaquin River regions. These reservoirs, including Clair Engle Lake, Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, Millerton Lake, San Luis Reservoir, and New Melones Reservoir, provide both water-dependent and water-enhanced recreation opportunities. Water-dependent recreation at these reservoirs includes power boating, water skiing, sailing, and fishing. Water-enhanced recreation includes camping, picnicking, hiking, and sightseeing. Most of these activities occur primarily during the summer months, typically May through September. Boating and fishing are typically the most popular year-round recreation activities at the reservoirs.

Shasta Lake is the most heavily used reservoir in the Sacramento River Region with approximately 2.4 million visitor days (also known as recreational visitor days [RVDs]) in 1992, followed by Lake Oroville with 418,000 visitor days, Folsom Lake with 362,000 visitor days and Lake Natoma with 186,000 visitor days. In the San Joaquin River Region, New Melones is the most heavily used CVP reservoir, with approximately 498,000 visitor days in 1992, followed by Millerton Lake with 316,000 visitor days, and San Luis Reservoir with 210,000. However, 1992 was a dry year and is not indicative of a long-term average.

Secondary CVP and SWP reservoirs, such as Keswick, Lake Red Bluff, Thermalito Forebay and Afterbay, Lake Natoma, O'Neill Forebay, and Bethany, also provide recreation opportunities. Because of their relative small size and proximity to larger reservoirs, these reservoirs are not as heavily visited as the major CVP and SWP reservoirs.

RIVERS

Rivers below major reservoirs provide important water-dependent and water-enhanced recreation opportunities. Major rivers below CVP and SWP reservoirs are the Trinity, Sacramento, American, Feather, San Joaquin, and Stanislaus. Rivers below reservoirs operated by other agencies are the Yuba, Tuolumne, Merced, Calaveras, and Mokelumne. These rivers provide important water-dependent recreation opportunities, including fishing, power boating, rafting, kayaking, and canoeing. Most of these activities occur during summer months. Fishing is typically the most popular year-round activity.

The Sacramento River is the most heavily used river in the Sacramento River Region with use in 1992 estimated at approximately 161,000 visitor days, followed by the American River with 27,000 visitor days. In the San Joaquin River Region, the San Joaquin, Merced, Tuolumne, and Stanislaus are the most frequently visited rivers, with a combined use in 1992 of approximately 538,000 visitor days.

WILDLIFE REFUGES

Federal and State wildlife refuges located in the Sacramento River, San Joaquin River, and Tulare Lake regions provide both consumptive and non-consumptive recreation opportunities. These opportunities are typically associated with the presence of waterfowl and include hunting and observing wildlife. Other activities are fishing and picnicking. Most visitation at the refuges coincides with the presence of waterfowl.

For all activities, combined annual visitation to wildlife refuges in the Sacramento River Region in 1992 totaled approximately 103,000 visitor days. Annual visitation to wildlife refuges in the San Joaquin River Region and Tulare Lake Region in 1992 each totaled 56,000.

FISH, WILDLIFE, AND RECREATION ECONOMICS

This section describes the economic benefits and expenditures associated with recreation and fishing resources that may be affected by CVPIA. Recreational uses at reservoirs, rivers, and wildlife refuges were described in the previous section. Additional use and benefits are associated with ocean commercial and sport fishing.

SACRAMENTO RIVER REGION

In 1992, recreation use at affected reservoirs, rivers (sport fishing only), and wildlife refuges in the Sacramento River Region totaled approximately 3.6 million visitor days. Recreation and trip-related spending at these sites was an estimated $70 million, which generated $34 million in personal income and 2,250 person-years of employment within the region. Recreation benefits, as measured by the amount over actual expenditures that recreationists are willing to pay for recreation opportunities, are estimated at $38 million for 1992. The majority of the economic activity comes from recreation associated with reservoirs, such as Shasta Lake, Lake Oroville, and Folsom Lake.

SAN JOAQUIN RIVER REGION

Recreation use in 1992 at reservoirs, rivers, and wildlife refuges in the San Joaquin River Region totaled approximately 2.9 million visitor days. The resulting trip-related expenditures are estimated at $52 million, which generated $26 million in personal income and 1,720 person-years of employment within the region. Recreation benefits associated with use at important recreation areas in the San Joaquin River Region in 1992 are estimated at $33 million.

TULARE LAKE REGION

Waterfowl hunting and wildlife observation at Kern NWR in the Tulare Lake Region totaled approximately 2,700 visitor days in 1992, resulting in an estimated $76,000 in trip-related spending and $84,000 in recreation benefits.

SAN FRANCISCO BAY/SACRAMENTO-SAN JOAQUIN DELTA REGION

Based on information from 1985 (Wade et al., 1987), recreation use of the Bay-Delta Region is estimated to have been approximately 7 million visitor days in 1992. Sport fishing accounted for an estimated 205,000 visitor days, which resulted in approximately $8.9 million in annual trip-related spending. Recreation benefits associated with this sport fishing activity are estimated at $3.7 million, based on an average benefit of $18 per day.

PACIFIC COAST REGION

The salmon sport fishery affected by stocks from the Sacramento and San Joaquin rivers includes coastal areas from Monterey, California, to the Oregon-Washington border. Saltwater sport fishing for salmon in the Pacific Coast Region accounted for an estimated 293,000 visitor days of recreation in 1992. Private fishing vessels accounted for approximately 216,000 visitor days of recreation, and charter vessels accounted for the remaining 77,000 visitor days. Total use resulted in an estimated $20 million in trip-related expenditures, which generated an estimated $9.9 million in personal income and 663 person-years of employment within the region. Annual recreation benefits associated with this activity are estimated at $18.5 million, based on an average benefit of $63 per day of salmon sport fishing.

The commercial salmon fishery is managed by the PFMC, which regulates when and how fish can be harvested. The California Department of Fish and Game sold 2,970 salmon fishing vessel permits in 1992; of these, about 1,100 landed salmon. The low percentage of permitted vessels landing salmon is largely due to closure of large areas to commercial fishing during 1992 and to the general deteriorating conditions in the salmon fishery. Table III-8 summarizes commercial salmon fishing activity in 1992. Over 1.6 million pounds of salmon were landed, with an ex-vessel value of about $4.4 million. The salmon industry in the Pacific Coast Region supported an estimated 550 person-years of employment in 1992, or about 24 percent of total commercial fishing employment in the region.

NON-USE VALUES

In addition to the use-related benefits described above, many people derive benefit from knowing that the natural environment is being preserved in good health. These benefits, which can be quantified in monetary terms, are often referred to as non-use (or existence) values. Some studies show that non-use values can exceed the use-related benefits associated with an ecosystem. Because of the difficulty and effort needed to develop supportable estimates of non-use values for resources affected by CVPIA implementation, no quantitative analysis is presented in this report. However, it is recognized that the non-use values associated with enhancing the natural environments affected by CVPIA implementation are important and potentially large.

TABLE III-8

COMMERCIAL SALMON FISHING ACTIVITY IN THE PACIFIC COAST REGION IN 1992

Subregion	Fishing Effort (days fished)	Pounds of Salmon Landed (thousands)	Total Pounds Landed (millions) (1)	Ex-Vessel Value of Salmon (millions of 1992 dollars)	Total Ex-Vessel Value of All Seafood Landed (millions of 1992 dollars) (1)
North Coast	NA (2)	21.5	77.2	0.05	38.6
San Francisco	6,300	989.0	56.1	2.71	35.
Central Coast	13,500	603.0	72.1	1.64	38.7
Total	**19,800**	**1,613.5**	**205.4**	**4.40**	**113.2**

NOTES:
(1) Total pounds landed and total ex-vessel values include information on all species landed in the subregions.
(2) Data for fishing effort in the subregions were unavailable but were very small in 1992 because of closure of the Klamath Management Zone to commercial fishing.

SOURCES:
California Department of Finance, 1993; PFMC, 1993a; U.S. Bureau of the Census, 1994.

LEGEND:
NA = No information on the subregion is currently available.

REGIONAL ECONOMICS

Between 1940 and 1992, the population of California grew at a 2.9 percent compound annual rate, while that of the U.S. grew at a 1.3 percent rate (California Department of Finance, 1995). Growth in California was stimulated by such factors as the baby boom following World War II, expanded job opportunities in electronics and defense-related sectors, and climate and other quality of life considerations in California.

REGIONAL ECONOMIC BASELINE CONDITION

Base year data for the IMPLAN regional economic models were constructed for the Sacramento River, San Joaquin River, Tulare Lake, North Coast, Central Coast, San Francisco Bay, and Central and South Coast regions. The North Coast and Central Coast regions are included because of potential effects on fisheries and related economies. The San Francisco Bay and Central and South Coast regions were used only to estimate the impacts of changes in M&I water costs caused by the alternatives.

All base year data for the regional analysis are in 1991 dollars or units because these data were the most current available at the time the models were estimated for this study. Changes to overall price levels between 1991 and 1992 were modest, about 2.8 percent economy-wide. The estimates from the regional models are, therefore, considered to be representative of 1992-level impacts.

Table III-9 shows 1991 levels of economic activity by sector for the seven regions. Final demand is the value of sales exclusive of sales between industries in each region, but total industry output includes these intra-regional sales. Output is often used as an indicator of size of the regional economy. Total place of work income is the sum of employee compensation and property income. IMPLAN also estimates employment by industry.

EMPLOYMENT

Patterns of employment in the Sacramento River Region reflect the changing rural and urban complexion of the region. The share of total employment provided by production agriculture has declined substantially since 1940. Similar patterns occurred in the San Joaquin River Region and the Tulare Lake Region. While production agriculture currently provides less than 4 percent of wage and salary employment, the percentage varies widely among the counties. For example, production agriculture accounted for 33 percent of employment in Colusa County, 19 percent in Glenn County, and 16 percent in Yuba County in 1992. However, agriculture accounted for less than one percent of employment in Sacramento, Placer, and Nevada counties.

In the North Coast Region, the forestry, fishing, and agriculture sector was the largest employer in 1940. At that time, production in this sector provided 26.4 percent of total household employment in the region. By 1992, the forestry, fishing, and agriculture sector accounted for only 4.2 percent of wage and salary employment, or about 7,200 jobs. Currently, the largest proportions of wage and salary jobs in the region are in the services, wholesale and retail trade, government, and manufacturing sectors.

Employment patterns in the San Francisco Bay and South Coast regions reflect the urban economies of these regions. Agriculture, forestry, and fisheries account for a small fraction of employment. Services, trade, manufacturing, and government are the primary employers.

MUNICIPAL AND INDUSTRIAL WATER USE AND COSTS

The affected environment for M&I water use includes any M&I providers who may be affected by CVPIA alternatives. Providers are considered to be potentially affected if they receive CVP contract water, if their water is delivered or stored by CVP facilities, or if, as buyers of water, they might be affected by CVPIA water transfer provisions.

California's population is now about 30 million persons. A rapid increase in population over time has profoundly affected the use of the Central Valley land and water resource base. More people have meant greater urban water demand. Until recently, most urbanization in California occurred near the coastal cities. In the last decade, there has been a relative shift in new development from the coast to the Central Valley and inland deserts.

The affected environment for urban water use in the Sacramento River Basin is concentrated within the Sacramento Metropolitan Statistical Area (MSA, 1990 population 1,481,000), and near the City of Redding. Both of these areas include some CVP M&I contractors. Major urban

TABLE III-9

BASELINE 1991 DATA FOR REGIONAL ECONOMICS ANALYSIS

Industry	Final Demand (MM$)	Total Industry Output (MM$)	Total Place of Work Income (MM$)	Employment (Number of Jobs)
Sacramento River Region				
Agriculture, Forestry, Fishing	1,848	2,704	936	57,630
Mining	746	834	578	1,770
Construction	8,794	9,763	3,346	104,600
Manufacturing	9,547	12,130	4,745	82,200
Transportation, Comm.,	3,047	5,714	3,018	45,010
Wholesale, Retail Trade	8,269	9,822	6,438	264,940
Finance, Insurance, Real	9,276	12,260	7,920	107,620
Services	11,585	15,148	9,548	327,240
Govt. Enterprise & Special	11,677	12,822	10,752	306,250
Total	64,787	81,196	47,281	1,297,260
Population	2,671,300			
San Joaquin River Region				
Agriculture, Forestry, Fishing	5,288	7,718	2,321	150,010
Mining	1,818	2,023	1,599	1,490
Construction	4,749	5,306	1,808	58,180
Manufacturing	12,888	15,511	4,909	91,090
Transportation, Comm.,	2,204	3,936	1,887	32,600
Wholesale, Retail Trade	4,885	6,292	4,186	169,740
Finance, Insurance, Real	4,892	6,970	4,577	59,590
Services	7,082	8,784	5,432	191,010
Govt. Enterprise & Special	4,172	4,462	4,065	136,520
Total	47,979	61,003	30,784	890,220
Population	1,944,100			
Tulare Lake Region				
Agriculture, Forestry, Fishing	4,181	5,316	1,649	108,270
Mining	2,332	2,513	1,060	3,830
Construction	2,676	3,382	1,043	34,980
Manufacturing	3,800	4,767	1,544	26,600
Transportation, Comm.,	1,432	2,281	1,224	22,770
Wholesale, Retail Trade	2,287	2,910	1,941	80,700
Finance, Insurance, Real	1,948	2,713	1,788	21,590
Services	2,864	3,917	2,379	85,400
Govt. Enterprise & Special	2,819	2,962	2,649	84,570
Total	24,340	30,761	15,277	468,710
Population	994,000			
North Coast Region				
Agriculture, Forestry, Fishing	474	785	268	15,070
Mining	296	318	125	710
Construction	2,221	2,453	843	26,150
Manufacturing	3,676	4,463	1,731	34,090
Transportation, Comm.,	1,051	1,573	710	10,900
Wholesale, Retail Trade	1,975	2,396	1,567	66,990
Finance, Insurance, Real	2,379	3,118	2,020	27,980
Services	2,841	3,713	2,330	87,030
Govt. Enterprise & Special	1,395	1,489	1,358	45,610
Total	16,309	20,308	10,952	314,520
Population	636,300			

TABLE III-9. CONTINUED

Industry	Final Demand (MM$)	Total Industry Output (MM$)	Total Place of Work Income (MM$)	Employment (Number of Jobs)
Central Coast Region				
Agriculture, Forestry, Fishing	2,440	3,038	950	57,790
Mining	601	650	477	720
Construction	2,272	2,563	871	28,010
Manufacturing	4,118	4,814	1,944	32,750
Transportation, Comm., Utilities	1,682	2,275	973	15,880
Wholesale, Retail Trade	2,630	3,178	2,058	89,730
Finance, Insurance, Real Estate	2,261	3,147	2,072	27,950
Services	3,838	4,998	3,240	110,080
Govt. Enterprise & Special Ind.	2,840	3,042	2,429	82,960
Total	22,680	27,706	15,014	445,860
Population	848,600			
San Francisco Bay Region				
Agriculture, Forestry, Fishing	1,191	1,572	737	29,990
Mining	3,718	3,810	1,819	4,780
Construction	15,205	17,313	6,957	169,010
Manufacturing	67,753	81,877	35,683	449,000
Transportation, Comm., Utilities	14,297	21,422	11,137	153,780
Wholesale, Retail Trade	23,904	29,844	19,357	642,710
Finance, Insurance, Real Estate	25,561	35,289	24,187	269,060
Services	36,225	52,661	34,087	994,810
Govt. Enterprise & Special Ind.	15,537	17,045	14,323	416,410
Total	203,390	260,833	148,288	3,129,540
Population	5,007,200			
Central and South Coast Region				
Agriculture, Forestry, Fishing	4,998	6,980	2,975	143,950
Mining	6,644	7,007	2,854	12,520
Construction	46,384	53,027	19,615	550,140
Manufacturing	149,168	184,117	81,661	1,350,450
Transportation, Comm., Utilities	23,383	44,719	23,403	349,600
Wholesale, Retail Trade	66,710	82,545	51,581	1,955,030
Finance, Insurance, Real Estate	73,836	101,390	69,404	774,660
Services	102,574	148,797	93,595	2,774,150
Govt. Enterprise & Special Ind.	43,693	48,778	40,690	1,246,640
Total	517,391	677,360	385,779	9,157,150
Population	17,585,500			

centers in the San Joaquin Valley include the cities of Fresno (MSA population 515,000) Stockton (347,000), and Merced. The City of Fresno is the largest urban center in the San Joaquin Valley. CVP water users in the San Joaquin Valley include Fresno, Stockton, Coalinga, Huron, and many other relatively small users.The City of Bakersfield (MSA population 403,000) is the main urban center within the Tulare Basin, in the South San Joaquin Valley, and is also the only major M&I user of SWP water in the Central Valley.

The San Francisco/Oakland area (1990 population about 5.5 million) and Los Angeles/San Diego area (about 17 million) include two of the four largest urban areas in the United States. Both areas are largely built out, but continued population growth occurs by densification, on fringe areas and by inland expansion. The San Francisco area is potentially affected through the North

Bay and South Bay Aqueducts of the SWP and through CVP contract water deliveries through the Contra Costa Canal and the San Felipe Division of the CVP. The Central and South Coast includes areas served by the California Aqueduct of the SWP from San Luis Obispo County south through Los Angeles and San Diego County.

RETAIL WATER USE PATTERNS AND COSTS

Annual per capita use and average water bills vary greatly among providers within the affected environment. Summer and winter residential water use is similar in the northern coastal cities, reflecting climate and landscaping practices. In the Central Valley and southern coast, summer use per unit time is typically double winter use. Average annual use per residential account recently ranged from 0.17 acre-feet per year in San Francisco to 0.72 acre-feet in Sacramento. Lower use does not necessarily mean lower costs; Santa Barbara residents use almost the same amount of water per residence as San Franciscans, but they pay about three times as much for it. Commercial and industrial use are an important share of M&I use. Use patterns vary widely by region and industry.

Table III-10 shows 1990 normalized data for the M&I provider groups. Retail average cost data for a representative provider were obtained from DWR, and price data were obtained from a survey of providers. Retail average cost includes service charges, while price is the charge per unit of water only. Data on 1990 water use and water supplies were generally developed from DWR. Demand during dry periods is greater than average because there is less recharge of urban landscape soil moisture.

CVP WATER SUPPLIES

The CVP supplies M&I project water to more than 40 entities in the CVP service area. Contract deliveries ranged from 270,000 to 446,000 acre-feet and averaged 352,000 acre-feet between 1983 and 1991.Use of CVP contracts among M&I contractors varies considerably. Some municipal users have used their full contract amounts in recent years; but most are not expected to do so until sometime after the year 2000. In addition to these contract deliveries, the CVP must be operated to provide municipal water under state water rights and exchange contracts. Water rights if requested, must be given priority over any other CVP deliveries. Total demand for water under CVP M&I contracts, water rights contracts, and exchange contracts could exceed 800,000 acre-feet as early as 2010.

WATER TRANSFERS

M&I water users normally participate in water markets as buyers. In general, M&I users located in the Central Valley have not participated in water markets because supplies are sufficient, or because other available supplies are less expensive than water transfers. The coastal regions have recently participated in water markets to obtain spot supplies during the drought. The Drought Water Bank provided 307,000 acre-feet and 39,000 acre-feet for M&I use in 1991 and 1992, respectively, most through Metropolitan Water District of Southern California. Water was also purchased from Placer and Yuba counties. More recently, some M&I users have proposed more permanent transfers to meet their future needs.

TABLE III-10

1990 DATA FOR M&I PROVIDER GROUPS

Region	Retail Avg Cost $/acre-feet (1)	Retail Price $/acre-feet	Demand Served (thousand acre-feet)		CVP Contract and Water Rights and SWP Entitlement (thousand acre-feet)	Other Water Supplies (thousand acre-feet)	
			Avg.	Dry		Avg.	Dry
Sacramento River	254 to 311	0 to 205	566	613	361.7	204.8	251.4
Bay Area (2)	500 to 731	348 to 523	1,094	1,153	511.7	769.0	670.0
San Joaquin Cities	263 to 311	126 to 150	337	339	199.5	148.1	150.5
Central (3) and South Coast	461	383	3,784	3,916	2,332.7	2,499.4	2,321.2

NOTES:
(1) Includes service charges. The range provided is for subregions within the region.
(2) Includes the CVP San Felipe Service Area.
(3) Data are for South Coast only. The Central Coast Region includes providers served by the SWP coastal aqueduct, which did not deliver water in 1990.

THE DELTA AS A SOURCE OF DRINKING WATER

The Delta provides drinking water for approximately 20 million people. Consequently, the quality of its water can affect water treatment requirements and costs. A number of factors affect Delta water quality. Saline water intrudes into the Delta because of the interaction of tidal action, freshwater outflow and diversions, and atmospheric conditions. M&I treated effluent and agricultural return flows and drainage also are discharged to the Delta. Agricultural drainage is of particular concern because the peat soils of the Delta contribute organic chemicals to the agricultural drainage water. Organic chemicals contribute to the formation of trihalomethanes (THMs) during the disinfection process. By-products of the disinfection process, such as THMs, have been found to pose a threat to human health. Disinfection by-products (DBPs) have only been consistently measured since the early 1980s, as the U.S. Environmental Protection Agency (USEPA) first adopted a maximum contaminant level (MCL) for THMs in 1981 pursuant to the Safe Drinking Water Act. Delta island agricultural drainage in 1987 contributed up to 45 percent of the organic THM precursors during April to August and more than 50 percent during the winter leaching period (DWR, 1991).

Water in the Delta generally meets public water supply water quality standards identified by the USEPA and the California Department of Health Services (DHS). However, stricter Federal standards have been promulgated and are significantly more difficult and costly to meet. The standards of concern relate to DBPs and the potential requirements for more rigorous disinfection. In addition, the standard for arsenic, which is found naturally in Delta waters, is under evaluation and will be lowered. A new MCL will be proposed in January 2000.

Microbiological organisms of principal concern as agents of disease or indicators of potential contamination in drinking water include coliform bacteria, viruses, and parasites.

Under authority of the Safe Drinking Water Act (SDWA) (Public Law 99-339), originally enacted in 1974, USEPA established drinking water regulations for 22 constituents. Amendments passed by Congress in 1986 require USEPA to set standards for 83 compounds within three years, establish 25 additional standards every three years, establish criteria for filtration of surface water supplies, and enforce requirements that all public water systems provide disinfection.

In 1996, Congress re-authorized the SDWA. The amendments changed the standard-setting procedure for drinking water and established a State Revolving Loan Fund to help public water systems improve their facilities and ensure compliance with drinking water regulations. The 1996 amendments eliminated the requirement for the USEPA to establish 25 standards every three years, replacing it with a requirement to develop a list of high priority contaminants with adverse health effects. From this list, the USEPA will select five contaminants every five years and determine whether to regulate them.

MOSQUITOS

In addition to being persistent pests, mosquitos carry diseases known as arboviruses. At least 18 arboviruses of particular concern to humans exist in California (Reeves, 1990). Western Equine Encephalomyelitis and St. Louis Encephalomyelitis (both commonly known as “encephalitis”) are arboviruses of particular concern. Neither virus is usually reported unless patients develop acute symptoms; therefore, the prevalence of both viruses is significantly underreported. Mosquitos also transmit malaria (a parasitic blood disease) to humans and heartworm (a parasite) to dogs.

Encephalitis and malaria cases have been reported in all three major hydrologic regions in the Central Valley. The Tulare Lake Region has had more outbreaks of human encephalitis than either the Sacramento River or San Joaquin River regions, whereas the highest rate of malaria is reported in the Sacramento River Region.

Any environment in which water is allowed to stand in shallow, quiescent areas can serve as habitat for breeding mosquitos. These environments include wetlands, wildlife refuges, rice fields, pastures, drains, and slack water areas along streams, canals, and reservoirs.

Local mosquito control agencies have been developed to control vectors in an effort to control epidemics of human encephalitis and malaria. The mosquito abatement districts and control agencies adapt their practices in response to hydrologic conditions and the extent of areas that support appropriate breeding habitat. The three methods of mosquito control commonly used in California are water management, biological control, and chemicals.

SOCIAL CONDITIONS

SOCIAL GROUPS

Based on a review of numerous social indicators, and upon interviews with key community and economic leaders throughout the Central Valley, five social and economic groups were identified for inclusion in the Draft PEIS social analysis. The following potentially affected groups were identified: 1) farmers and ranchers who irrigate all or a portion of their lands with CVP water supplies, 2) farm workers and agribusiness workers who support agricultural production, 3) commercial fishermen and fishing businesses, 4) recreationists and recreation workers, and 5) Native American Tribes, specifically the Hoopa and Yurok tribes located in Trinity County. Each of these groups is described in more detail in this section.

Farmers

Farmers are those individuals who own land and/or manage farm operations for lands receiving CVP water supplies. They are decision-makers who must determine the crops to plant and related farm production expenditures and who could be affected by changes in agricultural water supply quantities or reliability.

Farmers rely on long-term and firm water supplies to manage farm production. Lack of stability in water supplies can affect their ability to obtain loans for farming operations, plan for future equipment needs and farm inputs (seed, fertilizer, etc.), and make decisions for long-term investments in irrigation systems and permanent crops. Many farmers have commented that supply reliability is key to making farm operating decisions and protecting farm investments, particularly investments in long-term cropping systems such as fruits, trees, and vineyards that require water in all years. Reduced irrigation supplies for long-term crops can affect crop productivity in future seasons, causing economic hardship in more than one water year or total loss of a crop.

In general, the economy of the rural communities relies on the success of farming for its livelihood. When farming conditions are good, farmers can support local community businesses. However, when farming conditions are poor, local communities also can suffer economic losses due to lack of expenditures from farmers. Farmers would like to see increased water supply reliability so that they can plan for long-term production goals, obtain funding, and maintain a trained work force.

Farm Workers and Agribusiness Workers

Farm workers and agribusiness workers are those individuals indirectly involved in farm production. Farm workers are hired by managers to assist with planting, irrigation, thinning, pruning, harvesting, and sorting and packing of crops. These workers may be hired on a seasonal basis or may be permanent farm employees. Generally, farm labor demands are greatest for fruit and vegetable crops that require more intensive farm management. Crops such as grains, cotton, sugar beets, pasture, and alfalfa have low farm labor demands.

Agribusiness workers are those individuals who own, operate, or are employed by businesses that provide production supplies such as seed, fertilizer, and pesticides; supply equipment and repair service; or serve as markets for farm products including packing and processing plants. Farm workers and agribusiness workers could be indirectly affected by changes in water supplies and farm production. In addition, these individuals are further removed from control of the production process and must rely on information gathered from farmers and ranchers to determine needs for services and products.

Lack of stability in CVP supplies can directly affect farm production, including acres planted and types of crops produced, and the need for farm labor. Similarly, changes in water supplies and cropping patterns will affect the need for farm supplies, equipment and repair needs, and packaging and processing needs. In recent years, the Central Valley has experienced losses of olive and melon packing plants, tomato processors, and cotton gins as plants have been consolidated, moved to other regions, or gone out of business. Many seasonal workers can face economic hardship due to lack of work when farming conditions are poor and farmers plant fewer acres or change to less labor-intensive crops. Farm workers and agribusiness workers would like to see farmers receive reliable water supplies so that they could have job assurance and a steady income as well as plan for farm production needs, including seed, fertilizer, equipment, and sale of other necessary inputs.

Commercial Fishermen and Fishing Businesses

Commercial fishermen and fishing businesses rely on fishing for their income. Businesses that support commercial fishing include boat sales and repair, fuel and service, fishing equipment sales, and fish packing and processing plants. Commercial fishermen and fishing businesses are located along the California coast extending from San Luis Obispo to the Oregon border, but are concentrated along the northern coastal towns. Changes in water supplies in inland streams and rivers can affect water quality, temperature, or quantities in streams where fish migrate and spawn. The resulting changes in fish abundance directly affect the quantity of fish available for ocean commercial and sport harvest, and thus directly affect the livelihood of fishermen and supporting businesses.

The fishing industry expanded in the 1980s, but has since declined with numerous businesses and processing plants closing because of declines in fish harvest numbers, particularly salmon.

Income for commercial fishermen has decreased while costs have continued to rise with increased regulation of the fishing industry, including increased safety requirements for fishing boats and crew members. Reduced harvest numbers and shortened season limitations have further impacted both the commercial and sport fishing industry.

With declining incomes and increasingly costly safety regulations, fishermen are less able to hire help for their boats and must fish longer periods and at distances farther from shore. Long-time fishermen were concerned with recent changes in the industry affecting their ability to maintain and sell their boats. The fishermen have put a substantial investment in the boats and often cannot sell the boats for their full value because of reduced interest in fishing. Many fishermen indicated that they no longer wished for their children to learn the fishing trade, because it is becoming increasingly more difficult and dangerous to make a living fishing for salmon.

Commercial fishermen would like to see more water dedicated to fishery resource needs. They would like to see reduced Delta exports that they feel jeopardize fish migration and would like to reverse some of the losses in spawning and rearing areas that have contributed to an overall decrease in anadromous fish populations. The fishermen are not opposed to all water exports or to farming, but would like to see greater equity in the allocation of limited water resources. For example, fishermen believe that during drought conditions, water diversions are maintained to the maximum extent possible, resulting in an unfair balance in favor of farming rather than fishing.

Recreationists and Recreation Workers

Recreationists are boaters, sport fishermen, hunters, and bird watchers who use reservoirs, rivers and streams, and wildlife refuges that store, convey, or use CVP water supplies. Sport fishing also occurs along the coastal area, and individuals engaged in sport fishing on the coast are included in the recreationists group. Recreation workers are those persons employed by service industries such as river guides, marina operators, boat repair businesses, and recreation supply businesses that provide gear and equipment for hunters, boaters, and fishermen. Members of this group generally are located in Central Valley towns near CVP facilities, wildlife refuges, and rivers, and in coastal fishing communities.

Recreation in CVP reservoirs can be affected by seasonal variations in reservoir levels. During recent drought conditions when reservoir levels dropped significantly, marinas often had to relocate facilities or were unable to use facilities. Operators of reservoir recreation businesses also commented that business can drop substantially when reservoir levels are low because of increased boating hazards created by reduced lake area and exposed hazards, as well as loss of scenic values. Sport fishing also has declined as fish numbers have dropped, resulting in decreased needs for river guides and fishing supplies in inland and coastal areas. These businesses have had to reduce staff in recent water-short years. Staff reductions can have a substantial effect on the local community, particularly reservoir and coastal communities whose economies are centered around activities related to fishing and boating.

Recreationists would like to see more water dedicated to recreation uses. Marina owners at CVP reservoirs would like to have reservoir levels maintained at higher levels during critical vacation times. Recreationists and recreation workers recognize that these interests often conflict with water needs of downstream urban and irrigation users.

Native American Tribes

Two Native American tribes were selected for the social analysis: the Hoopa Valley Tribe and Yurok Tribe, both located in Trinity County. These tribes rely on Trinity River water supplies and fishery for subsistence living and ceremonial uses, and have therefore been directly affected by management of the CVP. Declines in fishery numbers, primarily salmon, combined with effects of declines in the timber industry, have had an impact on the tribal economies, resulting in changes in tribal community interaction.

Changes or diversion of Trinity River flows could affect the lifestyle of these individuals. Poverty and unemployment rates for tribal members living on the Hoopa and Yurok reservations are high. Declines in fishery resources can affect the ability of tribal members to provide for their families at a subsistence level, affect the ability of a tribe to perform important tribal ceremonies, and generally affect the communities' ability to provide for trade between tribal members and with other tribes for services and other supplies.

The Hoopa and Yurok tribes would like to see greater flows maintained in the Trinity River. If less water were diverted to the Sacramento Valley, instream flows would be greater and could contribute to an increase in the salmon fishery and other fisheries necessary for subsistence living and ceremonial uses, such as the Boat Dance in the fall.

SOCIAL INDICATORS

Social indicators selected for analysis include unemployment, housing costs, and the need for and ability of communities to provide social service support programs. Unemployment in Central Valley rural areas, particularly the San Joaquin Valley, is higher than in urban areas such as San Francisco, Sacramento, Fresno, and Los Angeles. This is attributable to the large seasonal labor markets in these areas and the limited availability of other employment opportunities. Urban areas generally have more opportunity to absorb displaced workers, whereas employment in rural areas is centered around farming. If a farming economy declines, available employment opportunities also decline.

Literature available for rural areas generally is limited to the San Joaquin Valley and, therefore, the environmental analysis drew heavily from these resources. Seasonal unemployment in some communities, such as Mendota, is very high, approaching 40 percent at times. The average unemployment rate for Fresno County ranged from 10 to 14.5 percent between 1988 and 1992. The high level of seasonal unemployment in Mendota may be attributable to the limits of agricultural production. A study by the Giannini Foundation indicated that, in 1982-1983, the average farm worker was able to work only 23 weeks (less than half of the year). The lack of available work results in low income and the need for supplemental incomes during periods of unemployment. The study also indicated that the workers would like to work more but work was not available. The study further states that jobs such as harvesting have a span of 10 to 15 years and are not a career. This could lead to workers leaving the work force or continuing to work at jobs that are less demanding, but also pay less.

Studies of the western San Joaquin Valley support a finding that increases in population have led to greater total revenues for the region. However, these revenues are supported by a larger population and actually reflect a lower per capita income. Per capita income in the San Joaquin Valley decreased in Fresno, Madera, Kings, and Merced counties between 1980 and 1990. During the same time frame, income in Stanislaus and San Joaquin counties increased slightly, possibly because of their proximity to the San Francisco Bay Area. Per capita income in Fresno County for 1990 was $15,346 while per capita income for the City of Mendota was substantially less at $4,920. Although revenues for the region have increased, expenditures to provide social support services to a poorer population also have increased.

The need for social services in areas of high unemployment is greater than in other areas. Higher levels of unemployment in the western San Joaquin Valley can be attributed to several factors, including a work force with limited skills, lack of formal education, and in need of training in English as a second language. Although the work force is very skilled in farm labor operations such as pruning, sorting, packing, and irrigation technology, these skills do not readily transfer to other labor markets. Therefore the demand for workers with these skills is limited and training programs will be necessary to bring new employment opportunities to these individuals (Applied Development Economics, Inc. 1994). It is assumed that similar conditions exist in the Sacramento Valley, but to a lesser extent because fewer acres are dedicated to crops with intensive labor requirements. Data to support this assumption are lacking.

Housing costs and rental costs were compared for several counties in the Central Valley (Butte, Colusa, Fresno, Merced, Sacramento, San Joaquin, Shasta, and Stanislaus counties) and for Mendocino County along the coast. Median housing costs for all areas increased substantially from 1980 to 1990, ranging from 26 percent in Fresno County to 55 percent in San Joaquin County. Fresno County has a large rural housing base that may have held down median housing costs, while San Joaquin County may have had larger increases in housing costs because of its proximity to the San Francisco Bay Area. Housing costs for rural counties increased less than for urbanized counties. Housing costs increased 43 percent from 1980 levels in Mendocino County. While housing costs were reflective of regional influences, increases in median rental costs increased at a relatively similar rate for all counties from 1980 to 1990. Increases in rental costs ranged from a low of 45 percent in Shasta County to a high of 55 percent in San Joaquin County. On average, rental costs increased by 47 percent for the ten-year period, a substantially higher rate of increase than that in housing costs. This finding is significant, particularly in areas with large seasonal employment or where a larger percentage of the population is unable to purchase a home. The increases indicated that a larger percentage of income is required for housing, leaving less money available for savings or other expenses such as transportation, health care, food, clothing, or education.

Several studies have focused on San Joaquin Valley agriculture and the response of agriculture to reductions in water supply. These studies have used data collected during drought conditions from 1987 to 1992, excluding 1990. One study, *The Impact of Water Supply Reductions on San Joaquin Valley Agriculture*, generally referred to as the Rand Study December 1994, indicated that there was little change in agricultural employment and crop revenue in Fresno County during this period.

The Rand Study found that agricultural revenues decreased by approximately 7 percent during the drought. It was recognized that greater reductions were likely offset by changes to higher value vegetable crops and potentially due to improvements in irrigation efficiency. The study also indicated that farmers may have been able to conserve water without substantial hardship or the need to implement drastic cropping or land use changes. However, the study cautioned that long-term reductions in the water supply could also force farmers to adjust to temporary reductions and may lead to greater changes in response to drought periods. This could lead to reductions in farm labor needs, expenditures, and revenues, which could affect the ability of a community to provide essential services.

CULTURAL RESOURCES

PREHISTORIC RESOURCES

The PEIS study area has a long and complex cultural history with distinct regional patterns that extend back more than 11,000 years before present (B.P.) time. The first generally agreed on evidence for the presence of prehistoric peoples in the study area is represented by the distinctive fluted spear points called "Clovis" points, found on the margins of extinct lakes in the San Joaquin Valley. Based on information obtained from sites outside the CVPIA study area, the ancient hunters who used these spear points existed only between 11,200 B.P. and 10,900 B.P. This span of time is often called the Clovis Period. Most researchers believe the Clovis Period was followed by another widespread complex, although the indicative artifacts consist of stemmed spear points rather than the fluted points that typify the Clovis Period. This poorly defined early cultural tradition is best known from a small number of sites in the San Joaquin Valley and the Sierra Nevada foothills and is thought to date 8,000 to 10,000 B.P.

Approximately 8,000 years ago, many California cultures shifted the main focus of their subsistence strategies from hunting to seed gathering, as evidenced by the increase in food-grinding implements found in archeological sites dating to this period. Recent studies suggest that this cultural pattern is more widespread than originally described and is, in fact, found throughout the study area. Radiocarbon dates associated with this time period vary between 8,000 and 2,000 B.P., but cluster in the 6,000 to 4,000 B.P. range (Basgall and True, 1985).

Cultural patterns, as reflected in the archeological record and, particularly, specialized subsistence practices, became better defined within the last 3,000 years. The archeological record becomes more complex as specialized adaptations to locally available resources were developed and populations expanded. Many sites dated to this time period contain mortars and pestles or are associated with bedrock mortars, implying that the occupants exploited acorns intensively. The range of subsistence resources increased and exchange systems expanded significantly from the previous period. Along the coast and in the Central Valley, archeological evidence of social stratification and craft specialization is indicated by well-made artifacts, such as charmstones and beads, which were often found with burials.

Of the various types of prehistoric sites that may be affected by the CVPIA alternatives, habitation sites, especially those sites containing midden soils, are most susceptible to damage. Soils containing middens tend to be loose and easily eroded by wave action or the movement of water across a site. Midden soils often retain identifiable remnants of faunal material (e.g., bone or shell), possibly human burials, and occasionally perishable artifacts (e.g., basketry remains) that, if exposed, would deteriorate due to wet/dry cycling. Generally the scientific value of habitation sites lies in the information on prehistoric life ways that can be extracted. Any activity that moves, removes, or destroys aspects of a site will compromise that information. Habitation sites are highly susceptible to intentional vandalism by artifact collectors and unintentional damage by off-highway vehicle (OHV) users.

Lithic scatters, strictly defined as those sites that contain only material manufactured from stone, constitute another site type commonly found in the study area. The greatest danger to these sites is from artifact collection. Further, erosional forces could remove artifacts from a site, and the submersion of obsidian artifacts could prevent the proper dating of objects by hydration-dating techniques.

Rock art sites containing petroglyphs, pictographs, and intaglios (artistic alignments of rocks) can be extremely vulnerable to changes in water level. Sites that may have been previously submerged under reservoirs and are exposed during drawdowns may suffer from wet/dry cycling, erosion due to wave action, and vandalism.

Bedrock mortars (used for grinding vegetal materials) are the prehistoric resource type least susceptible to damage through hydrologic mechanisms. However, midden, often associated with bedrock mortars, would be vulnerable to hydrologic impacts.

HISTORIC RESOURCES

Historic resources (including archeological resources, structures, and buildings) within the study area include sites associated with early historic settlement, mining (hardrock and placer), agriculture (farming and ranching), transportation (railroads and roads), oil exploration, and logging.

Historic structures (including buildings, windmills, mining winches, and bridges) or their remains are highly susceptible to water level changes. The exposure of structures in reservoirs previously covered by inundation could subject them to erosion (especially if they are in a wave zone), wet/dry cycling, and vandalism.

Wooden portions of ditches and flumes (often associated with agriculture, mining, and logging) are highly susceptible to wet/dry cycling and erosion. Earthen ditches are affected principally by water level changes, especially wave action.

Debris scatters, which can be found within any type of historic site, are extremely vulnerable to water level changes. Erosion can completely remove a debris scatter, and wet/dry cycling can accelerate the decomposition of metal, wood, and leather artifacts. Debris scatter exposed by receding waters is very susceptible to vandalism.

Historic stone resources such as tailings piles (remnants from mining), and rock walls (often associated with ranching) are less prone to water damage unless these resources are left in a wave zone by changing water levels.

Table III-11 shows the number of historic-period resources in the PEIS study area that are listed in the National Register of Historic Places, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Interest.

TABLE III-11

HISTORIC RESOURCES IN THE PEIS STUDY AREA

Region	Properties in the National Register of Historic Places	California Historic Landmarks	California Inventory of Historic Resources	California Points of Historical Interest
Sacramento River	294	224	452	196
San Joaquin River	156	111	255	50
Tulare Lake	44	36	49	6
North Coast	139	56	115	17
Central Coast	10	5	6	2
San Francisco Bay	407	176	724	156

ETHNOGRAPHY

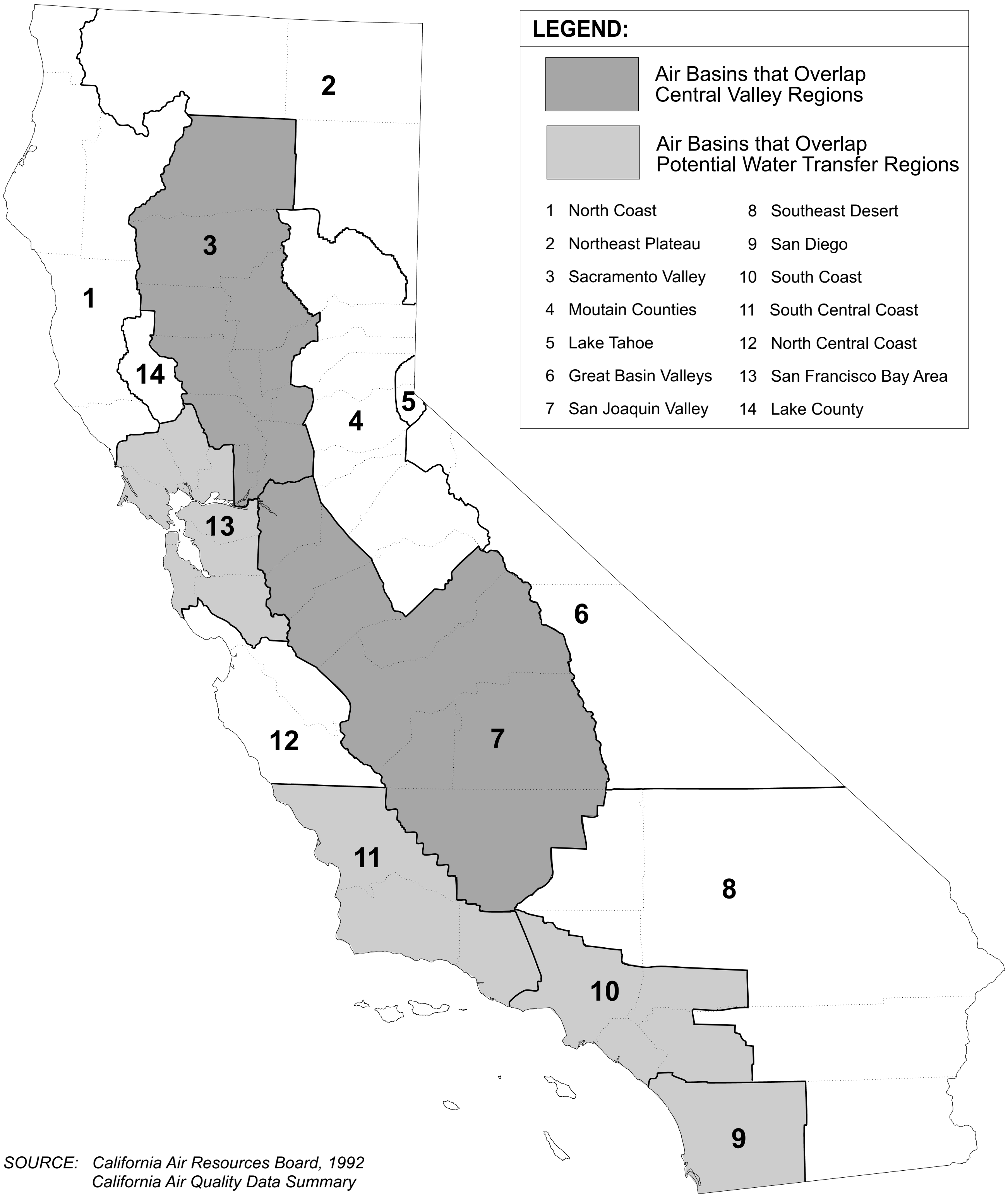
The study area encompasses lands occupied by more than 40 distinct Native American cultural groups. Although most California tribes shared similar elements of social organization and material culture, linguistic affiliation and territorial boundaries primarily distinguish them from each other. Prior to European settlement of California, an estimated 310,000 native Californians spoke dialects of as many as 80 mutually unintelligible languages representing six major North American stocks (Cook, 1976, 1978; Shipley, 1978).

All native Californians followed a basic hunter-gatherer lifestyle, subsisting through a seasonal round of plant collecting, hunting, and fishing. Then, as now, the environment was bountiful and the products of the various regions, such as shore, mountain, and desert, were often widely traded. Reliance on particular resources varied with location and season. Archeological evidence indicates a general evolution over time from subsistence strategies that were based primarily on hunting large game to a broad-based economy that placed greater emphasis on diversity.

AIR QUALITY

The California Air Resources Board (ARB)-designated air basins are distinct regions within the state of California that consist of similar meteorological and topographical conditions (California ARB, 1975). The following air basins, shown in Figure III-19, generally correspond to the Draft PEIS study area regions in the Central Valley.

Sacramento River Region:
- Sacramento Valley Air Basin
- San Francisco Bay Area Air Basin
- Mountain Counties Air Basin



SOURCE: California Air Resources Board, 1992 California Air Quality Data Summary

FIGURE III-19

CALIFORNIA AIR BASINS

San Joaquin River Region:
San Joaquin Valley Air Basin
Mountain Counties Air Basin

Tulare Lake Region:
San Joaquin Valley Air Basin

Most of the air pollutants in the study area may be associated with either urban or agricultural land uses. Pollutants commonly associated with agricultural land uses include particulate matter (PM) less than 10 microns (PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_X), and ozone (O_3) precursors. No clear relationship exists between agricultural acres and the occurrence or resulting concentrations of O_3 and PM_{10} in the atmosphere. Several variables other than land uses can affect air quality conditions, and these variables may change over time.

The air quality of the Northern Sacramento Valley Air Basin is currently designated as nonattainment with respect to national and State O_3 and PM_{10} standards. The Chico urban area is designated as nonattainment for national and State CO standards (California ARB, 1996). The air quality of the Southern Sacramento Valley Air Basin is designated as nonattainment with respect to national and State O_3 standards. Sacramento County is designated as nonattainment with respect to both national and State PM_{10} standards; whereas Placer, Solano, and Yolo counties are nonattainment with respect to the state PM_{10} standards only (California ARB, 1996).

The San Joaquin Valley Air Basin is designated as nonattainment with respect to the national and State O_3 and PM_{10} standards, and the urban areas of Fresno, Modesto, and Stockton are designated as nonattainment for national and State CO standards.

The Mountain Counties Air Basin is directly affected by the upward currents (east-northeasterly and southerly) from the Sacramento Valley and Bay Area air basins (ARB, 1984). The transport contribution from these regions is significant, as upwind air basins have independently caused exceedences of the State O_3 standard in the Mountain Counties Air Basin.

SOILS

The soils of the Central Valley are divided into four physiographic groups: valley land soils, valley basin soils, terrace soils, and upland soils. As shown in Figure III-20, valley land and valley basin land soils occupy most of the floor of the Central Valley. Valley land soils consist of deep alluvial and aeolian soils that make up some of the best agricultural land in the State. Areas above the Central Valley floor consist of terrace and upland soils. Overall, these soils are not as productive as the valley land and valley basin land soils. Without irrigation, terrace and upland soils are primarily used for grazing and timberland; with irrigation, additional crops can be grown.

Drainage and soil salinity problems have persisted in the San Joaquin Valley. A 1984 study (Backlund and Hoppes) estimated that about 2.4 million of the 7.5 million acres of irrigated cropland in the Central Valley were salt-affected. These saline soils generally exist in the valley trough and along the edges on both sides of the San Joaquin Valley. By the year 2000, it is

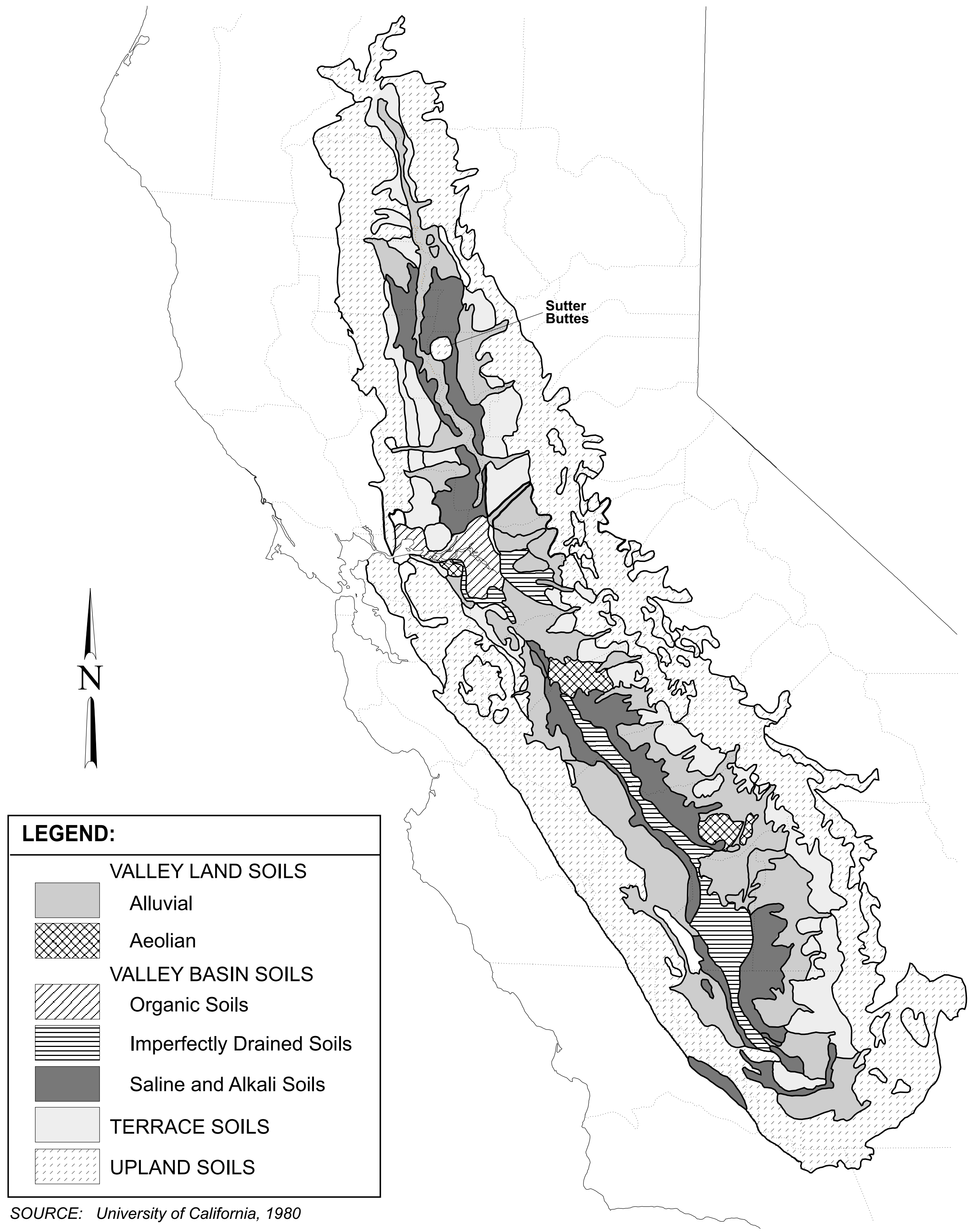


FIGURE III-20

SOIL TYPES IN THE CENTRAL VALLEY

projected that up to 918,000 acres of farmland in the San Joaquin Valley will be affected by a high water table existing less than 5 feet from the ground surface (1990 San Joaquin Valley Drainage Program Management Plan). In addition to drainage, problems associated with upstream aggregate mining have been identified, and have historically occurred in the Central Valley with the accumulation of metals (particularly selenium) that have been leached from natural deposits through the application of irrigation water.

Soil selenium is primarily a concern on the west side of the San Joaquin Valley. When the soils in this area are irrigated, selenium, other salts, and trace elements dissolve and leach into the shallow groundwater. Soils derived from the Sierra Nevada on the east side of the valley are less salty and contain much less selenium. Over the past 30 to 40 years of irrigation, soluble selenium has been leached from the soils into shallow groundwater.

In areas with high selenium concentrations, selenium leached from the soils enters the return flows and subsurface drainage flows. Irrigation of these soils mobilizes selenium, facilitating its movement into shallow groundwater that is retained in poorly drained soils or mechanically drained soils. In the absence of adequate drainage facilities, leaching cannot fully remove the salts from these soils because water cannot percolate beyond a clay lens under the shallow groundwater aquifer. To maintain agricultural production, drainage from these soils must be removed from the area. Reclamation has initiated the San Joaquin Basin Drainage Program to reduce the drainage problem.

Aggregate removal, or mining, occurs within many streams in the western foothills of the Sierra Nevada, along the coastal streams, and in the coastal dunes. In addition, unconsolidated gravels and slates are mined in the lower Sierra Nevada foothills. Problems commonly associated with instream gravel mining include increased sediments in the river and the removal of soils with nutrients and vegetation.

VISUAL RESOURCES

The visual landscape of the Sacramento River and San Joaquin River regions has changed considerably since before World War II. In the 1940s, the valley was largely open grasslands with scattered expanses of oak woodland. Wetlands, vernal pools, and riparian corridors added visual variety to the landscape. Settlement was sparse, with small communities located primarily along the rivers and scattered rural ranches. A significantly smaller area of the landscape was irrigated, and few of the rivers were regulated. Much of the view opportunity was limited to the road and railroad corridors.

After the population influx following World War II, rapid agricultural development and the growth of communities changed the visual landscape substantially and relatively quickly. Much of the grassland was replaced by irrigated cropland, rice fields, and orchards. Most of the wetlands, vernal pools, and riparian corridors were eliminated.

Construction of dams and reservoirs substantially altered the visual character of valleys in which reservoirs were constructed. The reservoirs added visual variety, because large water bodies are widely perceived as features of high visual interest, but changed the visual character provided by free-flowing streams. CVP canals also added visual variety to the landscape by their form and water feature qualities.

The Delta landscape once consisted of a vast system of wetlands and river channels. The construction of levees, beginning in the 1850s, dramatically changed the visual. The establishment of settlements in the Delta began in the mid-1800s. Continued urban growth has substantially altered the visual aspect of the Delta margins.

Wild and Scenic Rivers or designated river segments located within the PEIS study area include at least portions of the Klamath, the Trinity, the North Fork American, the Tuolumne, the Merced, and the Lower American rivers, as well as various tributaries.

Scenic highways are roads designated as scenic by the State of California or local agencies and are recognized as having exceptional scenic qualities or affording panoramic vistas. Officially designated State Scenic Highways (Caltrans, 1992), including State routes and interstates within the study area, include SR 151 immediately downstream of Lake Shasta; SR 160 in Sacramento County between the southern county line and I-5; I-5 between I-205 (San Joaquin County) and just south of SR 152 in Merced County (includes views of the Delta-Mendota Canal); and SR 152 from I-5 to the Madera County line (passes San Luis Reservoir).

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES

Chapter IV

ENVIRONMENTAL CONSEQUENCES

This chapter summarizes environmental consequences associated with the alternatives considered in the PEIS for the issue areas described under Affected Environment. As described in Chapter II, the alternatives are based on specific assumptions for multiple implementation methods addressing CVP water system operations, CVP water pricing, and fish and wildlife habitat improvements as compared to the No-Action Alternative. The Supplemental Analyses evaluate the differences between general assumptions for less defined implementation methods. The Supplemental Analyses are compared to Alternatives 1, 2, 3, or 4. Six of the Supplemental Analyses evaluate water transfer opportunities under CVPIA provisions.

The first section of this chapter presents the impact assessments for Alternatives 1, 2, 3, 4 and for 15 Supplemental Analyses as described in the Draft PEIS. The second section, beginning on page 244, presents the impact assessment for the Preferred Alternative as compared to the Revised No-Action Alternative. Tables at the beginning of the major issue area sections present a summary of the assumptions and results of the impact assessment for all the alternatives and Supplemental Analyses. For a discussion of the relative effects of the Revised No-Action Alternative and Revised Alternative 1 as compared to the No-Action and Alternative 1 presented in the Draft PEIS, see the Supplement to the Draft PEIS.

The assessment of environmental consequences for many of the resources evaluated in the PEIS was supported with the use of computer-based analytical tools. Prior to the evaluation of alternatives, a set of analytical tools was selected through a screening process. Over 200 analytical tools were reviewed to identify a set of tools that would generally provide similar geographic coverage and level of analytical detail to support the programmatic analysis required for the PEIS. The analytical tool or tools used and associated analytical methodology are described for each issue area. Environmental consequences associated with each of the alternatives considered in the PEIS are described for the following resources and issues:

- Surface Water Supplies and Facilities Operations
- Groundwater
- Fishery Resources
- Agricultural Land Use and Economics
- Municipal and Industrial Land Use and Demographics
- Vegetation and Wildlife Resources
- Central Valley Project Power Resources
- Recreation
- Fish, Wildlife, and Recreation Economics
- Regional Economics
- Municipal and Industrial Water Use and Costs
- The Delta as a Source of Drinking Water
- Mosquitos
- Social Conditions

- Cultural Resources
- Indian Trust Assets
- Air Quality
- Soils
- Visual Resources

SURFACE WATER SUPPLIES AND FACILITIES OPERATIONS

This section summarizes potential changes to the operation of CVP facilities, river flow regimes, and CVP water supply deliveries that would result from the implementation of the alternatives considered in the PEIS. The PEIS alternatives include a range of component CVPIA actions that would affect facility and river operations, as well as the availability of water supplies to CVP water users. These component CVPIA actions include the dedication of CVP water supplies to improve anadromous fish habitat, the delivery of firm Level 2 refuge water supplies, and releases from Lewiston Dam to provide increased instream Trinity River flows, as discussed in Attachment G. Additional actions include the retirement of land pursuant to the San Joaquin Valley Drainage Plan, and the acquisition of water from willing sellers for delivery to wildlife refuges, increased instream flows, and increased Delta outflow. A summary of the assumptions associated with each of the alternatives and Supplemental Analyses for the surface water analyses is presented in Table IV-1.

The analysis focuses primarily on the reoperation of surface water supply facilities, and describes changes in reservoir storage conditions, reservoir releases, resulting downstream river flows, deliveries of surface water pursuant to CVP and SWP contracts, and water acquisition quantities. A summary of the surface water impact assessment for the alternatives and Supplemental Analyses is presented in Table IV-2.

IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology used to support the analysis presented in this chapter is based on the use of surface water, groundwater, and agricultural economics computer model analyses. Model simulations were conducted at a planning level, in accordance with the programmatic nature of the overall PEIS analysis. The Project Simulation Model (PROSIM) and the San Joaquin Area Simulation Model (SANJASM) were used to evaluate the potential to re-operate system reservoirs to attempt to meet CVPIA objectives, and assess the resulting impacts to CVP water supply deliveries.

The model simulations for the PEIS analyses were conducted using the historical hydrology for the period 1922 through 1990, adjusted to be representative of a projected 2022 level of development. The projected land-use conditions were based on information developed for DWR Draft Bulletin 160-93 (DWR, 1993) and are assumed to be fixed over the simulation period. The historical hydrology during the 1922 through 1990 period is considered to be representative of the range of hydrologic conditions that may be expected under future CVP operations.

TABLE IV-1

SUMMARY OF ASSUMPTIONS FOR SURFACE WATER SUPPLIES AND FACILITIES OPERATIONS

Assumptions Common to All Alternatives or Supplemental Analyses	
Projected 2020 level water demands based on water rights, CVP contract amounts with limitations due to environmental documentation, and DWR Bulletin 160-93 projections, as described in Chapter II. Continued CVP operations under CVP-Operations Criteria and Plan, October 1992. Continued CVP and SWP operations under Bay-Delta Plan Accord, SWRCB D-1422, and Winter-Run Chinook Salmon, and Delta Smelt Biological Opinions as amended in 1995. Shasta Temperature Control Device in operation. SWP operations per Monterey Agreement.	
Alternative or Supplemental Analysis	**Assumptions Specific to the Alternative or Supplemental Analysis**
No-Action Alternative	Common assumptions only.
1	No-Action Alternative assumptions plus: Implementation of reoperation and (b)(2) Water Management for Bay-Delta Plan Accord component and additional operations on Sacramento River, American River, Stanislaus River, and Clear Creek. Water accounting for (b)(2) water use based on changes in deliveries to CVP Water Service Contractors. Firm Level 2 refuge supplies per 1989 Refuge Water Supply Study. Includes a 25 percent shortage per the Shasta Index. Improve flows for passage on spring-run streams and major Sacramento River tributaries Increased Trinity River instream fishery flows.
1a	Same as Alternative 1 plus: Implementation of preliminary (b)(2) Water Management actions in the Delta in addition to Bay-Delta Plan Accord.
1b	Same as Alternative 1 plus: Operation of fish barrier at head of Old River and on Georgiana Slough.
1c	Same as Alternative 1 plus: Several scenarios considered for use of CVP water not delivered.
1d	Same as Alternative 1 plus: Delivery of full Level 2 refuge water supplies in all years without shortage.

TABLE IV-1. CONTINUED

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
1e	Same as Alternative 1 plus: Transfer opportunities limited by available facilities capacity. Transfer of consumptive use or irrecoverable loss only.
1f	Same as Supplemental Analysis 1e.
1g	Same as Alternative 1.
1h	Same as Alternative 1.
1i	Same as Alternative 1 plus: Operation of Red Bluff Diversion Dam gates has no impact on ability to divert water into Tehama Colusa Canal.
2	Same as Alternative 1 plus: Acquire Level 4 refuge water supplies. Acquire up to 170,000 af/yr (total) on Stanislaus, Tuolumne, and Merced rivers, for instream and Delta fishery needs. Acquired water may not be exported from Delta. Acquire undetermined amounts of water on Sacramento River tributaries that support spring-run chinook salmon.
2a	Same as Alternative 2 plus: Operation of fish barriers at the head of the Old River and on Georgiana Slough.
2b	Same as Alternative 2 plus: Transfer opportunities limited by available facilities capacity. Transfer of consumptive use or irrecoverable loss only.
2c	Same as Supplemental Analyses 2b.
2d	Same as Alternative 2.
3	Same as Alternative 1 plus: Acquire Level 4 refuge water supplies. Acquire up to 800,000 af/yr (total) on Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers for instream fishery needs. Acquired water may be exported from Delta if other conditions allow. Acquire undetermined amounts of water on Sacramento River tributaries that support spring-run chinook salmon.
3a	Same as Alternative 3 plus: Transfer opportunities limited by available facilities capacity. Transfer of consumptive use or irrecoverable loss only.

TABLE IV-1. CONTINUED

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
4	Same as Alternative 1 plus: Implement (b)(2) Water Management actions in the Delta in addition to Bay-Delta Plan Accord. Acquire Level 4 refuge water supplies. Acquire up to 800,000 af/yr (total) on Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers for instream and Delta fishery needs. Acquired water may not be exported by Delta pumping facilities. Acquire undetermined amounts of water on Sacramento River tributaries that support spring-run chinook salmon.
4a	Same as Alternative 4 plus: Transfer opportunities limited by available facilities capacity. Transfer of consumptive use or irrecoverable loss only.
Revised No-Action Alternative	Common Assumptions only.
Preferred Alternative	Same as Alternative 1 plus: Implement (b)(2) Water Management actions in the Delta in addition to Bay-Delta Plan Accord. Acquire Level 4 refuge water supplies. Acquire up to 140,000 af/yr on Stanislaus, Tuolumne, and Merced Rivers and on tributary creeks of the upper Sacramento River to improve instream and Delta inflows in accordance with the November 1997 Administrative Paper. A portion of the acquired water would be managed for increased flows through the Delta. The remaining portion of the acquired water could be exported.

The models are based on a monthly time step and use general operations criteria representative of CVP operations. The simulations do not take into account daily or weekly changes in operations or river travel time. A discussion of the specific approach, model modifications, and data development required to apply these analytical tools to the analysis of the alternatives in the PEIS is provided in the PROSIM and SANJASM Methodology/Modeling Technical Appendices.

Subsequent to the completion of the surface water modeling conducted for the PEIS, Reclamation and the Service have discovered an inconsistency in the PROSIM input hydrology that may cause the model to overestimate the potential flexibility of CVP operations. As a result, current PROSIM simulations may under estimate the use of CVP storage and conversely over estimate water deliveries in some critical dry years. This inconsistency affects all of the PEIS simulations and has a minimal impact on the relative differences between the simulations. Therefore, there is little affect on the PEIS surface water impact assessment, due to the general programmatic nature of the PEIS analyses and the comparative use of the PROSIM simulation results.

TABLE IV-2

SUMMARY OF IMPACT ASSESSMENT FOR SURFACE WATER SUPPLIES AND FACILITIES OPERATIONS

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Reservoir operations, river flows, and Delta outflow are generally as described under affected environment, including Bay-Delta Plan Accord with changes in operations due to increased water rights and M&I demands at a 2020 level of development. Average annual refuge deliveries of about 335,000 acre-feet from historical sources. Average annual CVP deliveries of about 5,770,000 acre-feet. Average annual SWP deliveries of about 3,330,000 acre-feet.
	Changes Compared to the No-Action Alternative
1	Increase and stabilize fall/winter Shasta Lake releases per AFRP flow targets (see Attachment G). Average annual Shasta September carryover storage reduced by 60,000 acre-feet. Increase and stabilize fall/winter Folsom Lake releases per AFRP flow targets, and meet spring pulse flows as possible. Increase average annual Folsom Lake September carryover storage by 80,000 acre-feet toward AFRP targets. Increase Clear Creek flows to meet AFRP flow targets in all but critically dry years. Provide Stanislaus spring pulse flows in April through June in all but critical dry years. Average annual New Melones Reservoir September carryover storage decreases by 100,000 acre-feet. Trinity River flows increase from 50,000 to 410,000 acre-feet per year depending on water year type. Average annual Claire Engle Lake September carryover storage decreases by 200,000 acre-feet. Average Annual Trinity River Basin diversions to the Sacramento River decrease by 180,000 acre-feet. Average annual Delta outflows reduced by 60,000 acre-feet due primarily to the reduction in diversions from the Trinity River Basin. CVP provides additional 233,000 acre-feet in average annual refuge deliveries to provide Level 2 refuge water supplies. Replaces several intermittent water supplies. Reduction of 470,000 acre-feet in average annual CVP deliveries due to instream (b)(2) Water Management component, increased Level 2 refuge deliveries, and increased Trinity River instream flows. Potential increase of 100,000 acre-feet in average annual SWP deliveries due to incidental benefit as a result of the actions in Alternative 1.

TABLE IV-2. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to Alternative 1
1a	North of Delta reservoir and river operations are similar to Alternative 1, plus: Average annual Delta outflows increased by 140,000 acre-feet, due to use of (b)(2) Water Management for Delta components. Reduced CVP operational flexibility to fill San Luis Reservoir in the fall and supplement San Luis Reservoir releases in April and May. Average annual refuge deliveries are the same as Alternative 1. Reduction of 100,000 acre-feet in average annual CVP deliveries due to use of (b)(2) Water Management actions in addition to Bay-Delta Plan Accord. Decrease of 40,000 acre-feet in average annual SWP deliveries.
1b	Average annual conditions similar to Alternative 1, plus: Potential need for additional CVP and SWP reservoir releases during dry years to offset potentially higher salinity water entering the Delta due to increased reverse flows in the lower San Joaquin River west of Jersey Point.
1c	Reduction of 570,000 acre-feet in CVP average annual deliveries due to increased water pricing. Use of non-delivered CVP water not determined at this time. Options include reallocation to other CVP contractors, transfer by CVP contractors with reduced demand, or use for fish and wildlife purposes.
1d	Average annual conditions are similar to Alternative 1, plus: Increase of 30,000 acre-feet in dry period (1928-1934) average annual refuge deliveries. Reduction of 50,000 acre-feet in dry period (1928-1934) average annual CVP deliveries due to full water deliveries to refuges in critical dry years. Dry period (1928-1934) average annual SWP deliveries same as Alternative 1.
1e	Conditions are similar to Alternative 1, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
1f	Conditions are similar to Supplemental Analysis 1e.
1g	Conditions are similar to Alternative 1.
1h	Conditions are the same as Alternative 1.
1i	Conditions are the same as Alternative 1.

TABLE IV-2. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to the No-Action Alternative
2	CVP reservoir operations and river flows as a result of (b)(2) Water Management are similar to Alternative 1, plus: Increase April through June stream flows on the Stanislaus River due to acquisition of up to 60,000 acre-feet per year from willing sellers. Increase April through June stream flows on the Tuolumne River due to acquisition of up to 60,000 acre-feet per year from willing sellers. Increase April through June stream flows on the Merced River due to acquisition of up to 50,000 acre-feet per year from willing sellers. Acquired water is not exported from the Delta, resulting in an 80,000 acre-feet average annual increase in Delta outflow. Increase of 370,000 acre-feet in average annual refuge deliveries due to the CVP providing Level 2 deliveries and acquisition of additional Level 4 refuge water supplies. Reduction of 590,000 acre-feet in average annual CVP deliveries due to actions described under Alternative 1, plus assumed purchase of about 120,000 acre-feet per year for Level 4 refuge supplies from Sacramento River Water Rights and San Joaquin River Exchange Contractors. Potential increase of 80,000 acre-feet in average annual SWP deliveries due to the actions described under Alternative 1, plus assumed purchase of about 20,000 acre-feet per year for Level 4 refuge supplies from SWP willing sellers south of the Delta.
	Changes Compared to Alternative 2
2a	Average annual conditions are similar to Alternative 2, plus: Potential need for additional CVP and SWP reservoir releases during dry years to offset potentially higher salinity water entering the Delta due to increased reverse flows in the lower San Joaquin River west of Jersey Point.
2b	Conditions are similar to Alternative 2, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Reduction of CVP average annual deliveries due to increased water pricing are similar to Supplemental Analysis 1c. Use of non-delivered CVP water not determined at this time. Options include reallocation to other CVP contractors, transfer by CVP contractors with reduced demand, or use for fish and wildlife purposes.
	Changes Compared to the No-Action Alternative
3	North of Delta CVP reservoir operations and river flows as a result of (b)(2) Water Management are similar to Alternative 1. Increase stream flows on the Stanislaus River in fall and winter months with pulse flows in April through June, due to acquisition of up to 200,000 acre-feet of water per year from willing sellers. Generally increase stream flows on the Tuolumne River in most months with pulse flows in April through June, due to acquisition of up to 200,000 acre-feet of water per year from willing sellers.

TABLE IV-2. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Increase stream flows on the Merced River in all months with pulse flows in April through June, due to acquisition of up to 200,000 acre-feet of water per year from willing sellers. Increase winter and spring stream flows and decrease summer and fall flows on the Calaveras River, due to acquisition of up to 30,000 acre-feet of water per year from willing sellers. Increase fall through spring stream flows on the Mokelumne River, due to acquisition of up to 70,000 acre-feet of water per year from willing sellers. Increase spring, summer, and fall stream flows on the Yuba River, due to acquisition of up to 100,000 acre-feet of water per year from willing sellers. Increase flows on the San Joaquin River at Vernalis in nearly all months with pulse flows in April and May, due to upstream water acquisition from willing sellers. Slight reduction in January and February in wet water year types. Average annual Delta outflows increase by about 200,000 acre-feet due to upstream water acquisition. Refuge deliveries are the same as Alternative 2. Reduction of 390,000 acre-feet in average annual CVP deliveries, due to actions described under Alternative 2, plus ability to export acquired water. Assumed purchase of about 120,000 acre-feet per year for Level 4 refuge supplies from Sacramento River Water Rights and San Joaquin River Exchange Contractors. Potential increase of 270,000 acre-feet in average annual SWP deliveries, due to ability to export acquired water. Assumed purchase of about 20,000 acre-feet per year for Level 4 refuge supplies from SWP willing sellers south of the Delta.
3a	Conditions are similar to Alternative 3, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
	Changes Compared to the No-Action Alternative
4	North of Delta CVP reservoir operations and river flows as a result of (b)(2) Water Management are similar to Alternative 1. Tracy Pumping Plant exports are reduced due to (b)(2) actions in the Delta. The increases in stream flows due to acquired water are the same as Alternative 3. Acquired water is not exported from the Delta, resulting in an 780,000 acre-feet average annual increase in Delta outflow. Refuge deliveries are the same as Alternative 2. Reduction of 620,000 acre-feet in average annual CVP deliveries, due to actions in Alternative 3 plus use of (b)(2) Water Management for Delta components. Assumed purchase of about 120,000 acre-feet per year for Level 4 refuge supplies from Sacramento River Water Rights and San Joaquin River Exchange Contractors. Average annual SWP deliveries are similar to the No-Action Alternative. Assumed purchase of about 20,000 acre-feet per year for Level 4 refuge supplies from SWP willing sellers south of the Delta.

TABLE IV-2. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
4a	Conditions are similar to Alternative 4, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting from implementing the Preferred Alternative.	**Average Annual CVP Deliveries** 5,690,000 acre-feet **Average Annual SWP Deliveries** 3,320,000 acre-feet **Other Operations** Reservoir operations, river flows, and Delta outflow are generally as described under affected environment, with changes in operations due to increased water rights and M&I demands at a 2025 level of development. Average annual refuge deliveries of about 335,000 acre-feet from historical sources.
Preferred Alternative Changes as Compared to the Revised No-Action Alternative	**Average Annual CVP Deliveries** Reduction of 560,000 acre-feet due to instream (b)(2) Water Management component, increased Level 2 and Level 4 refuge deliveries, and increased Trinity River inflows. **Average Annual SWP Deliveries** Reduction of 70,000 acre-feet due to assumed coordination with (b)(2) water management actions. **Other Operations** Increase and stabilize fall/winter Shasta and Folsom lakes releases per AFRP flow targets. Average annual Shasta September carryover storage reduced by 130,000 acre-feet. Average annual Folsom Lake September carryover storage remains approximately the same. Increase Clear Creek flows to meet AFRP flow targets in all but critically dry years. Provide Stanislaus spring pulse flows in April through June in all but critical dry years. Average annual New Melones Reservoir September carryover storage decreases by 70,000 acre-feet. Trinity River flows increase from 50,000 to 410,000 acre-feet/year depending on water year type. Average annual Claire Engle Lake September carry over storage decreases by 130,000 acre-feet. Average Annual Trinity River Basin diversions to the Sacramento River decrease by 180,000 acre-feet. Average annual Delta outflows increase by 100,000 acre-feet due primarily to the reduction in diversions from the Trinity River Basin. CVP provides additional 380,000 acre-feet in average annual refuge deliveries to provide Level 2 and Level 4 refuge water supplies.

NO-ACTION ALTERNATIVE

The No-Action Alternative provides a base condition for comparison of PEIS alternatives analyses, and represents assumed future conditions at a projected 2022 level of development without implementation of CVPIA. As described in Chapter II of the PEIS, the No-Action Alternative assumes that CVP facilities would be operated in accordance with operating rules and criteria that were in effect or being developed as of October 1992, when the CVPIA was adopted.

The No-Action Alternative assumes the continued implementation of the Bay-Delta Plan Accord and WR-95-01 because the process to develop the new Delta water quality standards was being implemented at the time CVPIA was enacted. Similarly, the No-Action Alternative includes the 1993 Winter-Run Chinook Salmon Biological Opinion as amended in 1995 by NMFS, because Reclamation had begun to operate to preliminary provisions of the 1993 biological opinion in October 1992. As described in the Affected Environment, requirements of the 1995 Delta Smelt Biological Opinion are fulfilled through meeting the operations requirements of the Bay-Delta Plan Accord, WR-95-01, and 1995 amendments to the Winter-Run Chinook Salmon Biological Opinion. On the Stanislaus River, it is assumed that the interim drought management actions implemented during the drought period from 1987 through 1992 do not constitute a long-term operational approach, and therefore could not be anticipated to represent operational conditions in the year 2022. Descriptions of the Bay-Delta Water Quality Control Plan, the Winter-Run Biological Opinion, and the operations of New Melones Reservoir are provided in the description of the No-Action Alternative in Attachment G of the PEIS.

For the purposes of the PEIS No-Action Alternative, it is assumed that the COA, as described in Chapter II, would remain in place in the year 2022. The COA is the mechanism by which the CVP and SWP coordinate operations to meet Delta standards as defined by SWRCB Water Quality Control Plans. The current COA was developed based on the SWRCB D-1485 standards. Additional assumptions were required to adapt the COA to criteria included in the May 1995 Draft Water Quality Control Plan, as described in the Surface Water Supplies and Facilities Operations Technical Appendix.

ALTERNATIVE 1

Water management provisions in Alternative 1 were developed to utilize two of the tools provided by CVPIA, reoperation 3406(b)(1)(B) and 3406(b)(2) Water Management toward meeting AFRP, toward meeting the target flows for chinook salmon and steelhead trout in the CVP-controlled streams. The term “(b)(2) Water Management” is used to indicate the integrated use of 3406(b)(1)(B) and 3406(b)(2) water use. As described in Chapter II, Alternative 1 also includes the use of CVP water to provide firm Level 2 water supplies to refuges, and the preliminary Trinity River instream fishery flow release pattern developed by the Service for the PEIS.

CVP Operations and Deliveries

This section provides a discussion of the potential changes to the operation of CVP facilities, river flow regimes, and CVP water deliveries that would result from implementation of the

CVPIA actions integrated into Alternative 1. Friant Division operations under Alternative 1 would be similar to those under the No-Action Alternative.

CVP Operations

Trinity River Division. For the purposes of the PEIS programmatic analysis, Alternative 1 assumes increased Trinity River flows that range from 390,000 acre-feet in critical dry years to 750,000 acre-feet in wet years. Average flows down the Trinity River in Alternative 1 increase by 190,000 acre-feet per year as compared to the No-Action Alternative. Figure IV-1 shows a comparison of monthly Trinity River instream flow patterns as compared to the No-Action Alternative. CVP Trinity River diversions to Whiskeytown Lake are reduced by 180,000 acre-feet on an average annual basis to attempt to balance the net demands on Clair Engle Lake. Frequency distributions of the simulated annual diversions from the Trinity River Basin in the No-Action Alternative and Alternative 1 are presented in Figure IV-1. A schematic diagram of how to use a frequency distribution curve is presented in Attachment G. As shown in Figure IV-2, the increase in Trinity River minimum flow requirements in Alternative 1 reduces Clair Engle Lake average end-of-water year storage by about 200,000 acre-feet as compared to the No-Action Alternative. The overall reduction in Clair Engle Lake storage is primarily due to a major increase in minimum flow requirements in wetter years, and the low refill potential of the lake.

Alternative 1 includes use of (b)(2) water on Clear Creek to attempt to meet the target flows. The target flows are achieved in all but critically dry years, when natural inflows to Whiskeytown Lake and diversions from the Trinity River Basin are not sufficient to maintain both the target flows and minimum storage levels in Clair Engle and Whiskeytown Lakes per temperature requirements and physical capabilities of the dams. Figure IV-3 shows the increase in simulated average monthly Clear Creek flows in Alternative 1 as compared to the No-Action Alternative. The increase in flow on Clear Creek would result in generally lower water temperatures as compared to the No-Action Alternative.

Shasta and Sacramento River Divisions. The Alternative 1 operations of the Shasta and Sacramento River Divisions are affected by the multiple changes to CVP operations associated with (b)(2) Water Management, the delivery of firm Level 2 refuge supplies, and the increase in Trinity River minimum flow requirements. This reduction in Trinity River Basin diversions to the Sacramento River requires increased releases from Shasta Lake during spring and summer months for Winter-Run Biological Opinion temperature requirements, downstream water rights, minimum navigational flow requirements, water service contractors, and Delta water quality requirements. During fall and winter months, Shasta Lake releases are increased for (b)(2) flows, and supply water for export to San Luis Reservoir. The resulting decrease in Shasta Lake end-of-water year storage is shown in the comparison of frequency distributions for Alternative 1 and the No-Action Alternative in Figure IV- 2. In most dry and critical dry years, Shasta Lake releases are governed by water rights and fisheries objectives including the target flows, Winter-Run Biological Opinion, and Delta water quality requirements.

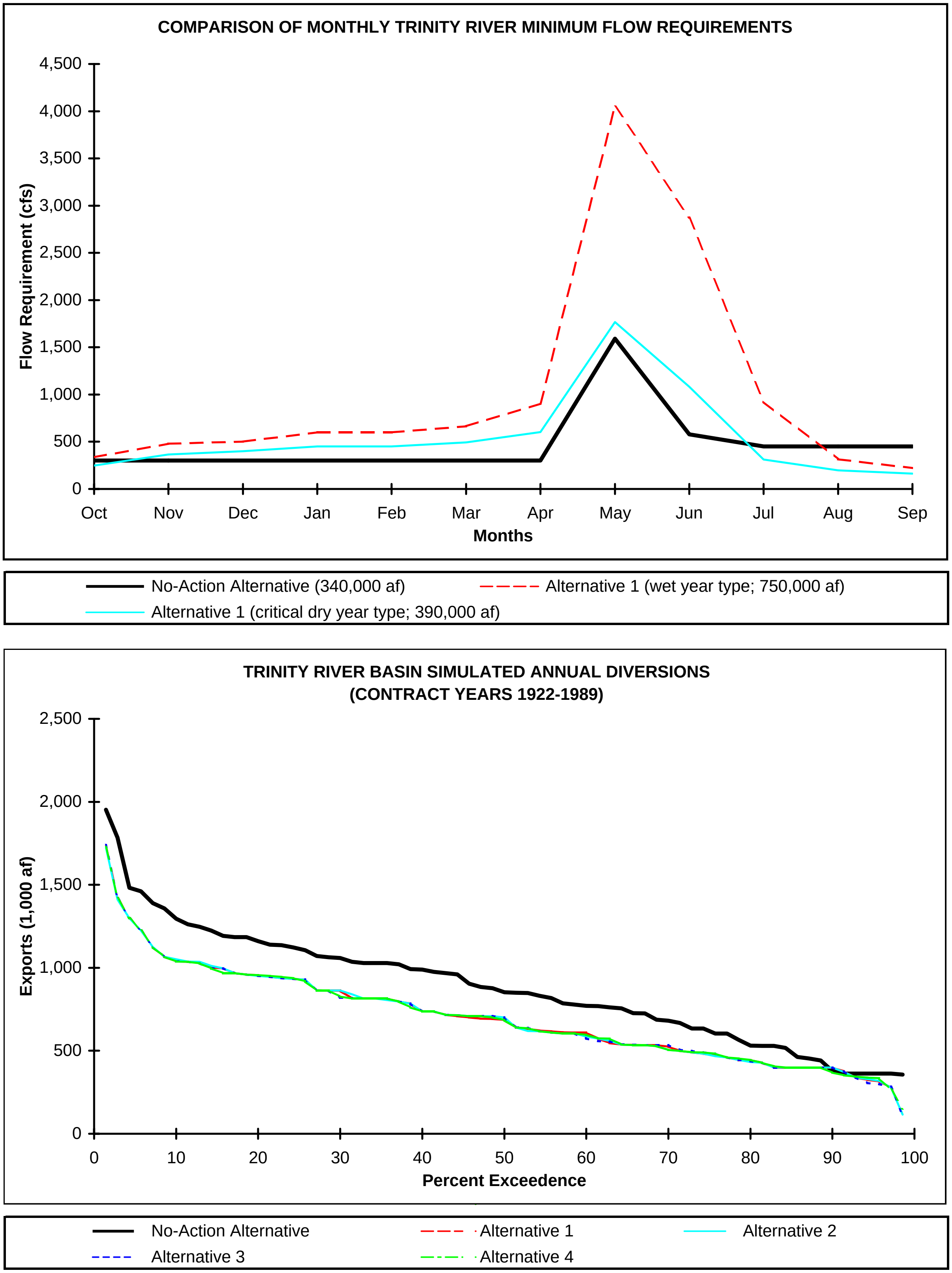


FIGURE IV-1
TRINITY RIVER MINIMUM FLOW REQUIREMENTS
AND SIMULATED ANNUAL EXPORTS

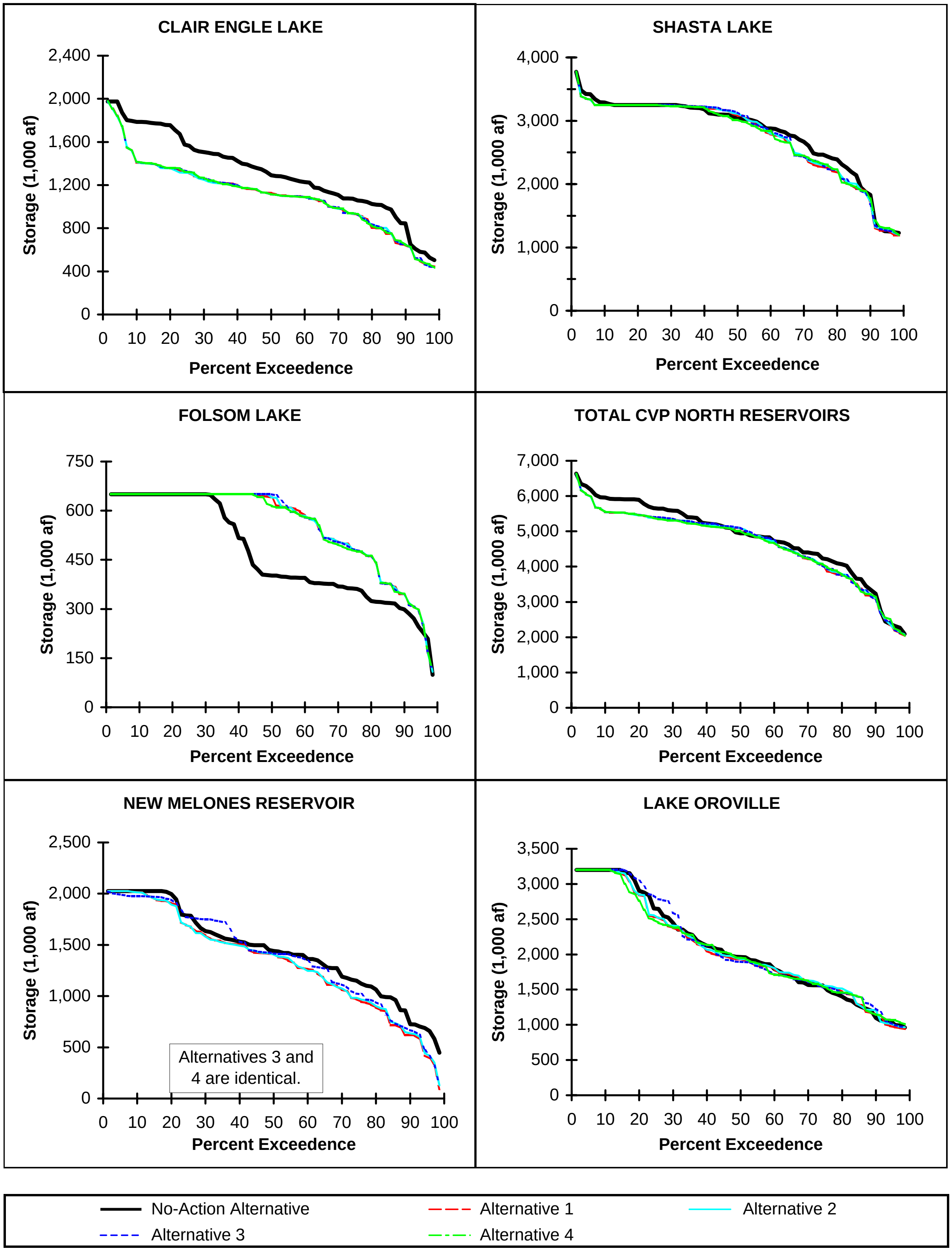


FIGURE IV-2

SIMULATED FREQUENCY OF END-OF-WATER YEAR STORAGE 1922-1990

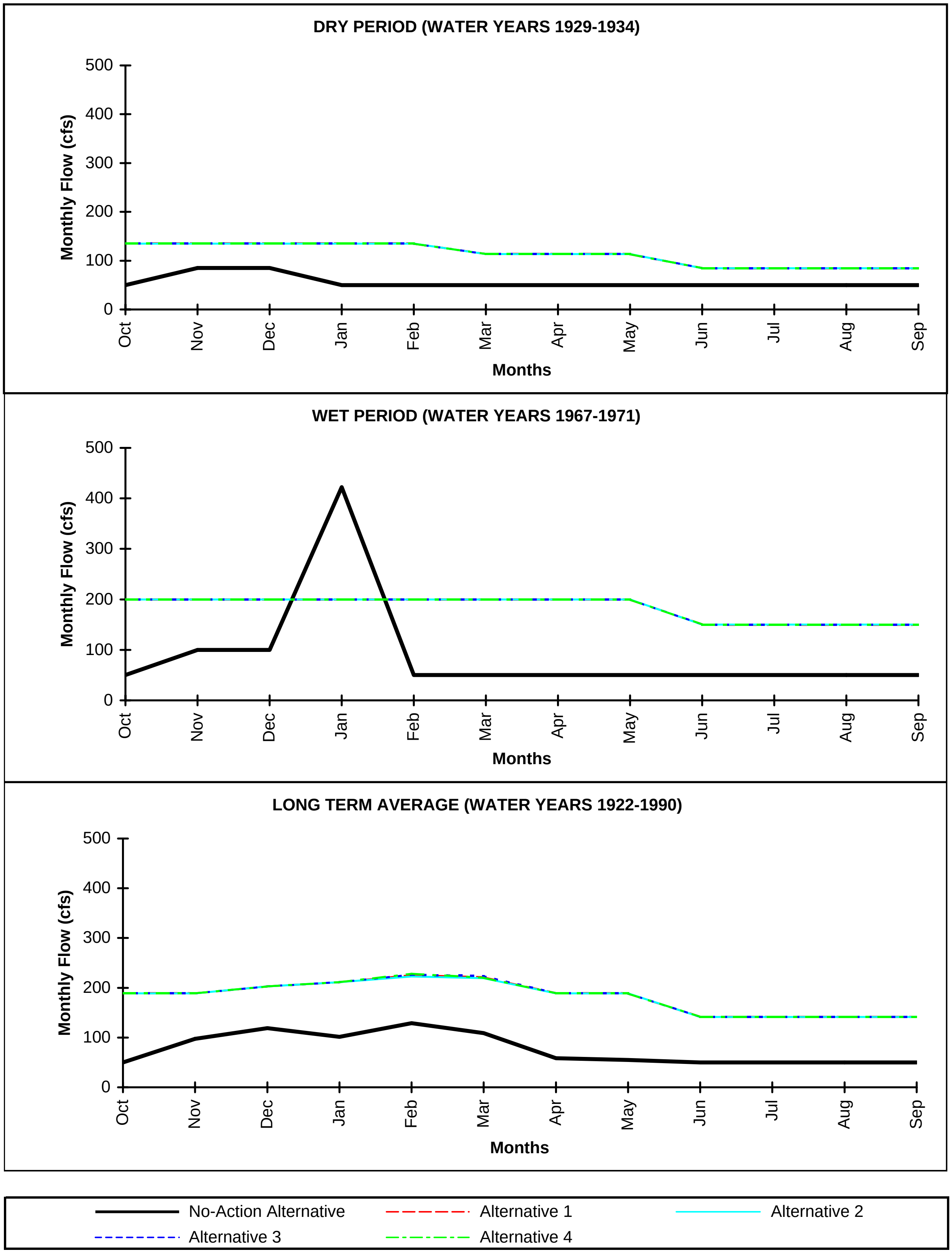


FIGURE IV-3
CLEAR CREEK BELOW WHISKEYTOWN
SIMULATED AVERAGE MONTHLY FLOWS

Under the No-Action Alternative, simulated flows on the Sacramento River below Keswick Dam meet the flow targets in almost all months, except during some of the drier years. The reduced diversions from the Trinity River Basin under Alternative 1 require increased releases from Shasta Lake to meet the target flows, and reduces the operational flexibility to meet winter-run temperature control requirements. This occurs because, although there are no target flows from May 1 through September 30, minimum Shasta Lake releases are still required during this period to maintain water temperatures in the Sacramento River for winter run. To the extent possible, releases from Shasta Dam are shifted from the spring and summer months to the fall and winter months to meet target flows, while maintaining summer temperature levels. The October through April Keswick target flows are based on October 1 storage in Shasta Lake and are therefore achieved in all months. A comparison of flows in the Sacramento River below Keswick Dam, Figure IV-4, shows that summer flows in Alternative 1 are lower than flows in the No-Action Alternative, and that fall and winter flows are generally similar. The variability of downstream temperatures for winter-run salmon under Alternative 1 is similar to the No-Action Alternative.

Changes to Folsom Lake operations for (b)(2) water purposes affect the need for Shasta Lake releases, and resulting Sacramento River flows below Keswick Dam. In Alternative 1, fall and winter releases from Folsom Lake are increased to attempt to meet American River target flows, to meet a greater portion of the downstream Delta export and water quality requirements, and to reduce the need for Shasta Lake releases in excess of the Keswick target flows. Reduced summer releases from Folsom Lake may require higher summer Shasta Lake releases to meet Delta water rights and water quality requirements. This additional burden on Shasta Lake during the summer may reduce the CVP's ability to respond to short-term increases in the need for water to meet irrigation demand.

American River Division. The primary goals on the American River are to increase Folsom Lake September end-of-water year storage, and provide higher, more stable fall and winter flows in the American River, as discussed in Attachment G. The frequency distribution in Figure IV- 2 shows that in Alternative 1, Folsom Lake end-of-water year storage increases by about 80,000 acre-feet as compared to the No-Action Alternative. The Draft AFRP September storage target of 610,000 acre-feet is met in about 50 percent of the 69 years in the PEIS simulation period. The reoperation of Folsom Lake average monthly storage in the dry, wet, and 69-year average simulation periods is shown in Figure IV-5.

The target flows in the October through February period below Nimbus Dam are achieved in 100 percent of the months in wet, above normal, and below normal water years. For the same period, target flows are met in 80 percent of the dry years and 40 percent of the critical dry years. A comparison of simulated average monthly flows in the American River below Nimbus Dam in the No-Action Alternative and Alternative 1 is presented in Figure IV-6.

Under Alternative 1, the integrated operations of Shasta and Folsom Lakes are balanced to attempt to meet as many of the (b)(2) water objectives as possible, while still fulfilling existing CVP obligations and operational criteria as defined under the No-Action Alternative. This is particularly difficult during summer periods, where the objective is to decrease releases on both

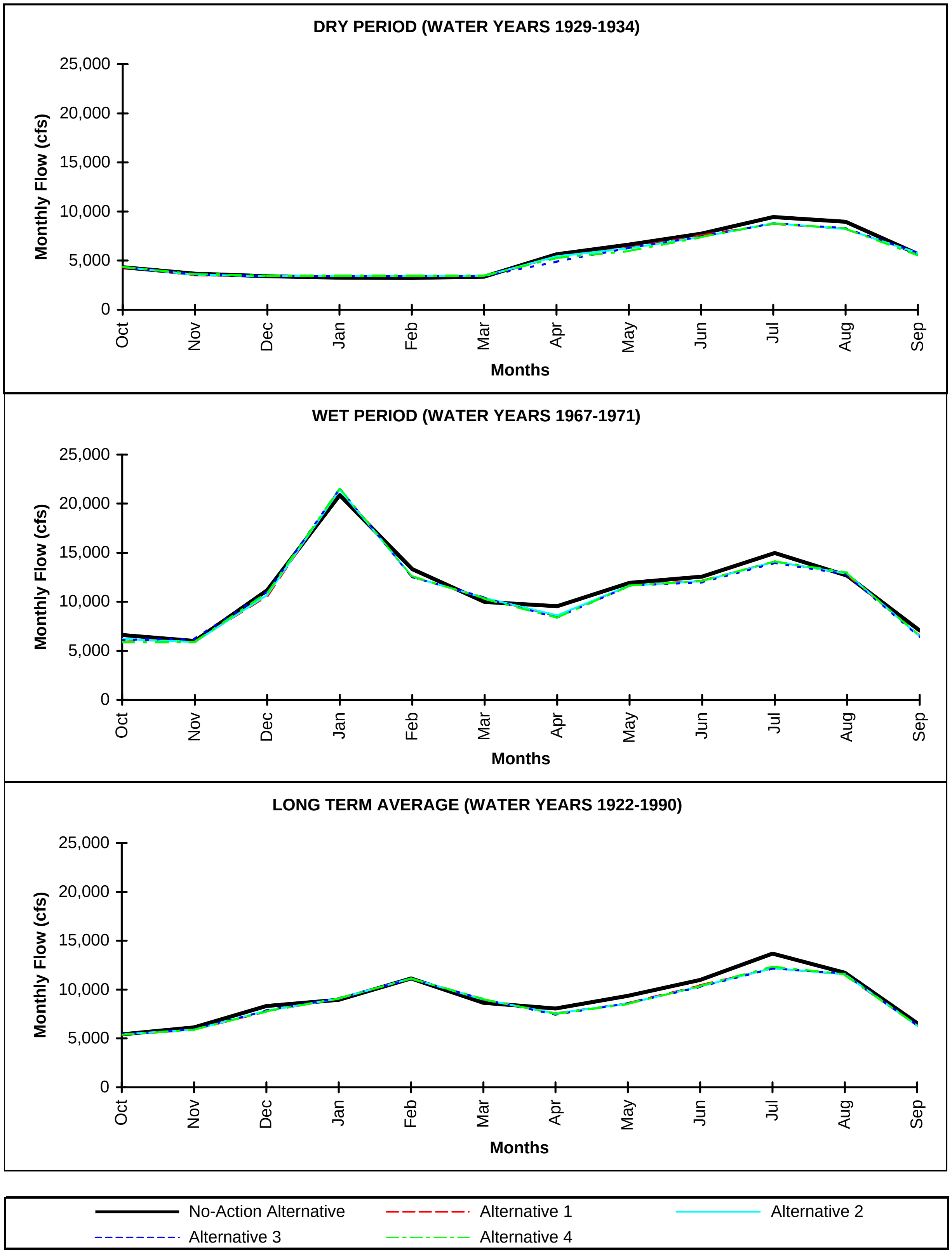


FIGURE IV-4
SACRAMENTO RIVER BELOW KESWICK
SIMULATED AVERAGE MONTHLY FLOWS

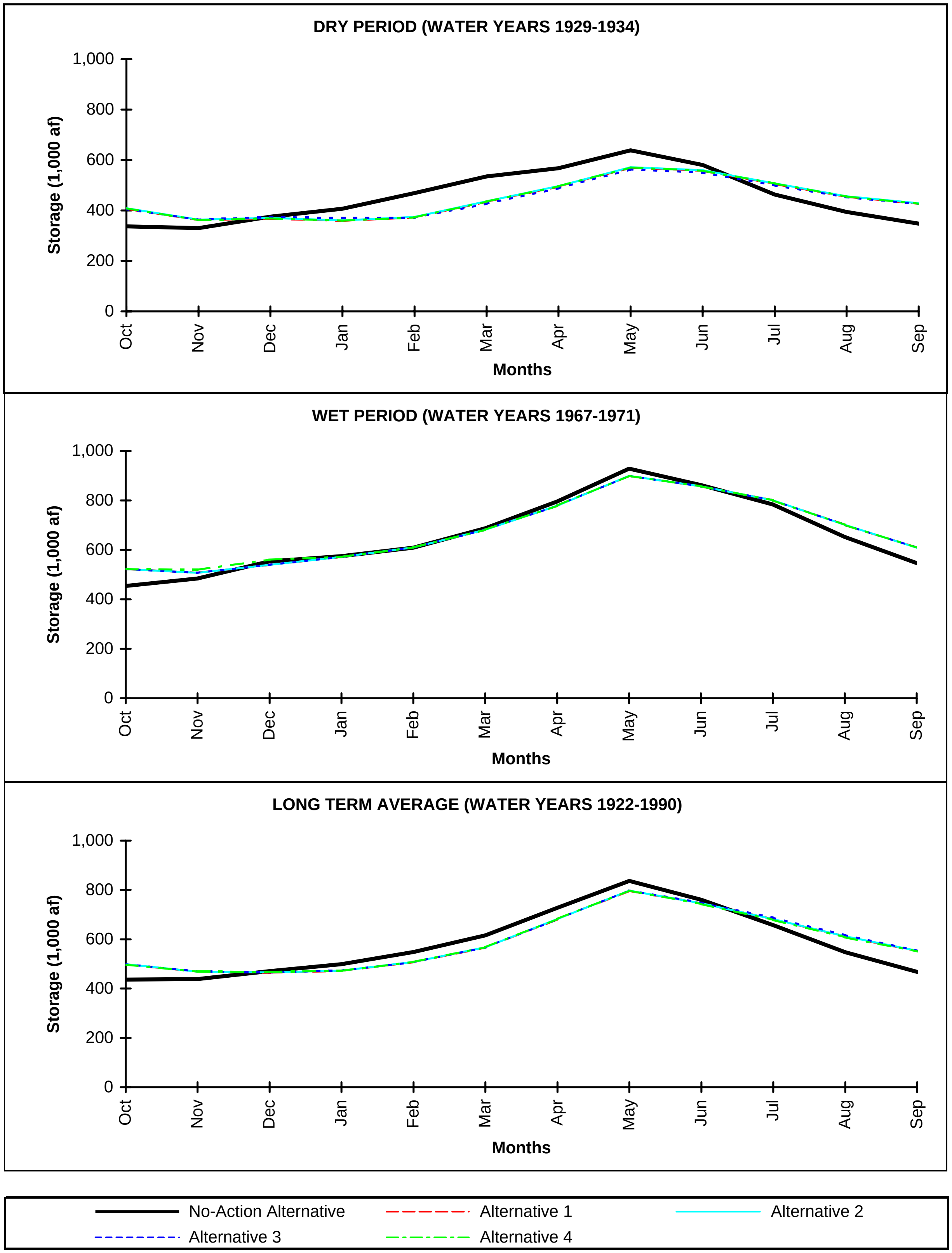


FIGURE IV-5

SIMULATED FOLSOM LAKE AVERAGE END-OF-MONTH STORAGE

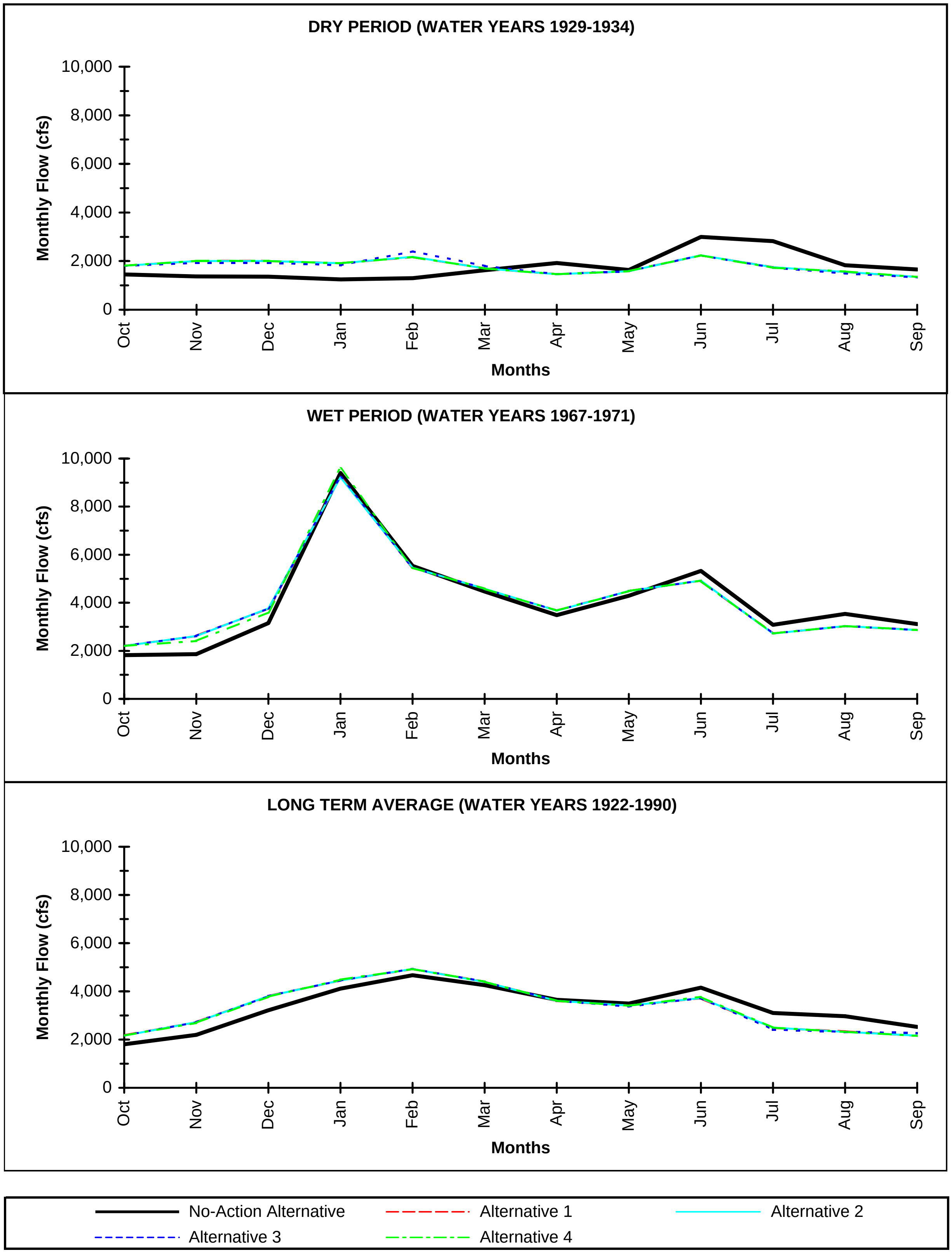


FIGURE IV-6

AMERICAN RIVER BELOW NIMBUS SIMULATED AVERAGE MONTHLY FLOWS

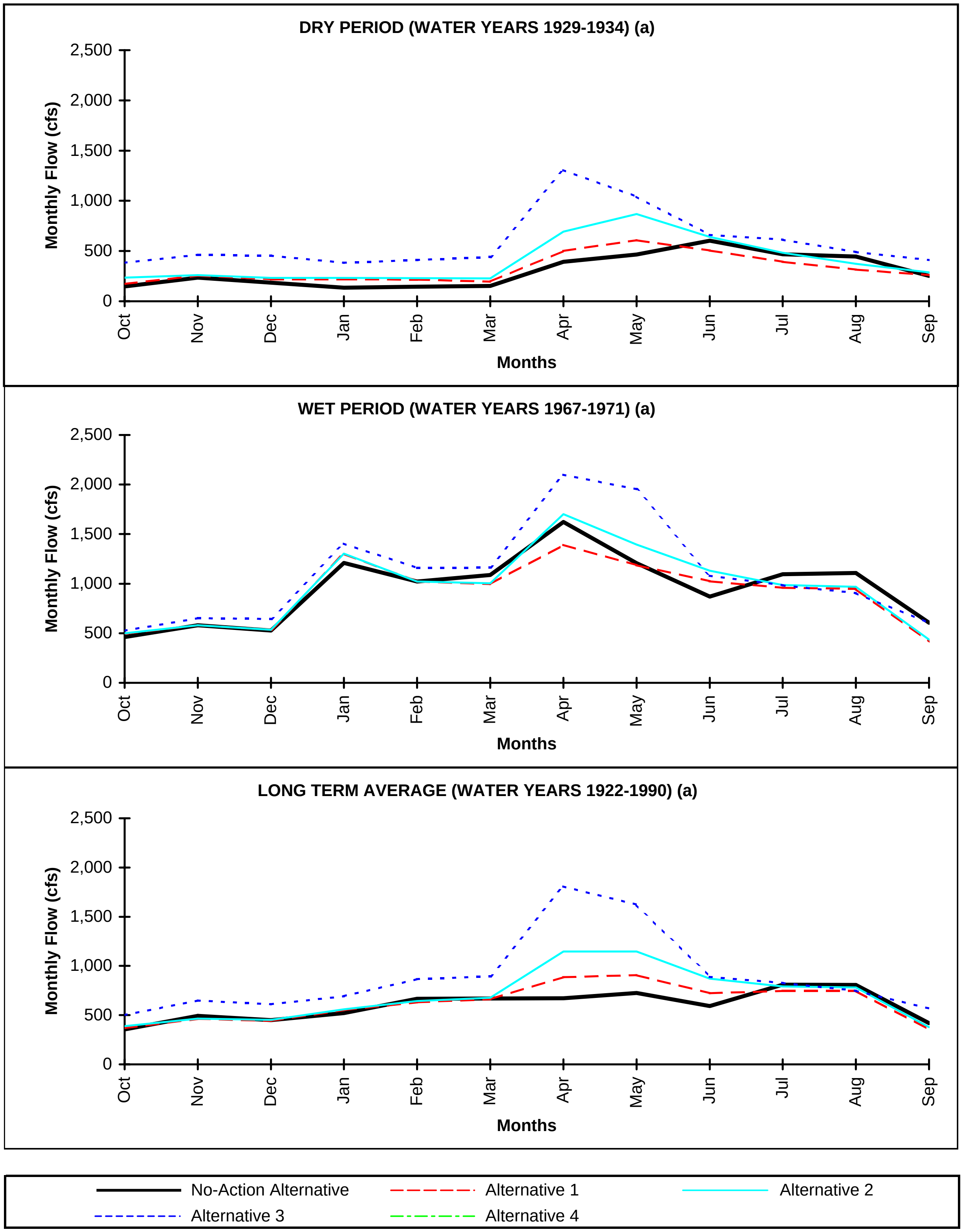
the Sacramento and American Rivers to provide additional September storage to help meet fall and winter flow targets. The ability to decrease summer releases is constrained by CVP obligations to provide water for existing minimum flow requirements, CVP M&I and agricultural contract obligations, water rights holders, and Delta water quality requirements.

Eastside Division. Under Alternative 1, New Melones Reservoir would be operated to provide higher instream flows on the Stanislaus River during non-critical years, as compared to the No-Action Alternative. This operation would result in lower end-of-water year storage levels than under the No-Action Alternative, as shown in Figure IV-2. Instream flows would not be increased during critically dry years, due to the limited water supply in the Stanislaus River watershed; therefore, storage levels during periods of consecutive critical dry years would be approximately the same as under the No-Action Alternative.

Simulated average monthly flows in the Stanislaus River below Goodwin Dam in the No-Action Alternative and Alternative 1 simulations are shown in Figure IV-7. As described in Chapter II, the (b)(2) Water Management operations at New Melones attempt to completely meet target flows from July through March, and partially meet target flows during April through June in non-critical years. Because of the limited available water supply in the Stanislaus River watershed, no change in instream flow objectives is made during critically dry years, as compared to the No-Action Alternative. The resulting operation would meet July through March target flows in all years, and would meet or partially meet target flows during the April through June period in some, but not all years. As a result of the reduced storage conditions in New Melones Reservoir, however, the threshold for maximum water quality releases (included in SANJASM for long-term simulations) during water deficient years is invoked in one additional year during the dry simulation period of 1929-1934, and results in lower average monthly flows during June, July, and August in that period.

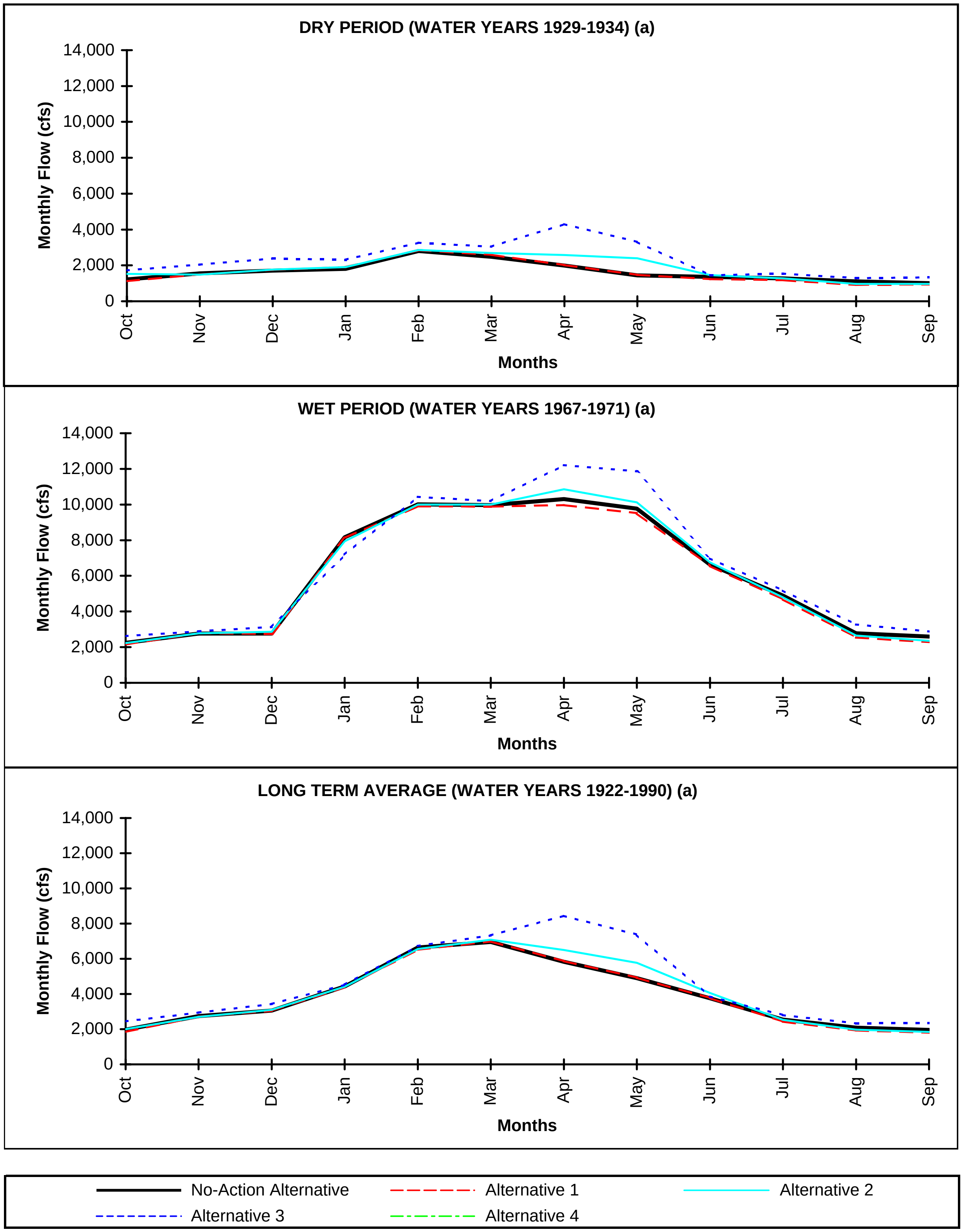
Simulated average monthly flows in the San Joaquin River at Vernalis in the No-Action Alternative and Alternative 1 are shown in Figure IV-8. Although the changes in flows resulting from modified Stanislaus River operations affect the flow at Vernalis, the changes are relatively small compared to the total flow at Vernalis. The simulated monthly water quality on the San Joaquin River at Vernalis during the irrigation (April - August) and non-irrigation (September - March) seasons for the No-Action Alternative and Alternative 1 is shown in the frequency distributions in Figure IV-9. The figures show that for both the irrigation and non-irrigation seasons, the frequency with which water quality exceeds the standard increases in Alternative 1 over the No-Action Alternative. The increase in the salinity concentration during the irrigation season occurs during the driest 10 percent of the simulated years, and corresponds to periods when releases from New Melones Reservoir for water quality are limited by available supplies. Salinity concentration increases during the non-irrigation season are primarily due to the increase in deliveries and subsequent return flows from the refuges in the San Joaquin Valley.

Delta Division. Figure IV-10 shows the change in simulated average monthly Tracy exports for the dry, wet, and long-term average periods. The figure shows an increase in October through January average monthly Tracy exports, for the dry and long-term average conditions, due to the increased upstream CVP releases to meet target flows. In many years, these combined upstream reservoir releases exceed the maximum pumping capacity of Tracy Pumping Plant. In



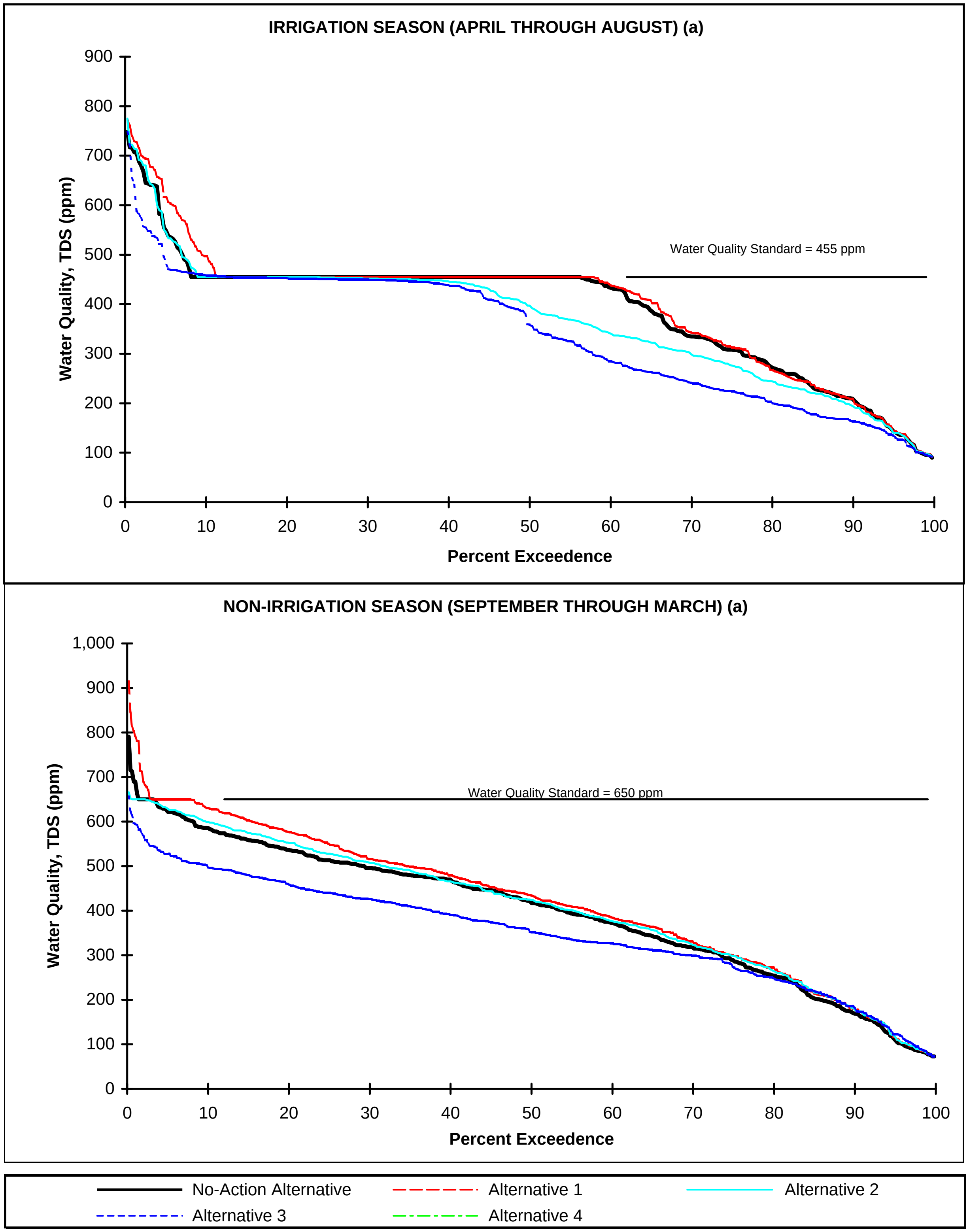
NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-7
STANISLAUS RIVER BELOW GOODWIN
SIMULATED AVERAGE MONTHLY FLOWS



NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-8
SAN JOAQUIN RIVER AT VERNALIS
SIMULATED AVERAGE MONTHLY FLOWS



NOTE: (a) Water quality conditions under Alternatives 3 and 4 are identical.

FIGURE IV-9

SIMULATED MONTHLY WATER QUALITY AT VERNALIS

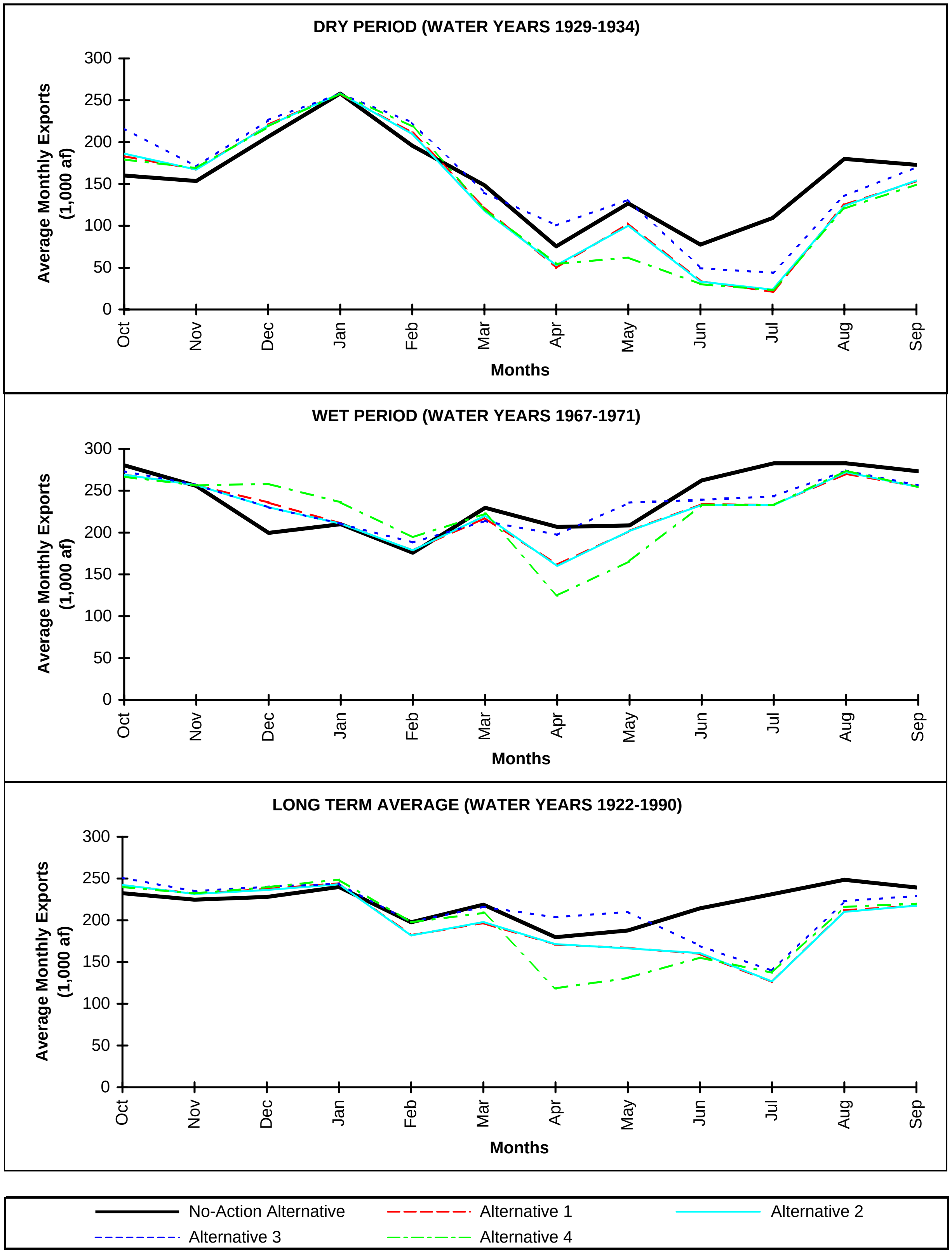


FIGURE IV-10

TRACY PUMPING PLANT SIMULATED AVERAGE MONTHLY EXPORTS

contrast, the Alternative 1 average monthly March through September Tracy exports are lower, due to decreased spring and summer Trinity River Basin diversions to the Sacramento River, and reduced summer upstream CVP reservoir releases. The net impact is about a 250,000 acre-feet reduction in average annual CVP exports through Tracy Pumping Plant. The frequency distribution in Figure IV-11 shows the Alternative 1 decrease in simulated annual Tracy Pumping Plant exports as compared to the No-Action Alternative.

In comparison to the No-Action Alternative simulation, average annual Delta outflows in Alternative 1 are reduced by approximately 60,000 acre-feet. However, the reduction in outflow is small in proportion to the total Delta outflow and cannot be easily discerned in the average monthly outflow plots shown in Figure IV-12.

West San Joaquin Division. The Alternative 1 impacts to CVP storage in San Luis Reservoir are a direct result of changes in Tracy Pumping Plant monthly exports. As shown in Figure IV-11, Alternative 1 average monthly CVP San Luis Reservoir storage levels are higher than in the No-Action Alternative, due to increased October through January Tracy Pumping Plant exports.

CVP Water Deliveries

This section describes potential changes to CVP water contract deliveries in Alternative 1, as compared to the No-Action Alternative, due to: 1) use of (b)(2) water toward meeting the target flows, 2) firm Level 2 refuge deliveries, and 3) assumed increased instream Trinity River flow requirements. The “target flows” were developed for the purposes of the Draft PEIS based upon preliminary information developed for the AFRP. The methodology used to develop the “target flows” is described in Alternatives G-2 and G-3. A summary comparison of deliveries to CVP contractors in the Alternative 1 simulation, as compared to the No-Action Alternative simulation, is provided in Table IV-3.

CVP Water Deliveries North of the Delta. CVP deliveries north of the Delta include deliveries to Sacramento River Water Rights Contractors, and Agricultural and M&I Water Service Contractors. CVP deliveries to Sacramento River Water Rights Contractors do not change in Alternative 1, since their delivery deficiencies are based on the Shasta Criteria. CVP water service contract deliveries decrease as available water supply is reduced due to the use of (b)(2) water, increased firm Level 2 refuge water supplies, and assumed decreased diversions from the Trinity River Basin.

Frequency distributions for the percent of full delivery to CVP Agricultural Water Service Contractors north of the Delta are presented for Alternative 1 and the No-Action Alternative in Figure IV-13. The figure generally shows a 5 to 10 percent reduction in the frequency of deliveries across all delivery levels, with the minimum delivery dropping from about 15 to 0 percent of full contract amount. The minimum delivery to M&I Water Service Contractors is limited to 75 percent of the contract amount, as shown in the frequency distribution in Figure IV-13. The minimum delivery is made in 15 percent of the years in the No-Action Alternative and 45 percent of the years in Alternative 1. The only exception occurs on the American River in

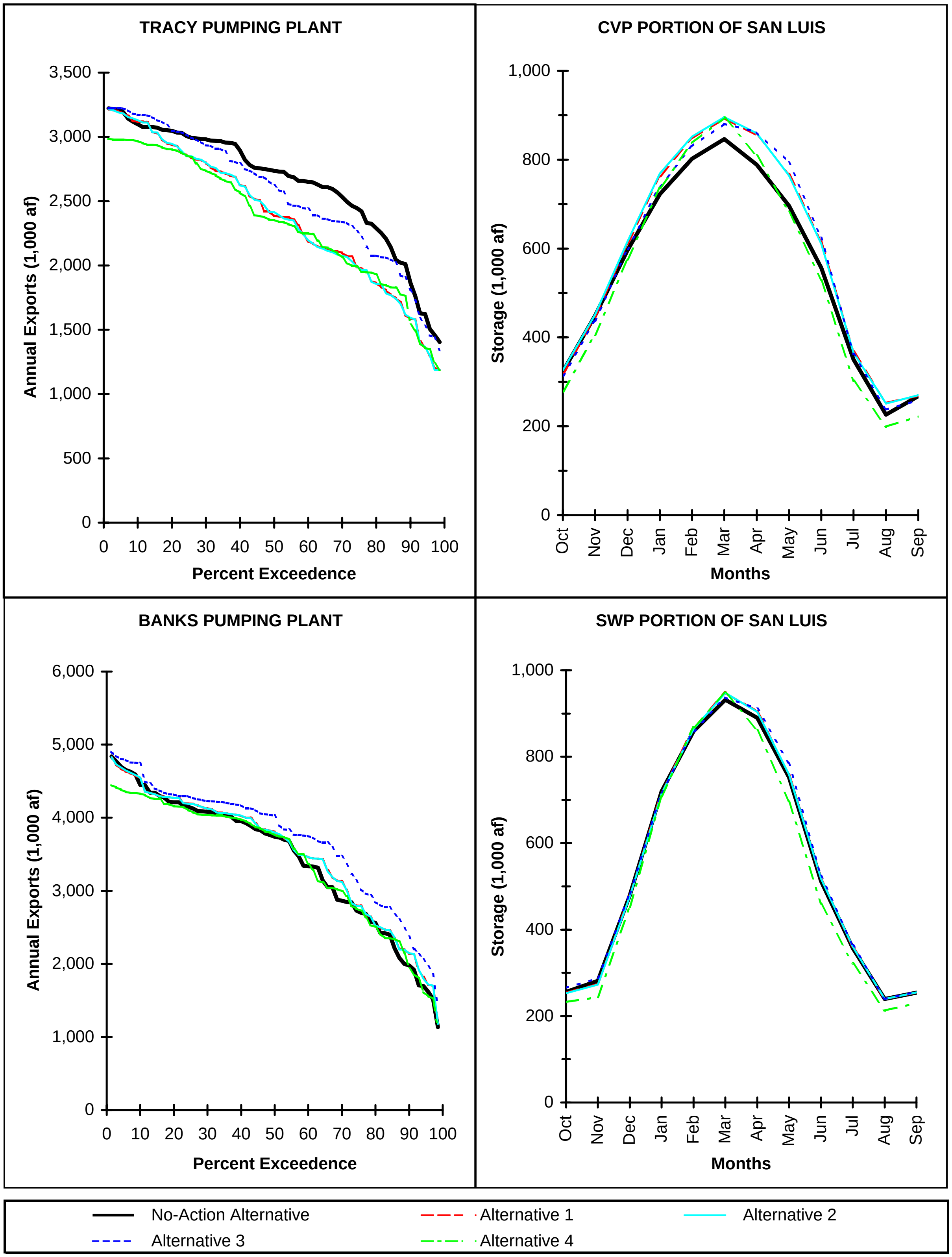


FIGURE IV-11
SIMULATED ANNUAL EXPORTS (CONTRACT YEARS 1922-1990)
AND SAN LUIS RESERVOIR AVERAGE END-OF-MONTH STORAGE
(WATER YEARS 1922-1990)

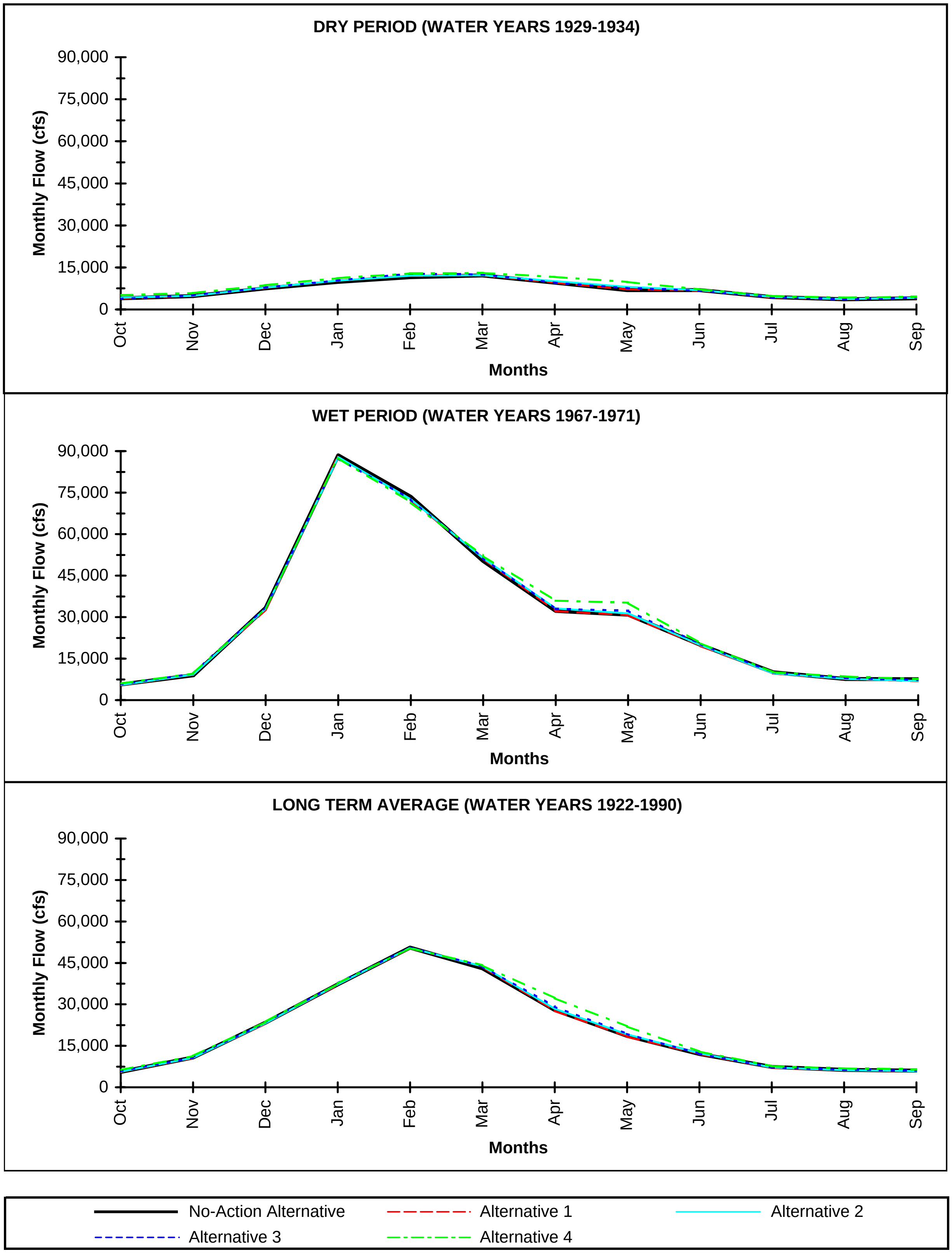


FIGURE IV-12

DELTA OUTFLOW SIMULATED AVERAGE MONTHLY FLOWS

TABLE IV-3

COMPARISON OF SIMULATED AVERAGE ANNUAL CVP DELIVERIES

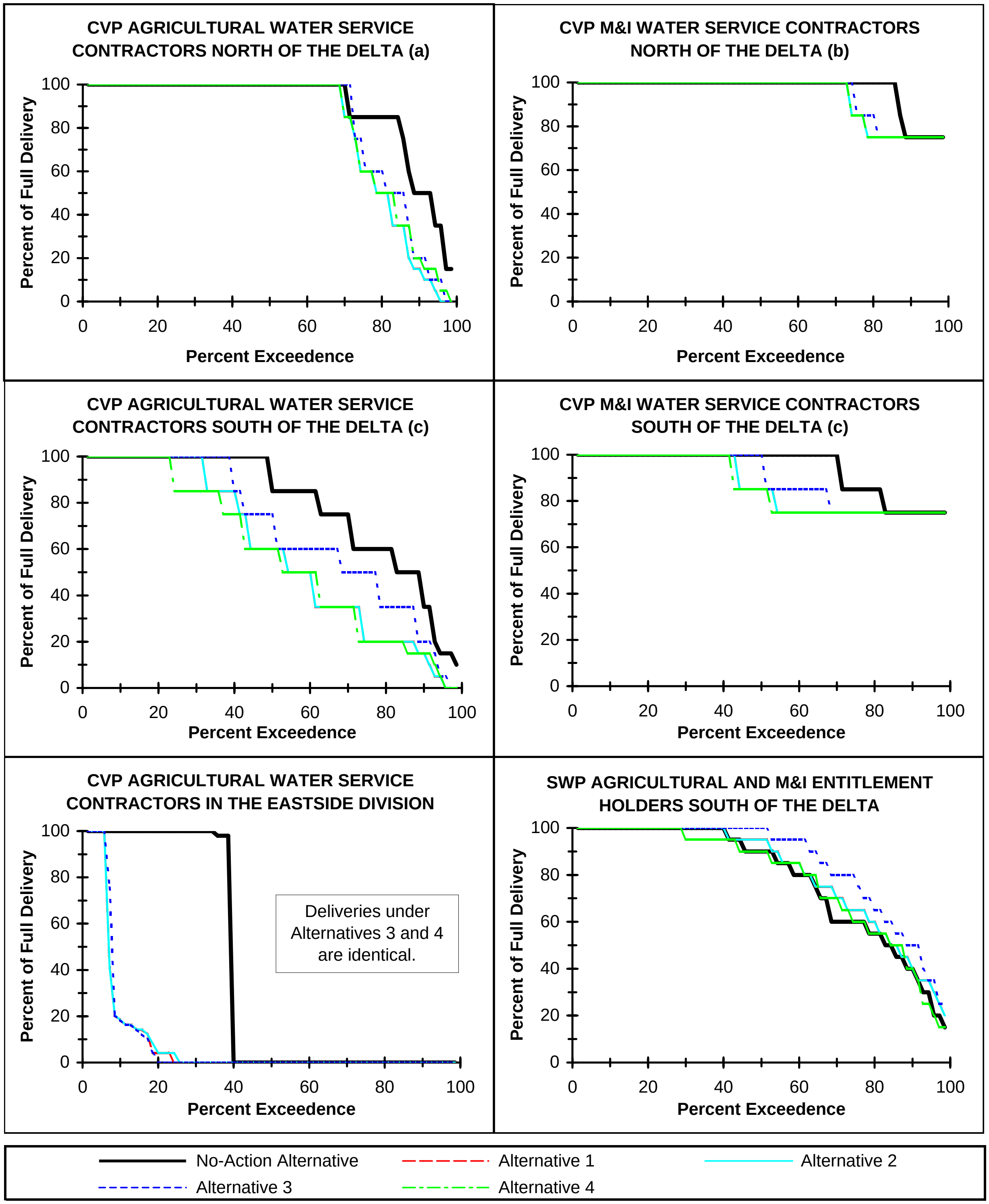
		CVP Deliveries (in 1,000 af)	Differences in CVP Deliveries in Comparison to the No-Action Alternative (in 1,000 af)			
Contract Years	**Type of Period**	**No-Action Alternative**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
1922 - 1990	Simulation Period	5,770	-470	-590	-390	-620
1928 - 1934	Dry Period	4,560	-510	-620	-340	-590
1967 - 1971	Wet Period	6,310	-290	-410	-300	-470

NOTES:
(1) CVP deliveries include deliveries to agricultural and M&I water service contractors, Sacramento River Water Rights Contractors, other water rights contractors, and San Joaquin Exchange Contractors. CVP deliveries do not include refuge water supplies.
(2) Values in Alternatives 2, 3, and 4 include purchase of up to 130,000 acre-feet of water per year for level 4 refuges from the Sacramento River Water Rights and San Joaquin River Exchange Contractors.

1977, when all M&I contract and water rights deliveries from the river are reduced below 75 percent in the No-Action Alternative and Alternative 1. The figure shows that full M&I deliveries are reduced from 85 to 70 percent of the years in the 69-year simulation period.

CVP Deliveries Eastside Division. Frequency distributions of the simulated percent of full deliveries to CVP agricultural water service contractors on the Stanislaus River are shown for the No-Action Alternative and Alternative 1 in Figure IV-13. The reduction in deliveries results from the use of (b)(2) water to help meet target flows in the Stanislaus River. Partial or full deliveries would be made in approximately 10 to 20 percent of the years in Alternative 1, compared to approximately 40 percent of the years under the No-Action Alternative. A Reader's Guide to use frequency distribution curves is included in Attachment D.

CVP Water Deliveries South of the Delta. CVP deliveries south of the Delta include deliveries to San Joaquin River Exchange Contractors, and Agricultural and M&I Water Service Contractors. CVP deliveries to San Joaquin River Exchange Contractors would not change under Alternative 1, since their delivery deficiencies are based on the Shasta Criteria. Deliveries to Agricultural and M&I Water Service Contractors south of the Delta are a function of available CVP water supply and the amount of water that can be exported through Tracy Pumping Plant. The frequency distribution for the percent of full delivery to CVP Agricultural Water Service Contractors south of the Delta is presented in Figure IV-13. The figure generally shows a 20 to 30 percent reduction in the frequency of deliveries across all delivery levels, with the minimum delivery dropping from about 10 to 0 percent of full contract amount. The minimum delivery to M&I Water Service Contractors is limited to 75 percent of the contract amount, as shown in the frequency distribution in Figure IV-13. The minimum delivery is made in 20 percent of the years in the No-Action Alternative and about 50 percent of the years in



NOTE: (a) Includes Sacramento River and American River Divisions.
(b) Includes Sacramento River and American River Divisions plus Contra Costa exports.
(c) Includes Delta (DMC only), West San Joaquin, and San Felipe Divisions.

FIGURE IV-13
SIMULATED FREQUENCY OF PERCENT OF FULL ANNUAL DELIVERIES (CONTRACT YEARS 1922-1990)

Alternative 1. The figure shows that full M&I deliveries are reduced from 70 percent of the years in the 69-year simulation period in the No-Action Alternative to 40 percent in Alternative 1.

CVP Water Deliveries To Refuges. Alternative 1 provides delivery of firm Level 2 water supplies to refuges. Table IV- 4 shows the average annual increase of about 230,000 acre-feet in Alternative 1 CVP refuge deliveries as compared to the No-Action Alternative. About 60,000 acre-feet of this increase were assumed to come from non-CVP sources in the No-Action Alternative. The 25 percent deficiency to refuge deliveries in critical dry years is based on the Shasta Criteria, as it is in the No-Action Alternative.

TABLE IV-4

COMPARISON OF SIMULATED AVERAGE ANNUAL CVP REFUGE WATER SUPPLIES

		Refuge Water Supplies (in 1,000 af)	Differences in Refuge Water Supplies in Comparison to the No-Action Alternative (in 1,000 af)	
Contract Years	**Type of Period**	**No-Action Alternative**	**Alternative 1**	**Alternatives 2, 3, and 4**
1922 - 1990	Simulation Period	260	+230	+370
1928 - 1934	Dry Period	230	+200	+330
1967 - 1971	Wet Period	270	+230	+380

SWP Operations and Deliveries

This section provides a comparison of Alternative 1 and No-Action Alternative SWP reservoir operations, resulting river flows, and water deliveries to SWP contractors.

SWP Operations

SWP operations are affected by the changes in seasonal releases from upstream CVP reservoirs for target flows. These changes to CVP operations shift the timing of flow entering the Delta, and affect the SWP responsibility to help meet in basin water rights and Delta water quality requirements under the COA.

Lake Oroville and Feather River Operations. Small differences in SWP Lake Oroville operations are the result of changes in response to the availability of excess water in the Delta, as a function of (b)(2) Water Management and reduced diversions from the Trinity River Basin. These changes in water availability require different Lake Oroville releases to meet COA obligations and/or Delta water quality requirements. Figure IV-2 shows a comparison of the frequency distributions for Lake Oroville end-of-water year storage for Alternative 1 and the No-Action Alternative.

Simulated average monthly flows in the Feather River at Nicolaus in the No-Action Alternative and Alternative 1 are presented in Figure IV-14. The small differences in the flows reflect decreased fall and increased summer upstream Lake Oroville releases in response to Delta needs. However, the changes in flow are small in proportion to total flows at Nicolaus.

SWP Delta Operations. Delta inflows during fall and winter months are increased because of greater upstream CVP reservoir releases for target flows. In many years, the additional fall and winter Delta inflow exceeds the pumping capacity of the CVP Tracy Pumping Plant. When this occurs, the SWP has the potential to increase Banks Pumping Plant exports to take advantage of the excess water, or pump at capacity while reducing upstream releases from Lake Oroville. A comparison of frequency distributions of simulated annual exports through Banks Pumping Plant in the No-Action Alternative and Alternative 1 simulations is presented in Figure IV-11. In comparison to the No-Action Alternative, the average annual increase in SWP exports is about 70,000 acre-feet. Figure IV-15 shows a comparison of average monthly Banks exports for the dry, wet, and 69-year simulation period.

It is possible that a portion of the water pumped at the Banks Pumping Plant would be wheeled by the SWP for delivery to CVP Cross Valley Canal contractors.

San Luis Reservoir Operations. The Alternative 1 impacts to SWP storage in San Luis Reservoir are a direct result of changes in Banks Pumping Plant monthly exports. As shown in Figure IV-11, Alternative 1 average monthly SWP San Luis Reservoir storage levels are similar to the No-Action Alternative.

SWP Water Deliveries

Under Alternative 1, SWP deliveries to agricultural and M&I entitlement holders south of the Delta would increase by about 100,000 acre-feet on an average annual basis, as compared to the No-Action Alternative. A comparison of frequency distributions for the simulated percent of full contract delivery in the No-Action Alternative and Alternative 1 is presented in Figure IV-13.

The increase in SWP deliveries in Alternative 1 is due to the SWP's ability to adjust operations to take advantage of excess Delta inflows resulting from increased upstream CVP reservoir releases for target flows. If a portion of water pumped at Banks Pumping Plant is wheeled by the SWP for delivery to CVP Cross Valley Canal contractors, then the amount of additional SWP deliveries shown in Table IV-5 would be reduced.

ALTERNATIVE 2

Alternative 2 includes the CVPIA provisions in Alternative 1, plus the acquisition of surface water from willing sellers toward meeting the delivery of Level 4 water supplies to refuges and meeting target flows for chinook salmon and steelhead trout in Central Valley streams. The Re-operation and (b)(2) Water Management components of Alternative 2 are similar to these components in Alternative 1. Alternative 2 also includes the implementation of the same habitat restoration actions included in Alternative 1.

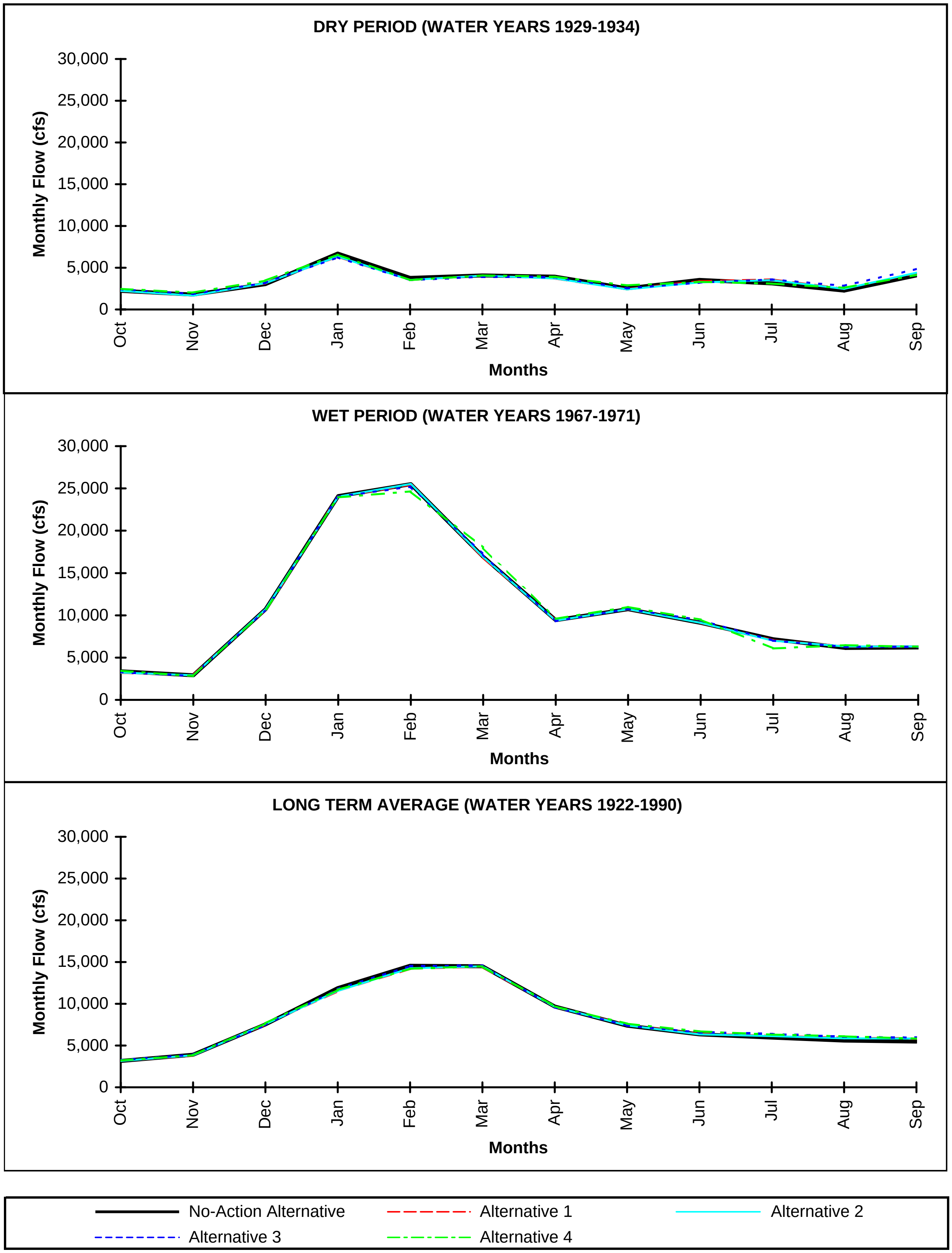


FIGURE IV-14

FEATHER RIVER AT NICOLAUS SIMULATED AVERAGE MONTHLY FLOWS

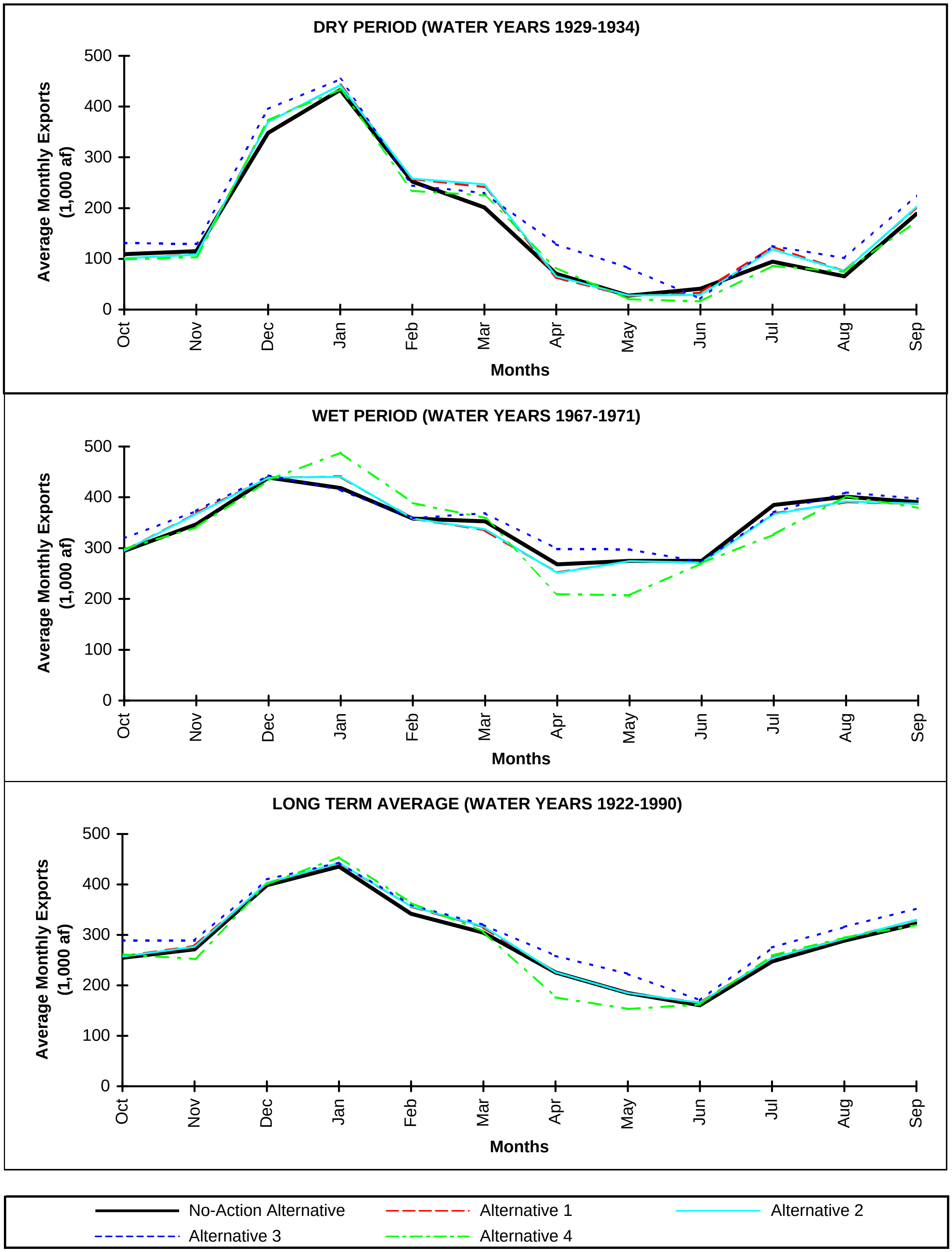


FIGURE IV-15

BANKS PUMPING PLANT SIMULATED AVERAGE MONTHLY EXPORTS

TABLE IV-5

COMPARISON OF SIMULATED AVERAGE ANNUAL SWP DELIVERIES

		SWP Deliveries (in 1,000 af)	Differences in SWP Deliveries in Comparison to the No-Action Alternative (in 1,000 af)			
Contract Years	**Type of Period**	**No-Action Alternative**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
1922 - 1990	Simulation Period	3,330	+100	+80	+270	-20
1928 - 1934	Dry Period	2,050	+150	+140	+350	0
1967 - 1971	Wet Period	4,140	-40	-70	+60	-150

NOTES:
(1) SWP deliveries include deliveries south of the Delta to entitlement holders. SWP deliveries do not include refuge water supplies.

Under Alternative 2, water would be acquired to provide delivery of Level 4 water supply requirements to wildlife refuges. It is assumed that this water would be acquired from reliable sources within the same geographic region as the refuges.

In addition, Alternative 2 includes the acquisition of water on the Stanislaus, Tuolumne, and Merced rivers, and the release of this water to help meet salmon and steelhead target flows on these streams, primarily the in April through June period, and to provide increased Delta outflow. Because this water would be acquired for both instream flows and Delta outflow, it could not be pumped by export facilities in the Delta.

Water Acquisition

Water Acquisition for Level 4 Refuge Water Supplies

In Alternative 2, water would be acquired to provide the difference between Level 2 and Level 4 refuge water supply requirements. A summary of assumed acquisition quantities is presented in Table IV-6.

Water Acquisition for Target Flows and Delta Outflow

Under Alternative 2, surface water supplies would be acquired from willing sellers on the Stanislaus, Tuolumne, and Merced rivers, and would be released to help meet target flows on these streams, and increase Delta outflow. The maximum quantity of water that would be acquired in Alternative 2 is limited by the funds available in the portion of the CVPIA Restoration Fund allocated for surface water acquisition.

TABLE IV-6

SURFACE WATER ACQUISITION FOR LEVEL 4 REFUGE WATER SUPPLIES

Refuge(s)	Annual Acquisition Amount (in 1,000 af)
Refuges North of the Delta	34.5
Refuges South of the Delta	130.8

For the purposes of this analysis, it is assumed that the maximum quantity of water to be acquired from each source would be the same in all years. This assumption approximates a condition of a long-term acquisition agreement that would stipulate a maximum annual quantity. Depending on hydrologic conditions, the actual amount of water that would be acquired in any year could be less than the maximum quantity.

The acquisition targets and long-term average acquisition quantities for water purchased from willing sellers for instream flows on the Stanislaus, Tuolumne, and Merced rivers is shown in Table IV- 7. The acquisition of up to 50,000 acre-feet from sources on the Merced River would occur in addition to the acquisition of 19,000 acre-feet for Level 4 refuge water supplies to the Merced NWR and East Gallo Unit. Therefore, the total amount of water acquired from willing sellers on the Merced would be up to 69,000 acre-feet.

TABLE IV-7

SUMMARY OF LONG-TERM AVERAGE ANNUAL WATER ACQUISITION QUANTITIES FOR INSTREAM FLOWS

	Alternative 2 (in 1,000 af)		Alternatives 3 and 4 (in 1,000 af)	
Location	**Target**	**Long-Term Average**	**Target**	**Long-Term Average**
Merced River	50	50	200	194
Tuolumne River	60	60	200	197
Stanislaus River	60	49	200	194
Calaveras River	--	--	30	27
Mokelumne River	--	--	70	62
Yuba River	--	--	100	87

It is assumed that water would be acquired from water rights holders on the Stanislaus, Tuolumne, and Merced rivers that possess diversion and storage rights on these rivers. The acquired water would be stored during the period of a contract year, and released in a manner to increase flows toward meeting the instream flow targets on these rivers and to increase Delta outflow. In effect, the acquisition of water would involve a shift in the release pattern from storage reservoirs, combined with a reduction in diversions by the willing sellers. It is assumed that acquired water would be stored and released from New Melones Reservoir on the Stanislaus River, New Don Pedro Reservoir on the Tuolumne River, and Lake McClure on the Merced River.

Under Alternative 2, the acquisition of water from willing sellers would be associated with reduced agricultural water use, and would therefore result in reduced return flows to downstream portions of the rivers. To avoid unintended impacts to downstream water users not involved in the sale or acquisition of water, base flow conditions would be maintained in portions of rivers that would be affected by the use of acquired water.

The target flows include pulse flow components on the Tuolumne and Merced rivers during April through June. Therefore, the primary emphasis for use of acquired water in Alternative 2 is during the months of April, May, and June. Simulated average monthly flows in the Merced River below Crocker Huffman Diversion in the No-Action Alternative and Alternative 2 simulations are shown in Figure IV-16. Simulated average monthly flows in the Tulumne River below La Grange Dam in the No-Action Alternative and Alternative 2 simulations are shown in Figure IV-17. A discussion of the changes in flow on the Stanislaus River and in the Delta are presented in the following section on CVP operations.

CVP Operations and Deliveries

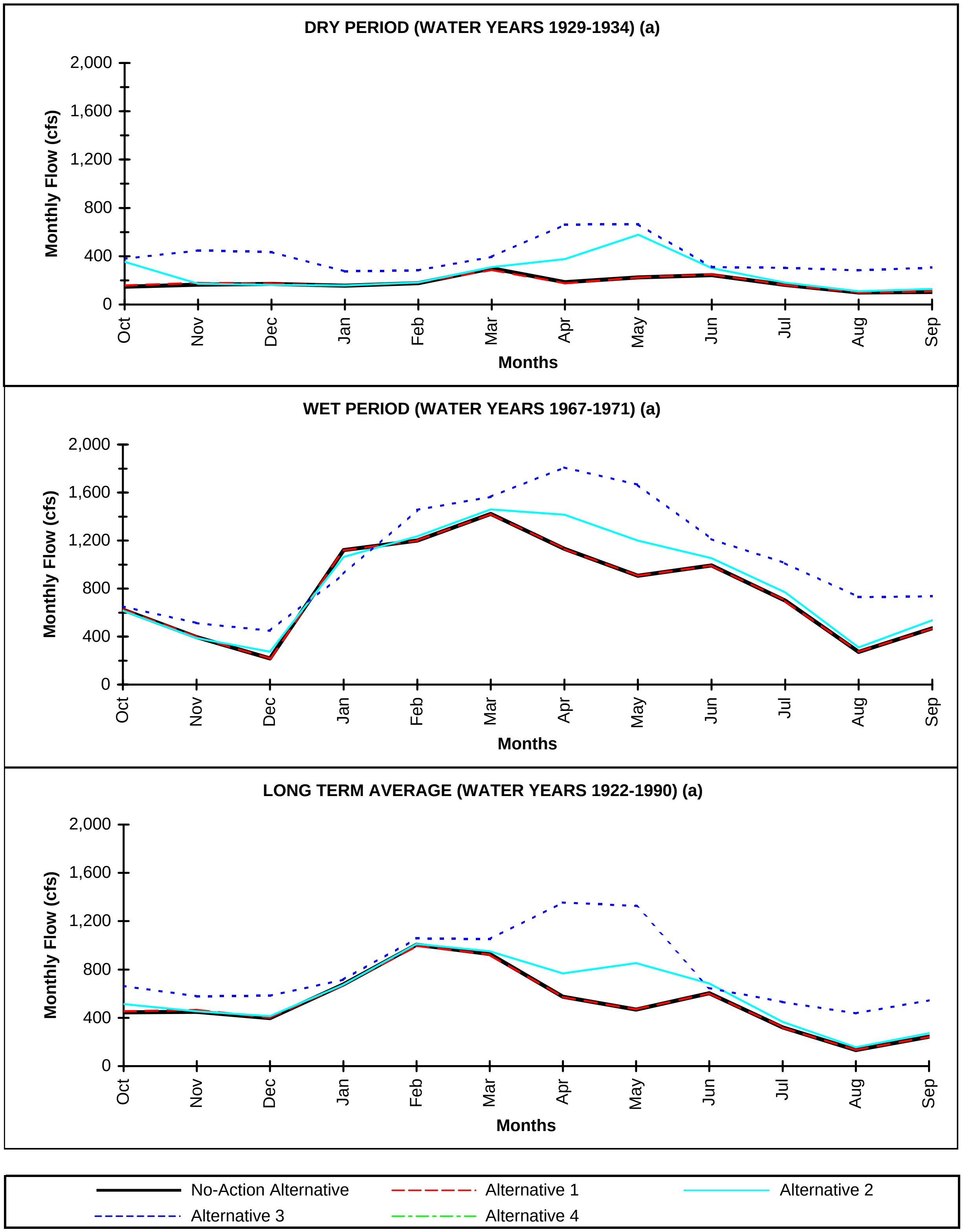
This subsection focuses on reservoir operations, resulting releases, and deliveries of water to CVP contractors. Discussions of the operations of CVP facilities and deliveries to CVP contractors are provided in the following sections.

CVP Operations

Under surface water acquisitions for target flows and refuge water supplies in Alternative 2, CVP reservoir operations and river flow regimes in the Trinity, Shasta, Sacramento, and West San Joaquin divisions would be similar to those described in Alternative 1. There would be a minor difference in operations due to a shift in reservoir releases for Level 4 refuge supplies. Figures presented under Alternative 1 also show the results of CVP operations under Alternative 2.

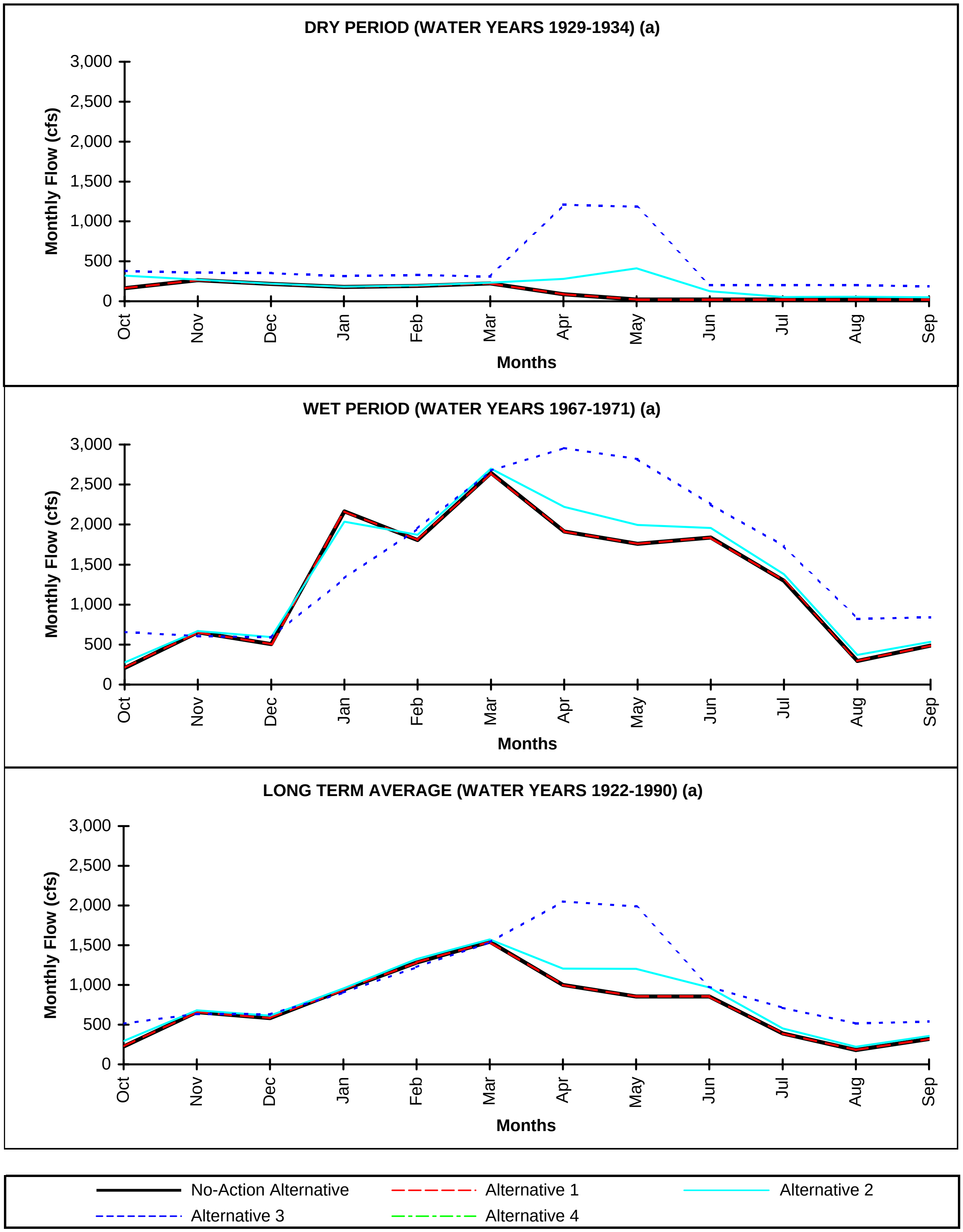
Friant division operations would be similar to the No-Action Alternative. The Delta and Eastside divisions would be affected by the water acquisitions on the Stanislaus, Tuolumne, and Merced rivers to help meet target flows on these streams, and increase Delta outflow. A discussion of impacts to operations in the Eastside and Delta divisions is presented below.

Eastside Division. As described under the operations under Alternative 1, target flows on the Stanislaus River would be met in the July through March period through reoperation and the use of (b)(2) water. Therefore, acquired water would not be required after the month of June to meet the Alternative 2 target flows. As a result, the acquisition and use of surface water on the Stanislaus River in Alternative 2 would result in little or no change in end-of-water year storage levels in New Melones Reservoir, as compared to Alternative 1 as shown in Figure IV-2.



NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-16
MERCED RIVER BELOW CROCKER HUFFMAN
SIMULATED AVERAGE MONTHLY FLOWS



NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-17
TUOLUMNE RIVER BELOW LAGRANGE
SIMULATED AVERAGE MONTHLY FLOWS

Simulated average monthly flows in the Stanislaus River below Goodwin Dam are shown in Figure IV-7. This figure shows that releases of acquired water under Alternative 2 would increase flows primarily in the April through June period. On an average monthly basis, flows would meet target flows in nearly all months of above and below normal, dry, and critical year types. Although average monthly flows increase in the April through June period in wet year types, they would not meet the target flows.

Simulated average monthly flows in the San Joaquin River at Vernalis are shown in Figure IV-8. In the months of July through March, average monthly flows under Alternative 2 would be similar to those in the No-Action Alternative. In the April through June period, however, the releases of acquired water on the Stanislaus, Tuolumne, and Merced rivers would result in increased flows on the San Joaquin River at Vernalis.

Frequency distributions of simulated monthly water quality on the San Joaquin River at Vernalis during the irrigation and non-irrigation seasons are shown in Figure IV-9. Under Alternative 2 operations, water quality at Vernalis would exceed the applicable water quality standards in approximately the same number of months during the simulation period as in the No-Action Alternative. During the irrigation season, water quality would be at concentrations below the standard (improved water quality) more frequently under Alternative 2, as compared to the No-Action Alternative. The water quality standard would be exceeded less frequently during the non-irrigation season than under the No-Action Alternative.

Delta Division. Releases of acquired water during April and May would provide increased flows at Vernalis, which would contribute toward meeting the Bay-Delta Plan Accord pulse flow requirements. In Alternative 2, the increase in Delta inflow from the San Joaquin River would not be exported by the CVP or SWP. Therefore, the additional inflows would contribute directly to Delta outflow, increasing average annual Delta outflow by about 80,000 acre-feet.

CVP Deliveries

Under Alternative 2, water would be acquired from willing sellers for delivery to refuges and for release toward meeting the target flows. The release of acquired water on the Stanislaus, Tuolumne, and Merced rivers would not be available for export because this water would be released for both instream flow needs and for Delta outflow purposes. The amount of water that would be available for delivery to the CVP contractors would not be affected, except for the small amount that is assumed to be acquired from willing sellers for Level 4 refuge supplies. Therefore, CVP deliveries under Alternative 2 would be similar to those under Alternative 1 as shown in Table IV-3. Figure IV-13 shows the frequency distributions for water service contractors north and south of the Delta, and in the Eastside Division.

Average annual deliveries to refuges would include Level 4 water as shown in Table IV-4.

SWP Operations and Deliveries

Under Alternative 2, it is assumed that the SWP would not participate as a willing seller because SWP M&I contractors with first right of refusal would purchase the water. In addition, the release of acquired water would be prescribed for instream flows and Delta outflow beneficial uses. Therefore, the impacts to the SWP operations and deliveries would be similar to those described under Alternative 1 as summarized in Table IV-5, and shown in the figures described under the discussion of Alternative 1.

ALTERNATIVE 3

Water management provisions in Alternative 3 include all of the provisions included in Alternative 1, as well the acquisition of surface water from willing sellers toward meeting Level 4 water supplies for refuges, and the acquisition of water for increasing instream flows toward flow targets identified in Attachment G-4. Water would be acquired to improve instream flow conditions on the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Yuba rivers. Under Alternative 3, water acquired for instream purposes may be exported by the CVP and SWP when it flows into the Delta.

The reoperation and (b)(2) Water Management components of Alternative 3 would be similar to these components in Alternative 1. In Alternative 3 (b)(2) water is used for upstream actions on CVP controlled rivers only, and toward meeting 1995 Water Quality Control Plan requirements.

Water Acquisition

Water Acquisition for Level 4 Refuge Water Supplies

Under Alternative 3, water would be acquired in the same quantities and from the same sources described under Alternative 2, to provide Level 4 water supplies to wildlife refuges.

Water Acquisition for Target Flows

Under Alternative 3, surface water would be acquired from willing sellers on the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Yuba rivers for instream flow purposes. The methodology that was described under Alternative 2 would also be applied to water acquisitions in Alternative 3.

Maximum acquisition quantities for instream flows on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers included in Alternative 3 are shown in Table IV- 7. It is assumed that water would be acquired from agricultural water users on these rivers that possess diversion and storage rights. The acquired water would be stored during the period of a contract year, and released in a manner to increase flows toward the targets. It is assumed that acquired water would be stored and released from Lake McClure on the Merced River, New Don Pedro Reservoir on the Tuolumne River, New Melones Reservoir on the Stanislaus River, New Hogan Reservoir on the Calaveras River, Camanche Reservoir on the Mokelumne River, and New Bullards Bar Reservoir on the Yuba River.

The flow targets for Alternative 3 include spring pulse flow components on the Stanislaus, Tuolumne, and Merced rivers during April through June. Therefore, the primary emphasis for use of acquired water in Alternative 3 is generally during the months of April, May, and June. Releases of acquired water during these months would also provide increased flows at Vernalis, which would contribute toward meeting the Bay-Delta Plan Accord pulse flow requirements, if a portion of the pulse was unmet due to lack of available CVP supplies. A discussion of each of the non-CVP controlled rivers is included below. The Stanislaus River is discussed in the following CVP operations section.

As shown in Figure IV-16, the use of acquired water on the Merced River under Alternative 3 would result in increased flows in all months with the primary emphasis in April and May, as compared to the No-Action Alternative. During the wet period of 1967-1971, a slight reduction in average flows during January would occur under Alternative 3, as compared to the No-Action Alterative. This would occur primarily as a result of reduced storage conditions that would not require flood control releases. During dry periods, flows would increase in all months.

Similar changes in flow would occur on the Tuolumne River under Alternative 3, as shown in Figure IV-17. Flows would be increased primarily during the April-May spring pulse flow period. Reduced storage levels would reduce required releases for flood control in January. During dry periods, flows would increase in all months.

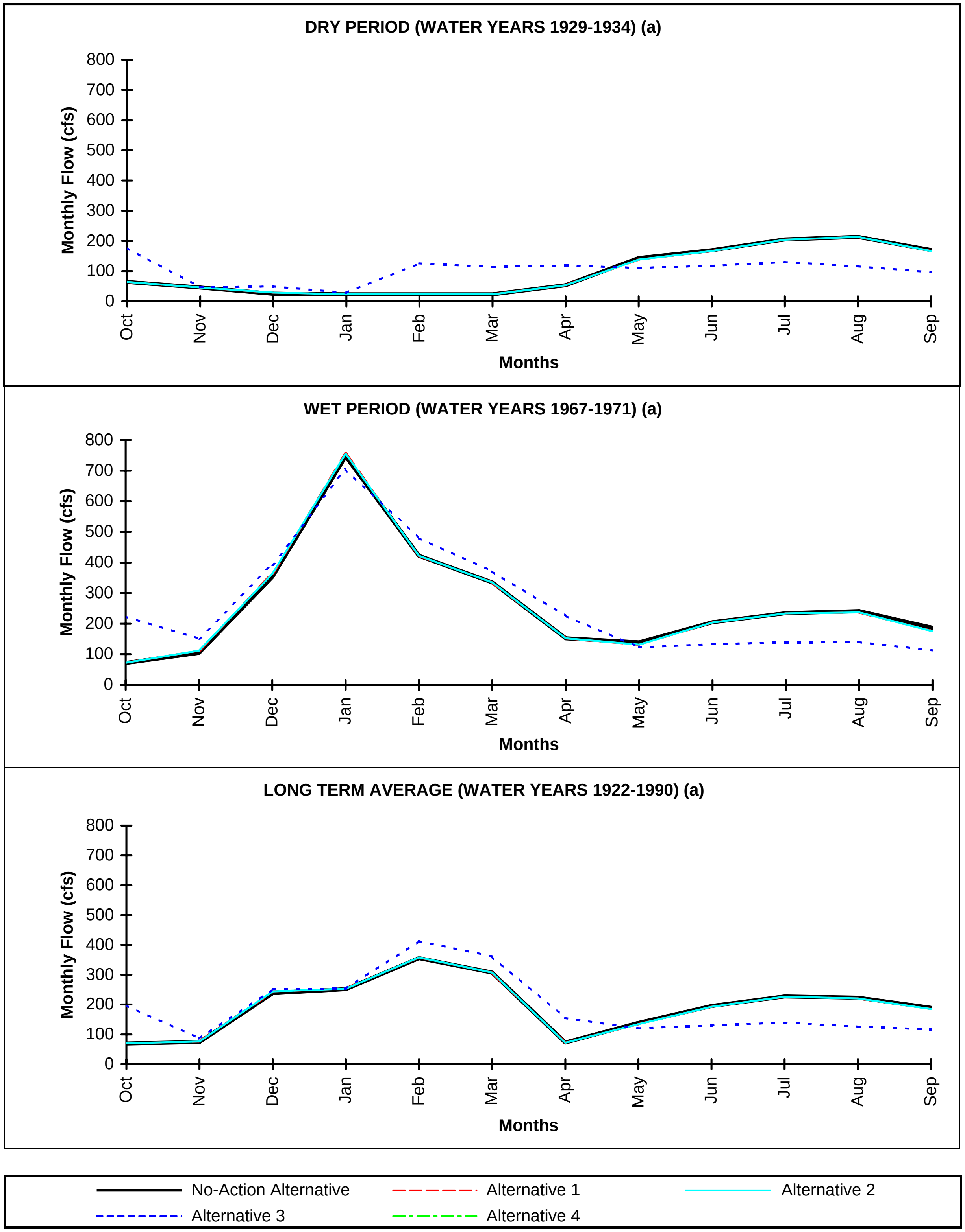
The flow targets on the Calaveras River in Alternative 3 were established for the reach between New Hogan Dam and the Belota Weir. This section of the river conveys releases for downstream agricultural diversion during the summer months. As shown in Figure IV-18, flows on the Calaveras River would increase in the winter and early spring months and decrease in the summer and fall months under Alternative 3 with the use of acquired water.

On the Mokelumne River, releases of acquired water result in increased flows in the fall through spring periods, with the greatest increases in April and May. As shown in Figure IV-19, flows during dry years would not change, due to the limited acquisition quantities during dry years.

On the Yuba River, releases from New Bullards Bar Reservoir and downstream diversions would be reoperated to provide water toward the flow targets under Alternative 3. As shown in Figure IV-20, the releases of acquired water would result in increased flows in the spring, summer, and fall months, as compared to flows under the No-Action Alternative.

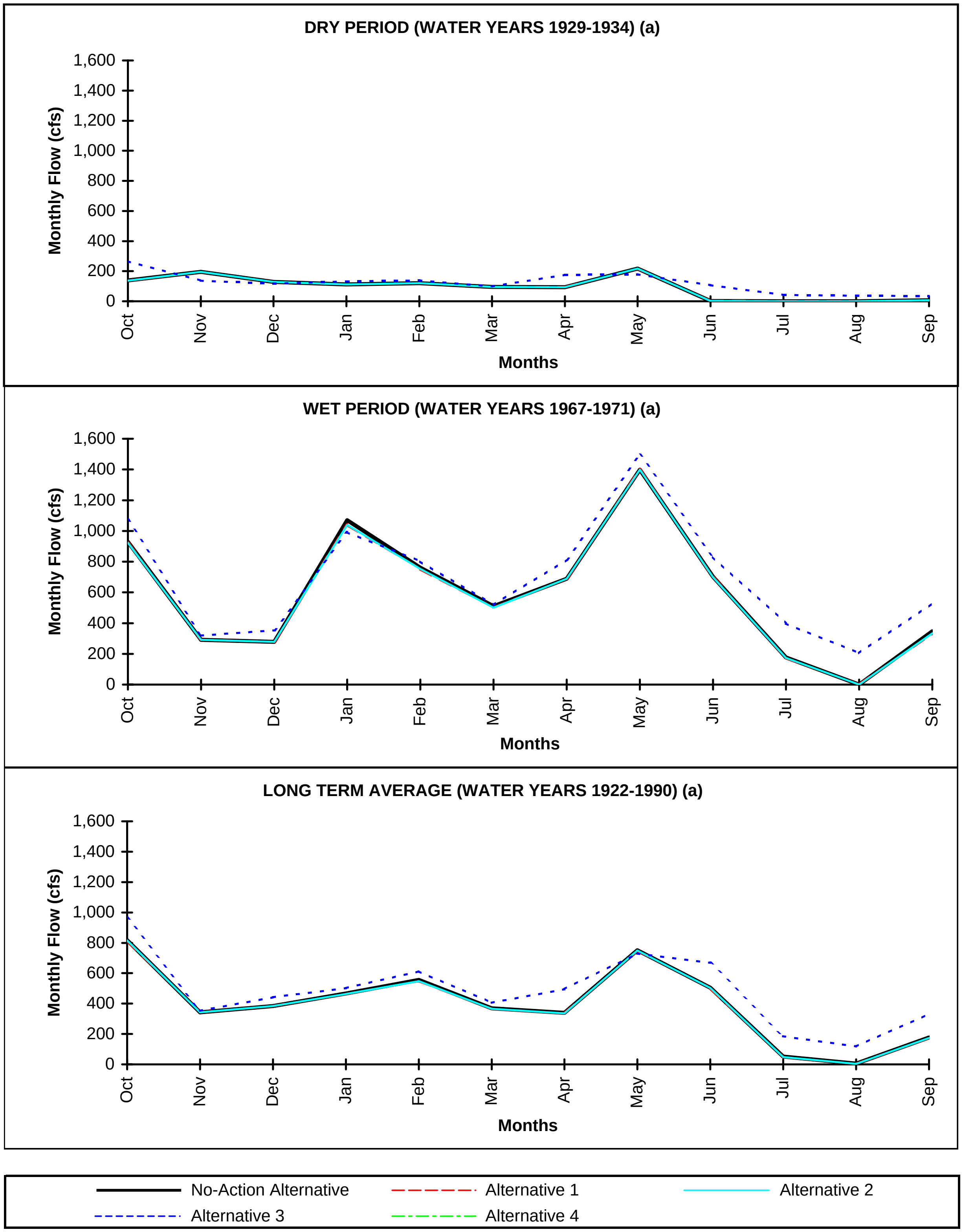
CVP Operations and Deliveries

Under Alternative 3, CVP operations north of the Delta would be similar to those described in Alternative 1. Delta operations and deliveries south of the Delta would change due to the ability to export acquired water in Alternative 3. A brief summary of CVP operations and deliveries is provided below.



NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-18
CALAVERAS RIVER BELOW NEW HOGAN
SIMULATED AVERAGE MONTHLY FLOWS



NOTE: (a) Simulated average monthly flows for Alternatives 3 and 4 are identical.

FIGURE IV-19
MOKELUMNE RIVER BELOW WOODBRIDGE
SIMULATED AVERAGE MONTHLY FLOWS

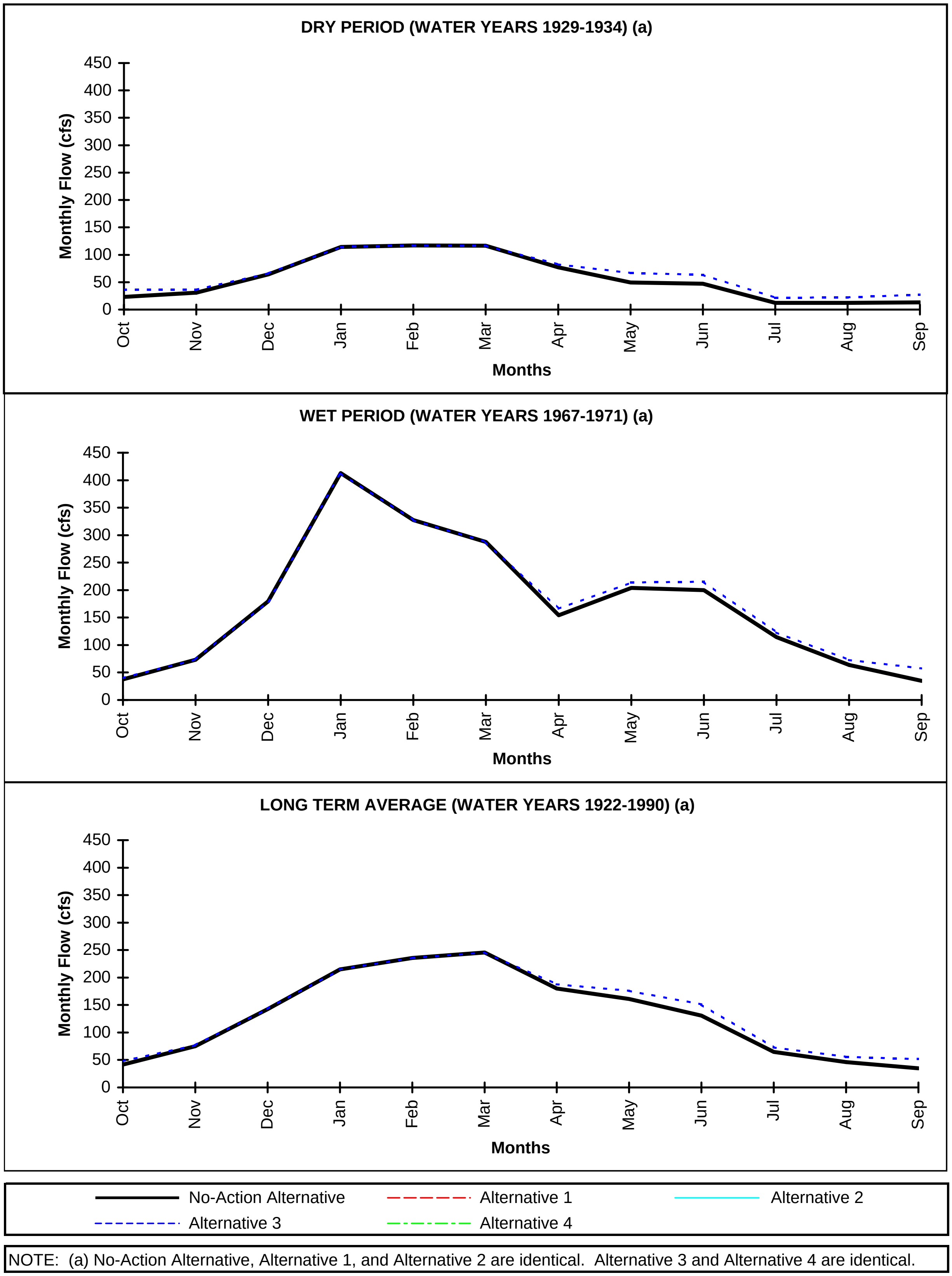


FIGURE IV-20

YUBA RIVER AT MARYSVILLE SIMULATED AVERAGE MONTHLY FLOWS

CVP Operations

CVP operations in the Trinity, Shasta, Sacramento River, and American River divisions would be similar to Alternative 1. Friant Division operations would be similar to the No-Action Alternative. Figures presented in Alternative 1 include the results of Alternative 3 operations and river flows for the these divisions. CVP operations in the Delta, Eastside, and West San Joaquin Divisions would be affected, due to higher San Joaquin River flows and the ability to export acquired water through Tracy Pumping Plant.

Eastside Division. Frequency distributions of simulated end-of-water year storages in New Melones Reservoir are presented in Figure IV-2. As shown on this figure, reservoir storages in Alternative 3 closely resemble storage conditions in Alternative 1, except during periods of near flood control storage levels, and periods with end-of-year storage between 1 and 1.5 million acre-feet. The increases in storage conditions in these circumstances result from a combination of improved flexibility in the operation of New Melones Reservoir due to higher flows on the San Joaquin River upstream of the Stanislaus River, and storage of portions of the acquired water.

The additional flow in the San Joaquin River due to the release of acquired water on both the Merced and Tuolumne rivers would improve water quality conditions, and reduce the quantity of required releases from New Melones necessary to maintain water quality conditions at Vernalis. Under Alternative 3 analysis, New Melones Reservoir operations were modified based on the increased flow on the San Joaquin River. This would result in increasing the frequency that target flows on the Stanislaus River would be met through reoperation and (b)(2) Water Management. End-of-year storage levels in New Melones Reservoir would also increase because a portion of the acquired water would be held through the end of the water year for release in October through December.

As shown in Figure IV-7, simulated average monthly flows in the Stanislaus River below Goodwin Dam under Alternative 3 would increase primarily in the April through June pulse flow period, with additional increases through the fall and winter months, as compared to the No-Action Alternative. The use of acquired water in accordance with biological priorities under Alternative 3 would result in flows below Goodwin Dam greater than 1,500 cfs more frequently than under the No-Action Alternative, or under Alternatives 1 and 2. Historical operations have indicated that flows above 1,500 cfs in this portion of the Stanislaus River can cause seepage and flooding problems to lands adjacent to the river.

The combined contribution of acquired water released on the Merced, Tuolumne, and Stanislaus rivers would result in increased flow in the San Joaquin River at Vernalis, as shown in Figure IV-8. On an average monthly basis, flows on the San Joaquin River at Vernalis would increase in nearly all months, with the increases primarily during April and May. The increased flow would also result in improved monthly water quality conditions, as shown in Figure IV-9. Under Alternative 3, water quality conditions at Vernalis would meet the monthly standards during both the irrigation and non-irrigation seasons in nearly all months of the simulation period.

Delta Division. As a result of upstream water acquisitions, simulated Delta inflows would increase by about 400,000 acre-feet in Alternative 3 as compared to the No-Action Alternative. In Alternative 3 this additional inflow may be exported by the CVP and SWP, as available under the COA. Figure IV-11 shows a comparison of the frequency distributions for simulated Tracy Pumping Plant annual exports. Under Alternative 3, annual exports through the Tracy Pumping Plant would decrease by about 90,000 acre-feet as compared to the No-Action Alternative, and increase by about 170,000 acre-feet as compared to Alternative 1. The CVP ability to export the acquired water is limited because the majority of the acquired water is released in the fall and the spring when Tracy Pumping Plant is already pumping at maximum regulatory or physical capacity. In addition, CVP releases from upstream reservoir cannot be reduced to take advantage of acquired water in the Delta, since (b)(2) water must be released in the fall and spring for upstream flow objectives. Figure IV-10 shows the change in average monthly exports as compared to the No-Action Alternative. Under Alternative 3, simulated Delta outflow would increase by about 200,000 acre-feet as compared to the No-Action Alternative, as shown in Figure IV-12.

West San Joaquin Division. Under Alternative 3, operations of the CVP portion of San Luis Reservoir are similar to those described under Alternative 1. As shown in Figure IV-11, simulated average monthly storage in Alternative 3 would be greater than in the No-Action Alternative, due to a combination of higher fall exports as part of (b)(2) Water Management and higher spring exports of acquired water.

CVP Water Deliveries

The CVP's ability to export acquired water is limited due to timing, and physical and regulatory limitations. Changes in delivery of water to CVP contractors between Alternative 3 and the No-Action Alternative are summarized in Table IV-3. Deliveries to CVP Sacramento River Water Rights Contractors would be similar to those described in the No-Action Alternative. Deliveries to CVP agricultural and M&I water service contractors north of the Delta and to agricultural water service contractors in the Eastside Division would also be similar to those in Alternative 1, as shown in Figure IV-13.

Deliveries to CVP San Joaquin Exchange Contractors would be similar to those described in the No-Action Alternative. Figure IV-13 shows the comparison of frequency distributions for CVP agricultural and M&I water service contractor deliveries as compared to the No-Action Alternative. The figure shows that water service contractors receive greater deliveries than in Alternative 1, due to the export of acquired water after it reaches the Delta. Alternative 3 includes annual deliveries of Level 4 water supplies to refuges as shown in Table IV- 4.

SWP Operations and Deliveries

SWP Operations

SWP operations and deliveries under Alternative 3 would be affected by the ability to export acquired water through Banks Pumping Plant. The large capacity of Banks Pumping Plant and the SWP's flexibility to reduce Lake Oroville releases would allow the SWP to adapt operations to take advantage of the acquired water as it becomes available in the Delta.

Lake Oroville and Feather River Operations. The slight differences in Lake Oroville end-of-water year storage are shown in a comparison of frequency distributions for Alternative 3 and the No-Action Alternative, in Figure IV-2. The difference in average monthly flows in the Feather River at Nicolaus are shown in Figure IV-14.

Delta Operations. SWP Banks Pumping Plant exports would increase in Alternative 3 by 270,000 acre-feet as compared to the No-Action Alternative. Frequency distributions for annual SWP exports are shown in Figure IV-11, and average monthly Banks Pumping Plant exports are shown in Figure IV-15.

San Luis Reservoir Operations. The Alternative 3 SWP average monthly storage in San Luis Reservoir is similar to the No-Action Alternative as shown in Figure IV-11.

SWP Water Deliveries

Annual deliveries to SWP agricultural and M&I entitlement holders south of the Delta under Alternative 3 would increase by an average of 270,000 acre-feet over the No-Action Alternative. This would occur because acquired water can be exported through Banks Pumping Plant after it reaches the Delta. A comparison of deliveries to SWP contractors in the Alternative 3 simulation, as compared to deliveries in the No-Action Alternative simulation, is provided in Table IV-5. Figure IV-13 shows a comparison of the SWP delivery frequency distributions for Alternative 3 and the No-Action Alternative.

ALTERNATIVE 4

Alternative 4 includes (b)(2) Water Management to meet target flows on CVP controlled streams and toward 1995 Water Quality Control Plan requirements, the delivery of firm Level 2 water supplies to wildlife refuges, and the revised minimum streamflow requirements on the Trinity River, as described under Alternative 1. In addition, Alternative 4 includes the acquisition of water for the delivery of Level 4 water supplies to wildlife refuges, as described under Alternative 2, and the acquisition of water for instream flows as described under Alternative 3. In addition, Alternative 4 includes the (b)(2) Water Managment Delta component and attempts to meet AFRP objectives in the Delta. A simplified version of (b)(2) Water Management was developed that integrated Delta (b)(2) water actions into Alternative 4. In contrast to the proposed preliminary February 1996 Delta (b)(2) actions that are evaluated in Supplemental Analysis 1a, the Delta (b)(2) actions evaluated in Alternative 4 were developed based on preliminary information released by the Service in October 1996, which is presented in Attachment G-5. The Delta (b)(2) actions outlined in Attachment G-5 are a refinement of the preliminary potential actions originally proposed in February 1996, and represent possible goals for long-term actions.

Water Acquisition

Under Alternative 4, water would be acquired from willing sellers to improve instream flows and to increase Delta outflow. The acquisition quantities, and the use of water for instream flow would be the same as those described under Alternative 3. Water would be acquired for increased instream flows on the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Yuba rivers. Water would also be acquired for delivery of Level 4 water supplies to wildlife refuges, in the same manner as described under Alternative 2. Figures IV-16 through IV-20 show the Alternative 4 flows on the above rivers, except for the Stanislaus River, which is described in the section on Eastside Division operations.

CVP Operations and Deliveries

CVP operations and water deliveries under Alternative 4 would be affected by the integrated use of (b)(2) water for upstream and Delta objectives. Deliveries to CVP contractors under Alternative 4 would be similar to deliveries under Alternative 1. Deliveries would not increase in Alternative 4 as a result of water acquired from willing sellers, since the water is acquired for instream and Delta outflow purposes, and therefore cannot be exported by the CVP. The CVP does receive some incidental benefit toward meeting Delta water quality and outflow requirements, since the increase in Delta outflow from acquired water improves monthly antecedent conditions in the Delta.

CVP Operations

CVP operations in the Trinity, Shasta, Sacramento River, and American River divisions would be similar to those described under Alternative 1. Operations of upstream CVP reservoirs would occur due to changes in Delta operations, but because the operation of these reservoirs is dominated by the need to make releases for water rights, upstream (b)(2) water objectives, and biological opinion requirements, the changes would be minor. Figures presented under Alternative 1 show a comparison of Alternative 4 operations and river flows for the above divisions, as compared to the No-Action Alternative. Friant Division operations would be similar to those described under the No-Action Alternative.

Eastside Division operations would be similar to those described under Alternative 3 because the acquisition of water from willing sellers on the Stanislaus, Tuolumne, and Merced rivers is identical in Alternatives 3 and 4. Operations in the Delta and West San Joaquin Divisions would be the most affected due to higher Delta inflows from acquired water and the additional Delta (b)(2) actions. The operations of these divisions are discussed below.

Delta Division. As a result of upstream water acquisitions, simulated Delta inflows increase by about 400,000 acre-feet in Alternative 4 as compared to the No-Action Alternative. In Alternative 4 this additional inflow may not be exported by the CVP, since it was acquired for instream and Delta outflow purposes. Tracy Pumping Plant exports decrease by about 300,000 acre-feet as compared to the No-Action Alternative, and decrease by about 40,000 acre-feet as compared to Alternative 1. Figure IV-11 shows the frequency distributions for simulated annual Tracy Pumping Plant exports for Alternative 4 and the No-Action Alternative. The Delta (b)(2) actions in Alternative 4 limit Tracy Pumping Plant exports from April 15 through May 15, and require that additional water be released from upstream reservoirs in February through June for additional (b)(2) requirements. Figure IV-10 shows the decrease in average monthly Tracy Pumping Plant exports as compared to the No-Action Alternative.

Simulated Delta outflow increases by about 780,000 acre-feet as compared to the No-Action Alternative. Average monthly Delta outflows in the No-Action Alternative and Alternative 4 simulations are presented in Figure IV-12. The primary increase in Delta outflow occurs in April and May due to the increase in Delta inflows from acquired water upstream releases, the reductions in Tracy and Banks Pumping Plant exports, and additional (b)(2) water releases for increased number of (b)(2) days in May and June.

Some of the Delta (b)(2) actions could not be implemented in all years over the 69-year simulation period due to existing operational constraints and criteria. These constraints include the need to meet water rights requirements, maintain SWP deliveries at the No-Action Alternative level, and maintain Reclamation’s ability to provide adequate storage in Shasta Lake to meet Winter-Run Biological Opinion temperature control requirements. For a detailed description of the implementation of (b)(2) Water Management in the Delta, see the Surface Water Supplies and Facilities Operations Technical Appendix.

West San Joaquin Division. Operations of the CVP portion of San Luis Reservoir are similar to operations under Alternative 1. As shown in Figure IV-11, Alternative 4 simulated average monthly storage is greater in March than in the No-Action Alternative. This is caused by higher fall exports due to upstream CVP reservoir releases for (b)(2) Water Management. CVP San Luis Reservoir storage is also reduced earlier in the spring due to reduced Tracy Pumping Plant exports in April and May.

CVP Water Deliveries

In Alternative 4, upstream acquired water would not be exported through Tracy Pumping Plant when it reaches the Delta. Therefore, the major effect on CVP deliveries is due to the additional (b)(2) actions in the Delta. These actions have minor effects on CVP deliveries north of the Delta, and primarily impact deliveries south of the Delta dependent on Tracy Pumping Plant exports. The changes in water deliveries to CVP contractors between Alternative 4 and the No-Action Alternative are summarized in Table IV-3.

Deliveries to CVP Sacramento River Water Rights Contractors would be similar to those described in the No-Action Alternative. Deliveries to CVP agricultural and M&I water service contractors north of the Delta would be similar to those in Alternative 1. The deliveries to CVP agricultural water service contractors in the Eastside division would be similar to those described in Alternative 1. Figure IV-13 show a comparison of the Alternative 4 and No-Action Alternative percent of full deliveries.

Deliveries to CVP San Joaquin Exchange Contractors would be similar to those described in the No-Action Alternative. Figure IV-13 shows the comparison of frequency distributions for CVP agricultural and M&I water service contractor deliveries as compared to the No-Action

Alternative. The figure shows that CVP water service contractors south of the Delta receive lower deliveries than in the No-Action Alternative, and slightly lower than in Alternative 1. The limitations on Tracy Pumping Plant April and May exports directly impact the amount of water that can be delivered to southern water service contractors.

Alternative 4 annual deliveries of Level 4 water supplies to refuges are the same as in Alternatives 2 and 3, as shown in Table IV-4.

SWP Operations and Deliveries

For the purposes of the PEIS (b)(2) Water Management analysis, it was assumed that the SWP would cooperate with implementation of the Delta (b)(2) actions by reducing exports during specified periods and making releases to contribute to additional levels of Delta protection. It was also assumed that any negative impacts to the SWP, due to this cooperation in Alternative 4, would not exceed the benefits shown in Alternative 1. Therefore, there would be no net impact on average annual SWP deliveries as compared to the No-Action Alternative.

SWP Operations

Alternative 4 SWP operations and deliveries are affected by (b)(2) Water Management upstream and in the Delta. The upstream CVP reservoir releases, in the fall for (b)(2) water flow targets, provide additional excess Delta inflow that can exported by the SWP. The Delta (b)(2) actions limit Banks Pumping Plant exports from April 15 through May 15, and require SWP releases for the additional number of (b)(2) days in May and June. The increase in Delta outflow due to the acquisition of water from upstream willing sellers provides incidental benefits to the SWP by improving antecedent monthly water quality conditions, so that Lake Oroville releases may be reduced in some months.

The slight differences in simulated Lake Oroville end-of-water year storage are shown in a comparison of frequency distributions for Alternative 4 and the No-Action Alternative, in Figure IV-2. The Alternative 4 simulated Feather River flows at Nicolaus are similar to the No-Action Alternative as shown in the comparison of average monthly flows in Figure IV-14.

Average annual SWP Banks Pumping Plant exports in Alternative 4 are similar to those estimated in the No-Action Alternative. Figure IV-11 shows a comparison of the frequency distributions for annual SWP exports. The reduction in average monthly Banks Pumping Plant exports in April and May as compared to the No-Action Alternative is shown in Figure IV-15. The Alternative 4 simulated SWP average monthly storage in San Luis Reservoir is similar to the No-Action Alternative as shown in Figure IV-11. SWP storage declines more rapidly in the April and May due to the reduced Banks Pumping Plant exports in those months.

SWP Water Deliveries

Alternative 4 simulated average annual deliveries to SWP agricultural and M&I entitlement holders south of the Delta are similar to annual deliveries under the No-Action Alternative. A comparison of deliveries to SWP contractors in the Alternative 4 simulation, as compared to deliveries in the No-Action Alternative simulation, is provided in Table IV-5. Figure IV-13 shows a comparison of the simulated SWP percent of full delivery frequency distributions for Alternative 4 and the No-Action Alternative. Full deliveries are slightly reduced, but deliveries in other years are greater than in No-Action Alternative, resulting in similar average annual values.

GROUNDWATER

This section describes changes to groundwater conditions associated with the CVPIA alternatives, as compared to the No-Action Alternative. Changes in groundwater conditions are presented for the study area shown in Figure IV-21, based on a quantitative analysis of the Central Valley region, and a qualitative analysis of groundwater resources associated with CVP service areas in the San Francisco Bay Region. A summary of the assumptions associated with each of the alternatives and Supplemental Analyses for the groundwater analyses is presented in Table IV-8. A summary of the groundwater impact assessment is presented in Table IV-9.

Groundwater conditions in the Central Valley regional aquifer system were simulated using the Central Valley Groundwater-Surface Water Simulation Model (CVGSM), a monthly planning model developed for the Central Valley regional aquifer system. Groundwater conditions were simulated using a 69-year historic hydrologic period under specified projected-level land use conditions. The 69-year period spans dry, wet, and normal hydrologic conditions. Imposing these conditions on the regional aquifer system provides a range of possible impacts.

Groundwater impacts for each alternative are summarized as changes to groundwater storage, groundwater levels, and land subsidence as compared to the No-Action Alternative. These conditions represent the groundwater basins' general response to changes in crop mix and irrigation technologies, surface water and groundwater use, and stream flow. Changes in groundwater storage are summarized for long-term average annual conditions. These changes indicate the ability of a groundwater basin to support water and land use management practices for each alternative. Groundwater levels at the end of the 69-year simulation period are compared between each alternative and the No-Action Alternative. The end of the simulation period was chosen in order to represent long-term differences in groundwater conditions. Groundwater level differences provide a measure of associated groundwater impacts such as pumping costs, changes in groundwater-surface water interaction, 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 of adjacent low-lying farm lands. These potential problems are all inferred from groundwater level differences between each alternative and the No-Action Alternative and are discussed qualitatively below, with the exception of pumping costs discussed under agricultural economics.

Declining groundwater levels can also be indicative of potential land subsidence in areas where clay and silt lenses susceptible to compaction are prevalent. The occurrence of land subsidence can damage water conveyance facilities, flood control and drainage levee systems, groundwater

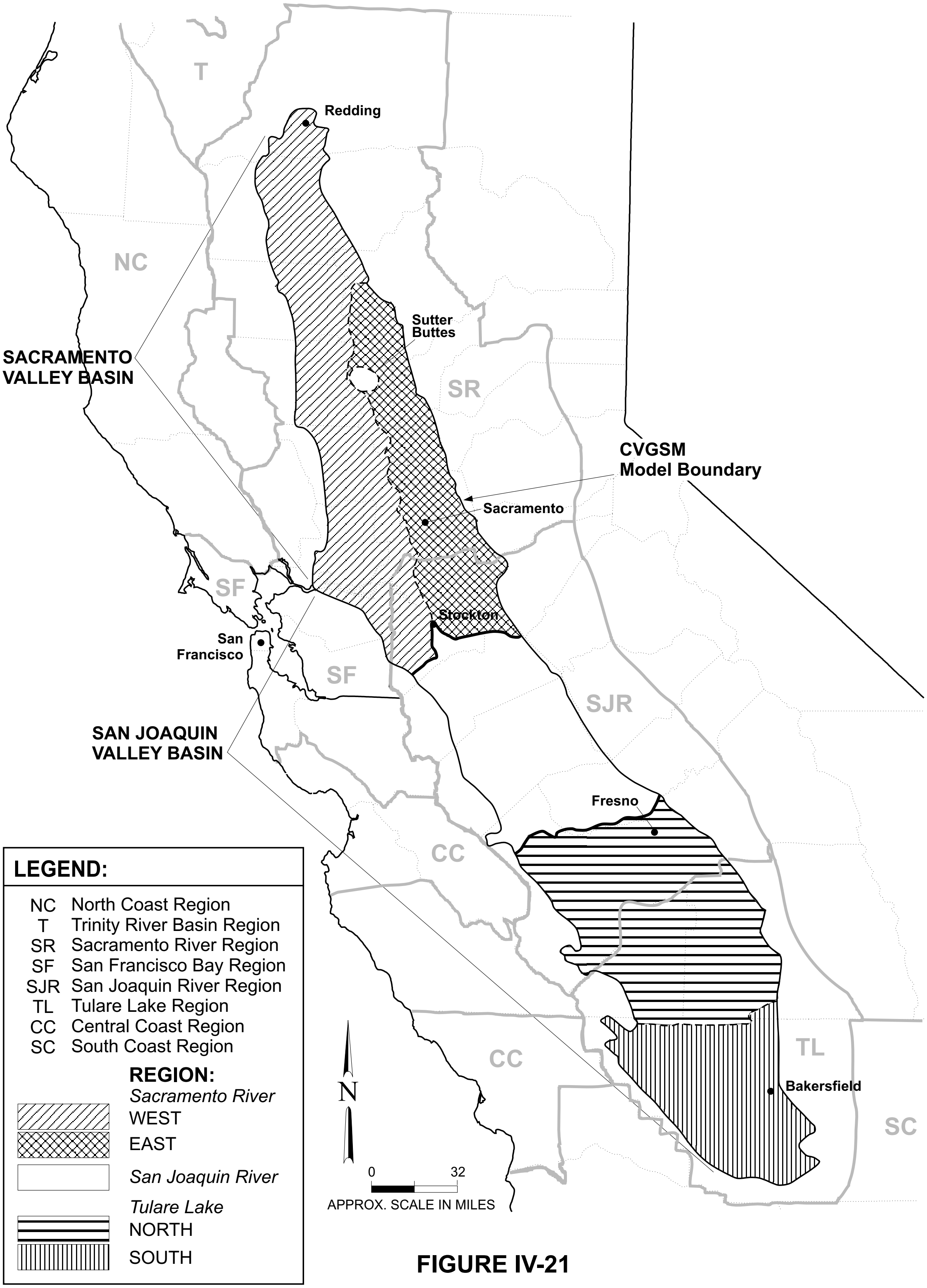


FIGURE IV-21

CVGSM MODEL AREA AND SUBREGION BOUNDARY

TABLE IV-8

SUMMARY OF ASSUMPTIONS FOR GROUNDWATER

Assumptions Common to All Alternatives or Supplemental Analyses	
Water delivery information based on Surface Water Analysis. Irrigated land use, applied water, and groundwater use consistent with Agricultural Economics and Land Use analysis.	
Alternative or Supplemental Analysis	**Assumptions Specific to the Alternative or Supplemental Analysis**
No-Action Alternative	Continued use of groundwater per California Department of Water Resources projections in Bulletin 160-93 and economic considerations.
1	Same as No-Action Alternative plus: Allow groundwater withdrawals to replace reductions in CVP deliveries due to implementation of (b)(2), Level 2 refuge water supplies, and increased Trinity River instream fishery flows. Decrease groundwater withdrawals in response to implementation of San Joaquin Valley Drainage Program land retirement recommendations.
1a	Increase groundwater withdrawals to replace reductions in CVP deliveries due to implementation of (b)(2) water in the Delta.
1b	Same assumptions as Alternative 1.
1c	Allow groundwater withdrawals to replace reductions in CVP deliveries due to price increases.
1d	Same assumptions as Alternative 1.
1e	Conditions are similar to Alternative 1 except in dry years when site-specific transfer operations may lead to reduction in applied water and associated groundwater recharge. Further site-specific analysis will be required.
1f	Conditions are similar to Supplemental Analysis 1e.
1g	Same assumptions as Alternative 1.
1h	Same assumptions as Alternative 1.
1i	Same assumptions as Alternative 1.
2	Same as Alternative 1 plus: No increase in groundwater withdrawals to replace acquired surface water. No acquisition of groundwater.
2a	Same as Alternative 2.
2b	Conditions are similar to Alternative X2 except in dry years when site-specific transfer operations may lead to reduction in applied water and associated groundwater recharge. Further site- specific analysis will be required.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Allow groundwater withdrawals to replace reductions in CVP deliveries due to price increases.

TABLE IV-8. CONTINUED

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
3	Same as Alternative 2 plus:
3a	No additional groundwater withdrawals due to surface water transfers.
4	Same as Alternative 3 plus: No increase in groundwater withdrawals to replace acquired surface water. No acquisition of groundwater.
4a	No additional groundwater withdrawals due to surface water transfers.
Revised No-Action Alternative	Same as No-Action Alternative.
Preferred Alternative	Same as Alternative 1 plus: No increase in groundwater withdrawals to replace acquired surface water. No acquisition of groundwater.

TABLE IV-9

SUMMARY OF IMPACT ASSESSMENT FOR GROUNDWATER

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	**Average Regional Depth to Groundwater** Sacramento River Region (west): 94 feet. Sacramento River Region (east): 100 feet. San Joaquin River Region: 85 feet. Tulare Lake Region (north): 200 feet. Tulare Lake Region (south): 313 feet. **Potential for Long-Term Change in Subsidence** Sacramento River Region: increase above Affected Environment near Davis-Zamora. San Joaquin River Region: increase above Affected Environment on westside. Tulare Lake Region: increase above Affected Environment on westside.
	Changes Compared to the No-Action Alternative
1	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): no change. Sacramento River Region (east): increase depth 2 percent. San Joaquin River Region: increase depth 2 percent. Tulare Lake Region (north): increase depth 3 percent. Tulare Lake Region (south): decrease depth 1 percent. **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative. San Joaquin River Region: increase from No-Action Alternative.

TABLE IV-9. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Tulare Lake Region: increase from No-Action Alternative.
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1 except in Tulare Lake Region (north) where average regional depth to groundwater increases by 6 percent.
1b	Conditions are similar to Alternative 1.
1c	Changes in groundwater conditions will depend on revised surface water operations. Use of non-delivered CVP water not determined at this time.
1d	Conditions are similar to Alternative 1.
1e	Conditions are similar to Alternative 1, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
1f	Conditions are similar to Supplemental Analysis 1e.
1g	Conditions are similar to Alternative 1.
1h	Conditions are the same as Alternative 1.
1i	Conditions are the same as Alternative 1.
	Changes Compared to the No-Action Alternative
2	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): increase depth 1 percent. Sacramento River Region (east): increase depth 2 percent. San Joaquin River Region: increase depth 3 percent. Tulare Lake Region (north): increase depth 4 percent. Tulare Lake Region (south): decrease depth 1 percent. **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative. San Joaquin River Region: similar to Alternative 1. Tulare Lake Region: similar to Alternative 1.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	Conditions are similar to Alternative 2, except in dry years when site-specific transfer operations may affect surface water operations. Further site-specific analyses will be required.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Changes in groundwater conditions will depend on revised surface water operations. Use of non-delivered CVP water not determined at this time.
	Changes Compared to the No-Action Alternative
3	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): increase depth 1 percent. Sacramento River Region (east): increase depth 5 percent. San Joaquin River Region: increase depth 4 percent. Tulare Lake Region (north): increase depth 1 percent. Tulare Lake Region (south): decrease depth 3 percent.

TABLE IV-9. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Potential for Long-Term Change in Subsidence Sacramento River Region: same as No-Action Alternative. San Joaquin River Region: less than Alternative 1. Tulare Lake Region: less than Alternative 1.
3a	Conditions are similar to Alternative 3, except in dry years when site-specific transfer operations may affect groundwater operations. Further site-specific analyses will be required.
	Changes Compared to the No-Action Alternative
4	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): increase depth 1 percent. Sacramento River Region (east): increase depth 5 percent. San Joaquin River Region: increase depth 5 percent. Tulare Lake Region (north): increase depth 5 percent. Tulare Lake Region (south): decrease depth 1 percent. **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative. San Joaquin River Region: similar to Alternative 1. Tulare Lake Region: increase from Alternative 1.
4a	Conditions are similar to Alternative 4, except in dry years when site-specific transfer operations may affect groundwater operations. Further site-specific analyses will be required.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting from implementing the Preferred Alternative.	**Average Regional Depth to Groundwater** Sacramento River Region (west): 94 feet Sacramento River Region (east): 101 feet San Joaquin River Region: 85 feet Tulare Lake Region (north): 201 feet Tulare Lake Region (south): 322 feet **Potential for Long-Term Change in Subsidence** Sacramento River Region: increase above recent conditions near Davis-Zamora San Joaquin River Region: increase above recent conditions on wes tside Tulare Lake Region: increase above recent conditions on west side
Preferred Alternative Changes as Compared to the Revised No-Action Alternative	**Change in Average Regional Depth to Groundwater** Sacramento River Region (west): no change Sacramento River Region (east): increase depth 1% San Joaquin River Region: increase depth 3% Tulare Lake Region (north): increase depth 5% Tulare Lake Region (south): no change **Potential for Long-Term Change in Subsidence** Sacramento River Region: same as No-Action Alternative San Joaquin River Region: increase from No-Action Alternative Tulare Lake Region: increase from No-Action Alternative

well casings, and other infrastructure. The CVGSM model simulates land subsidence based on aquifer compaction theory developed by the USGS. Potential land subsidence impacts for each alternative as compared to the No-Action Alternative are based on long-term land subsidence, which for this analysis is derived from the end of the 69-year simulation period.

NO-ACTION ALTERNATIVE

Central Valley Region

Groundwater levels representing the end of the 69-year simulation of the No-Action Alternative are shown in Figure IV-22. Along the west side of the Sacramento River Region the groundwater gradient tends to follow surface hydrographic features, except for a groundwater depression in the Yolo County area. This type of groundwater gradient suggests that groundwater conditions are near a state of equilibrium, as supported by the small change in the long-term average annual groundwater storage shown in Table IV-10. The hydraulic connection between streams and the underlying groundwater tables in these areas would be maintained similar to recent historic conditions. Groundwater levels on the east side of the Sacramento River Region are dominated by groundwater level depressions occurring north and south of the City of Sacramento, and in eastern San Joaquin County. These conditions are a reflection of groundwater use in excess of groundwater recharge, and would result in an average annual groundwater storage decline of 60,000 acre-feet. Hydraulic disconnection between stream reaches and underlying groundwater tables has developed historically in these areas, and under the No-Action Alternative would likely expand to affect larger reaches of these streams.

Land subsidence is known to occur in central Yolo County (see Davis-Zamora area, Figure VI-22). Under the No-Action Alternative, with groundwater levels declining in this area, increased land subsidence would likely occur relative to recent historic conditions. Groundwater quality would likely be degraded due to the induced migration of groundwater, high in total dissolved solids (TDS), known to exist south of the Sutter Buttes and southern Yolo County, toward depressed groundwaters to the south and east of this areas. Potential Boron problems in central Yolo County could also contribute to groundwater quality degradation from this induced migration. Agricultural subsurface drainage problems in the Sacramento River Region would not be altered as a result of prevailing groundwater conditions, and are expected to be similar to recent historic conditions. Average flows in the Sacramento River are similar to or lower than recent historic conditions in isolated areas subject to seepage-induced waterlogging. In addition, high groundwater tables did not encroach on these areas.

It is expected that waterlogging of low-lying farm land in these areas under the No-Action Alternative in the Sacramento River Region would not be altered as a result of prevailing groundwater conditions.

Under the No-Action Alternative groundwater levels at the end of the 69-year simulation on the east side of the San Joaquin River and Tulare Lake regions also generally follow hydrographic features associated with the San Joaquin River major tributaries and Tulare Lake Region streams. The hydraulic connection between San Joaquin River tributaries and underlying groundwater tables is similar to recent historic conditions. Portions of eastside streams are hydraulically disconnected from underlying groundwater tables under recent conditions. From Madera County south to the Tulare-Kern County boundary, simulated groundwater levels are lower in comparison to recent historic conditions, increasing the extent of this hydraulic disconnection.

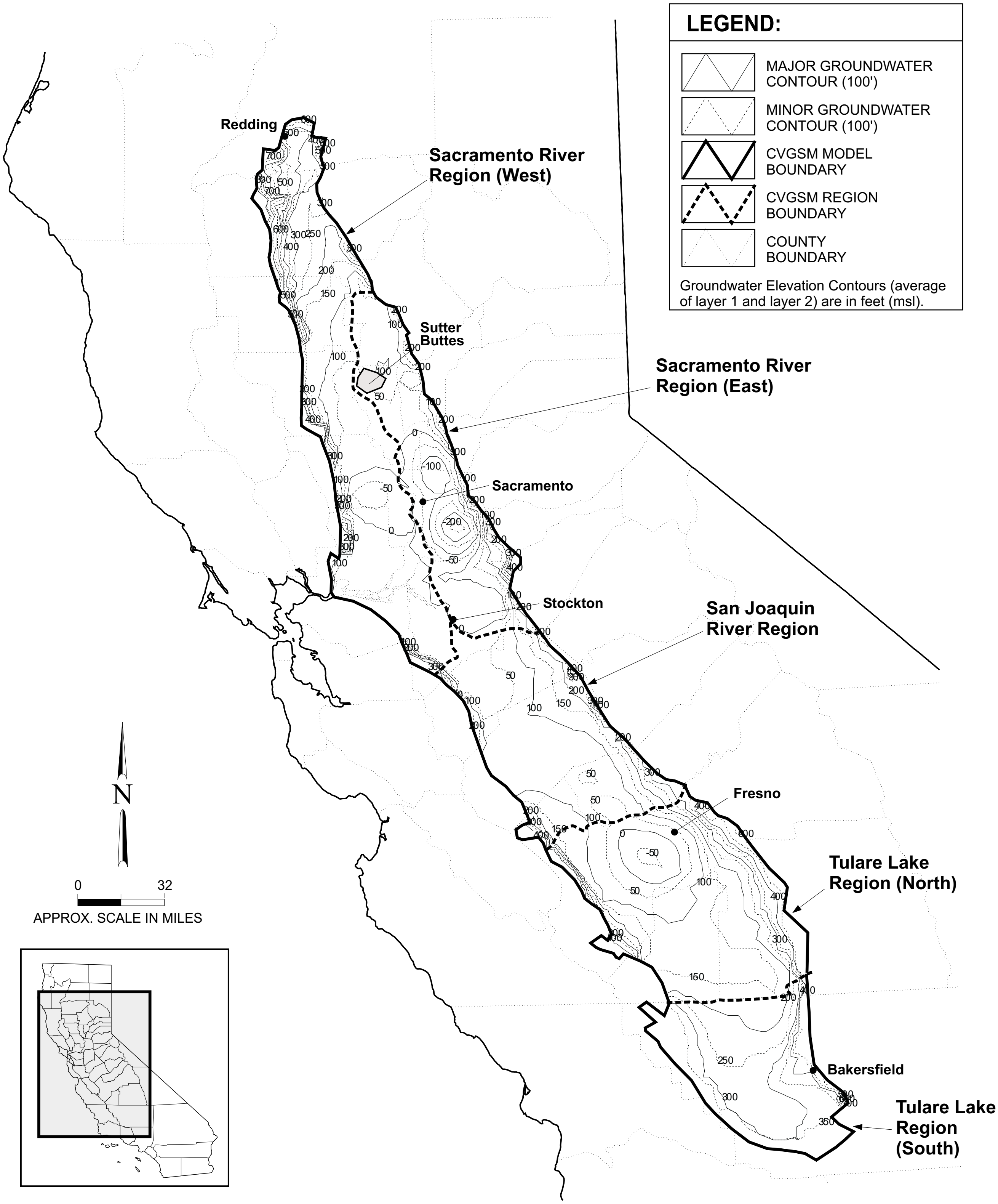


FIGURE IV-22

END OF SIMULATION GROUNDWATER ELEVATIONS FOR NO-ACTION ALTERNATIVE

TABLE IV-10

AVERAGE ANNUAL CENTRAL VALLEY GROUNDWATER CONDITIONS, 1922-1990, FOR ALTERNATIVES 1 THROUGH 4 AS COMPARED TO THE NO-ACTION ALTERNATIVE

	ALTERNATIVE (a)					DIFFERENCE (Alternative minus No-Action Alternative) (a)			
Region	**No-Action**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Sacramento River Region (West)									
Total Recharge	2034	2066	2065	2057	2062	32	31	23	28
Total Discharge	2038	2076	2074	2066	2071	38	36	28	33
Change in Groundwater Storage	-4	-10	-9	-9	-9	-6	-5	-5	-5
Sacramento River Region (East)									
Total Recharge	1725	1753	1760	1802	1803	28	35	77	78
Total Discharge	1785	1817	1825	1870	1872	32	40	85	87
Change in Groundwater Storage	-60	-64	-65	-68	-69	-4	-5	-8	-9
San Joaquin River Region									
Total Recharge	1849	1883	1894	1912	1902	34	45	63	53
Total Discharge	1875	1915	1928	1949	1944	40	53	74	69
Change in Groundwater Storage	-26	-32	-34	-37	-42	-6	-8	-11	-16
Tulare Lake Region (North)									
Total Recharge	3799	3833	3844	3802	3846	34	45	3	47
Total Discharge	4043	4129	4145	4057	4162	86	102	14	119
Change in Groundwater Storage	-244	-296	-301	-255	-316	-52	-57	-11	-72
Tulare Lake Region (South)									
Total Recharge	1529	1513	1518	1490	1521	-16	-11	-39	-8
Total Discharge	1411	1380	1384	1337	1395	-31	-27	-74	-16
Change in Groundwater Storage	118	133	134	153	126	15	16	35	8

NOTES:
(a) All values in 1,000 acre-feet/year. For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

Along the west side of the San Joaquin River Region groundwater levels vary gradually over much of the region. Groundwater levels in the extreme northern end decline toward groundwater depression areas in eastern San Joaquin County, and in the southern end they decline in the direction of depressed groundwater levels occurring in Fresno County. This large depression area is associated with an average annual groundwater storage decline that would occur in the Tulare Lake Region (North) of 243,000 acre-feet, the largest regional storage decline of the No-Action Alternative. Available water supplies have been augmented historically with surface water imported through the San Luis Canal and Friant-Kern Canal. However, under the No-Action Alternative projected level conditions, groundwater pumping would still occur at a rate in excess of groundwater storage replenishment.

Land subsidence is known to occur along the west side of the San Joaquin River and Tulare Lake regions as well as the southwestern portion of Tulare County and the southern end of Kern County. For the No-Action Alternative, increased land subsidence in this area would likely occur relative to recent historic conditions. Groundwater quality, under the No-Action Alternative for the San Joaquin River Region, would be similar to recent historic conditions. However, in the Tulare Lake Region groundwater quality would most likely be degraded due to the induced migration of groundwater with high TDS levels along the west side into the depressed groundwater levels in the mid-valley area, and possible upwelling of saline groundwater into productive groundwater zones. Groundwater contaminated with dibromochloropropane in eastern Fresno County could also be mobilized toward these depressed groundwater level areas. Some improvement of historic drainage and seepage problems would be expected as a result of regional groundwater level declines along the west side of the southern San Joaquin River Region and the west side of the Tulare Lake Region. However, increases in groundwater levels in the southern end of the Tulare Lake Region could possibly hinder agricultural subsurface drainage in areas of poorly drained soils.

San Francisco Bay Region

Groundwater resources of the San Francisco Bay Region are addressed qualitatively for areas receiving CVP project water. For the purposes of this analysis, present groundwater conditions described in Affected Environment are used as a frame of reference for determining potential impacts due to changes in CVP deliveries.

Groundwater resources in Santa Clara and San Benito counties are currently managed to minimize groundwater overdraft, land subsidence, and groundwater quality degradation. This task is facilitated by CVP project water imports via the San Felipe Division. Groundwater resources in parts of Alameda and Contra Costa counties are limited due to availability of supply, and poor water quality, and can result in groundwater overdraft and land subsidence in the absence of alternative supplies. The continued importation of CVP project water supplements these limited supplies and reduces the likelihood of further groundwater-related impacts.

ALTERNATIVE 1

The groundwater analysis for the Central Valley regional aquifer assumes groundwater pumping would increase to replace reductions in CVP or SWP deliveries to the extent that groundwater is economically feasible. In addition, Alternative 1 assumes that approximately 30,000 acres of land would be retired in the San Joaquin Valley in accordance with the San Joaquin Valley Drainage Program recommendations (SJVDP, 1990). This action results in reduced groundwater pumping in areas with retired lands.

Central Valley Region

The difference in groundwater levels at the end of the 69-year simulation between Alternative 1 and the No-Action Alternative are shown in Figure IV-23. This comparison indicates long-term regional groundwater conditions in the Sacramento River and San Joaquin River regions would be similar to the No-Action Alternative, with the exception of several isolated cases where groundwater levels would be lower by 10 to 20 feet. These differences would occur in response to reduced CVP project deliveries relative to the No-Action Alternative. These small declines would increase seepage rates of streams in contact with underlying groundwater tables. Regionally, the extent of hydraulic connection would not be greatly affected by these groundwater level changes, and would be similar to the No-Action Alternative. In the Sacramento River Region no additional land subsidence or changes in agricultural subsurface drainage conditions in comparison to the No-Action Alternative would occur. In the Sacramento River and San Joaquin River regions no change in groundwater quality or seepage-induced waterlogging relative to the No-Action Alternative would occur. Agricultural subsurface drainage conditions in the San Joaquin River Region would improve relative to the No-Action Alternative as a result of land retirement of approximately 1,200 acres in areas of poorly-drained soils.

Groundwater levels for Alternative 1 would be lower in comparison to the No-Action Alternative along the west side of the Tulare Lake Region, particularly in the northern portion of this region where differences exceeded 80 feet at the end of the 69-year simulation period. The groundwater budget for Tulare Lake Region (North) shows an overall increase in total recharge, but a larger increase in pumping. An increase in groundwater pumping of approximately 15 percent above the No-Action Alternative would occur in areas of this region receiving CVP project water. This increase is in response to decreased CVP Delta exports to these areas due to the dedicated water component of Alternative 1. This increase would be partially offset by decreased groundwater pumping in areas with land retirement. Total land retirement in the Tulare Lake Region (North) is approximately 17,200 acres. Average annual groundwater storage would decline an additional 20 percent relative to the No-Action Alternative.

The groundwater budget for the Tulare Lake Region (South) indicates groundwater recharge and pumping would decrease under Alternative 1 in comparison to the No-Action Alternative. The decrease in average groundwater pumping would occur in response to additional SWP Delta exports and land retirement. Total land retirement in the Tulare Lake Region (South) is approximately 11,600 acres. Groundwater levels in this area generally would increase slightly in comparison to the No-Action Alternative.

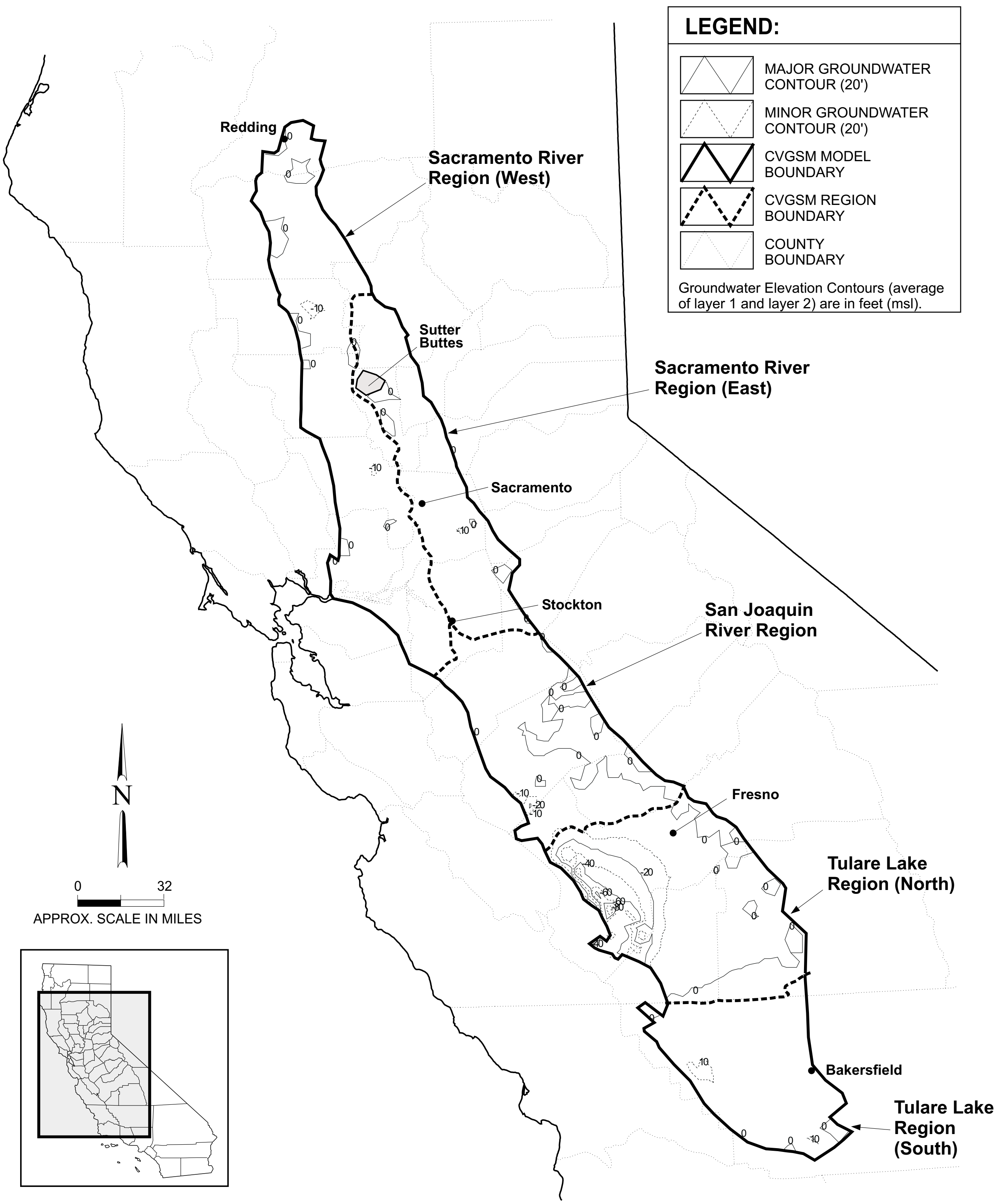


FIGURE IV-23

DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR ALTERNATIVE 1 AS COMPARED TO NO-ACTION ALTERNATIVE

The groundwater level differences along the west side of the southern San Joaquin River Region and the northern Tulare Lake Region would result in additional land subsidence, as shown in Figure IV-24, and would occur in the vicinity of the Delta-Mendota Canal and California Aqueduct. The presence of lower groundwater levels along the west side of the Tulare Lake Region in relation to No-Action Alternative could possibly cause additional upwelling of poor quality groundwater into productive groundwater zones. Agricultural subsurface drainage problems would improve in comparison to the No-Action Alternative as a result of land retirement of approximately 28,800 acres in areas of poorly-drained soils, and relative declines in groundwater levels. There are presently no regional seepage-induced waterlogging problems in the Tulare Lake Region and none of the options associated with Alternative 1 would initiate any seepage problem in comparison to the No-Action Alternative.

San Francisco Bay Region

Under Alternative 1, CVP deliveries to Santa Clara and San Benito counties would decrease on average 18,000 acre-feet per year relative to the No-Action Alternative. Local regulations of groundwater extraction by means of pump taxes, such as those levied by the Santa Clara Valley Water District, would discourage replacement of this CVP water with groundwater. For the purpose of this programmatic level of analysis it is assumed that any increase in groundwater pumping to offset these reduced CVP deliveries would be minimal. A small impact on groundwater conditions could occur in the vicinity of spreading basins as a result of lost deep percolation associated with the reduced CVP deliveries.

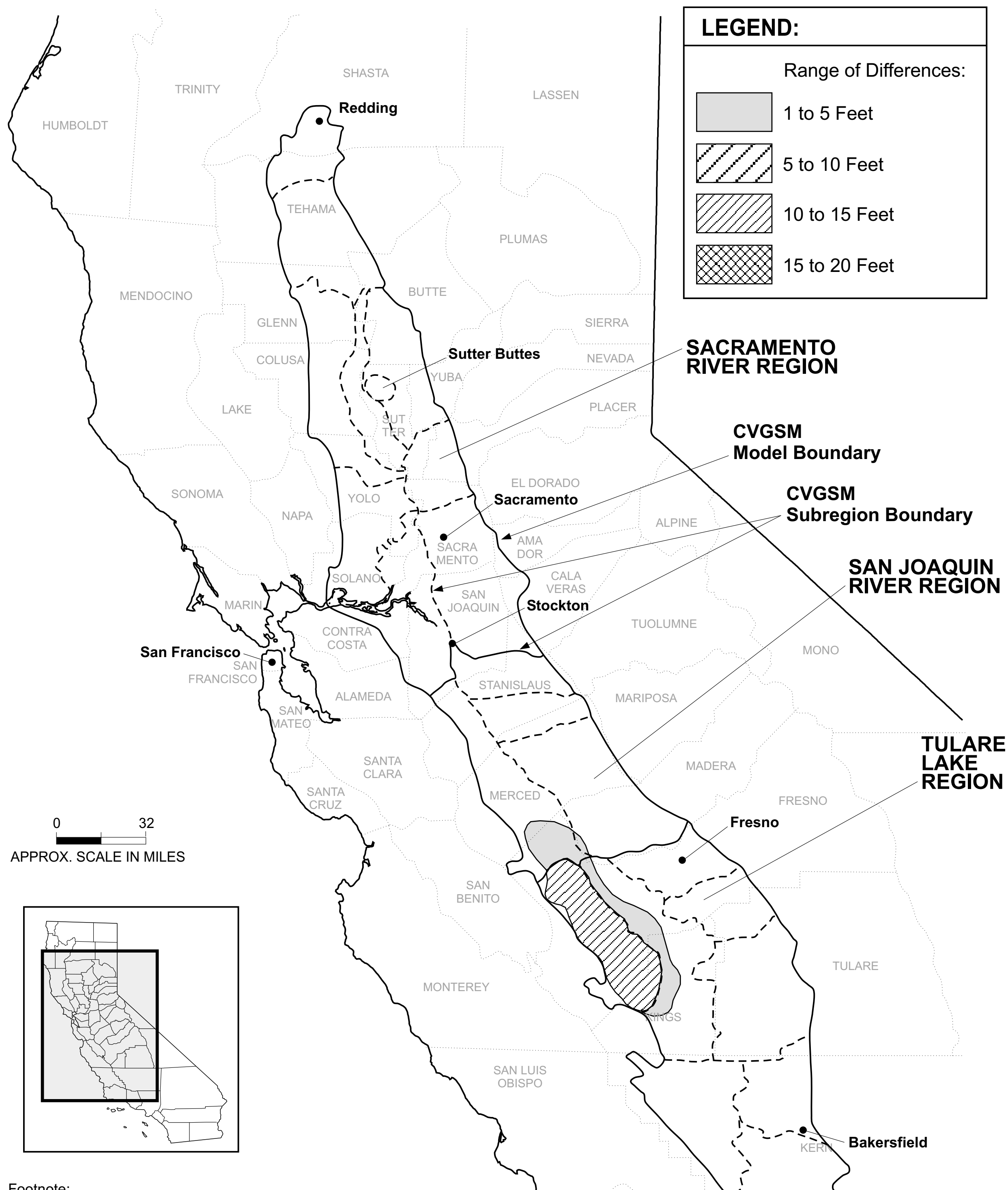
Under Alternative 1 CVP deliveries to Alameda and Contra Costa counties would be similar to the No-Action Alternative. Under these conditions no net impact on groundwater storage, levels, and quality would occur, and no additional land subsidence would occur in these areas.

ALTERNATIVE 2

Alternative 2 assumes that CVP water supplies would be replaced by increased groundwater pumping. However, the act does not allow increased groundwater pumping for purposes of replacement of acquired surface water. The analysis assumed that long-term average annual groundwater pumping under Alternative 1 would serve as the upper limit in areas of acquired water. However, economic incentive, triggered by other regions retiring lands due to water acquisitions, was responsible for increases in certain crop types in some areas resulting in increased groundwater pumping in these areas. The acquired water results in changes in crop mix and crop acreage, and irrigation technology impact, which are reflected as changes in water and land use practices in the groundwater analysis. All remaining assumptions underlying this analysis are the same as those for Alternative 1.

Central Valley Region

Differences in Alternative 2 groundwater levels, as compared to the No-Action Alternative for the end of the 69-year simulation are shown in Figure IV-25. Groundwater levels and quality, subsurface drainage conditions, and potential seepage problems in the Sacramento River Region would be similar to the No-Action Alternative, and in the Tulare Lake Region would be similar to Alternative 1.



Footnote:
Difference based on land subsidence occurring over the simulation period between Alternative 1 and the No-Action Alternative (Alternative 1 minus the No-Action Alternative). Values averaged over portions of CVGSM model subregions exhibiting land subsidence.

FIGURE IV-24

REGIONAL DIFFERENCES IN SIMULATED LAND SUBSIDENCE IN ALTERNATIVE 1 FROM NO-ACTION ALTERNATIVE

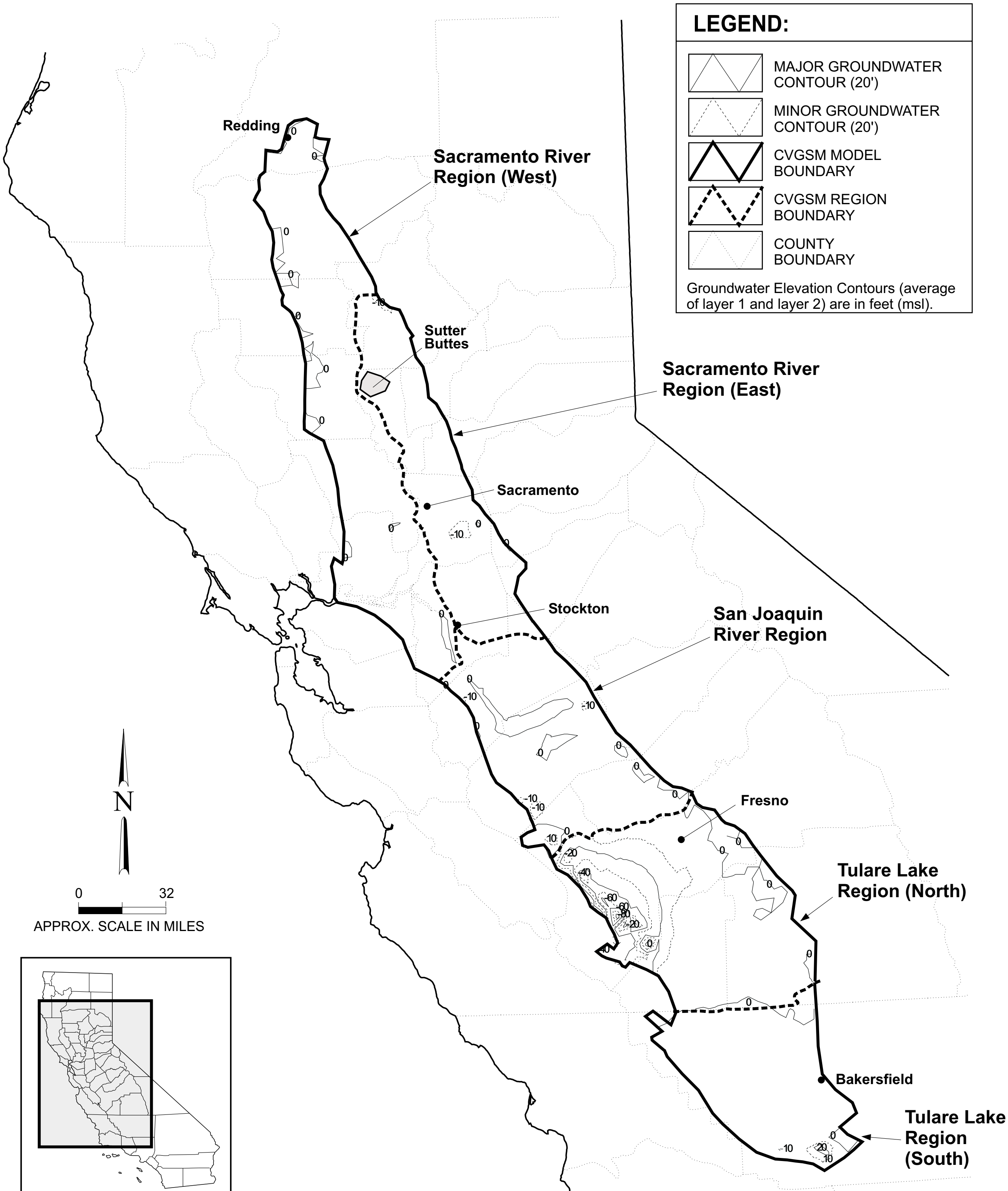


FIGURE IV-25

DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR ALTERNATIVE 2 AS COMPARED TO NO-ACTION ALTERNATIVE

Regional groundwater conditions in the San Joaquin River Region are generally similar to the No-Action Alternative. One difference occurs in the vicinity of the San Joaquin River basin tributaries where increased stream flows associated with acquired water would result in groundwater level increases relative to the No-Action Alternative. These increases would occur near areas of the San Joaquin River that have historically been sensitive to seepage-induced waterlogging problems. However, a comparison of flows in the San Joaquin River at Vernalis under Alternative 2 and the No-Action Alternative indicate no discernible differences. Based on this analysis, seepage problems to low-lying farm lands along the Stanislaus River and the lower reaches of the San Joaquin River are not expected to noticeably differ from the No-Action Alternative. These small differences in groundwater levels from the No-Action Alternative would not result in any changes in groundwater quality or agricultural subsurface drainage.

Additional land subsidence in comparison to the No-Action Alternative would occur in the San Joaquin River and Tulare Lake regions similar to Alternative 1.

San Francisco Bay Region

Changes in CVP deliveries to the San Francisco Bay Region would be the same as in Alternative 1. Impacts on groundwater resources as compared to the No-Action Alternative would be similar to those described for Alternative 1.

ALTERNATIVE 3

A key distinction of Alternative 3 from Alternative 2 is the assumption that the acquired water, once reaching the Delta, can be repumped as export deliveries out of the Delta. The groundwater analysis of Alternative 3 assumes groundwater pumping would be reduced as imported surface water supplies increased. The increased acquired water quantities also result in changes in crop mix and crop acreage, and irrigation technology. The groundwater analysis incorporates this information in the form of crop acreage and demands, and irrigation efficiencies. All remaining assumptions underlying this analysis are the same as those for Alternative 1 and 2.

Central Valley Region

Differences in the groundwater levels for the end of the 69-year simulation for Alternative 3 are shown in Figure IV-26. Groundwater conditions for the west side of the Sacramento River Region would be similar to the No-Action Alternative. Groundwater levels in the southeastern portion of the Sacramento River Region near the Calaveras River area of Eastern San Joaquin County in comparison to the No-Action Alternative would increase over the long term approximately 5 to 10 feet on a regional basis, primarily as a result of increased seepage from streams with increased flows from acquired water. Decreases in long-term groundwater levels of approximately 10 to 20 feet would occur on a regional basis in some areas along the east side from north of the Sutter Buttes to south of the City of Sacramento. This decrease would occur as a result of reduced deep percolation due to land fallowing associated with the acquisition of water, and increased groundwater pumping. Economic incentive to grow certain crop types, triggered by other regions retiring lands due to water acquisitions, was responsible for increases in groundwater pumping in these areas.

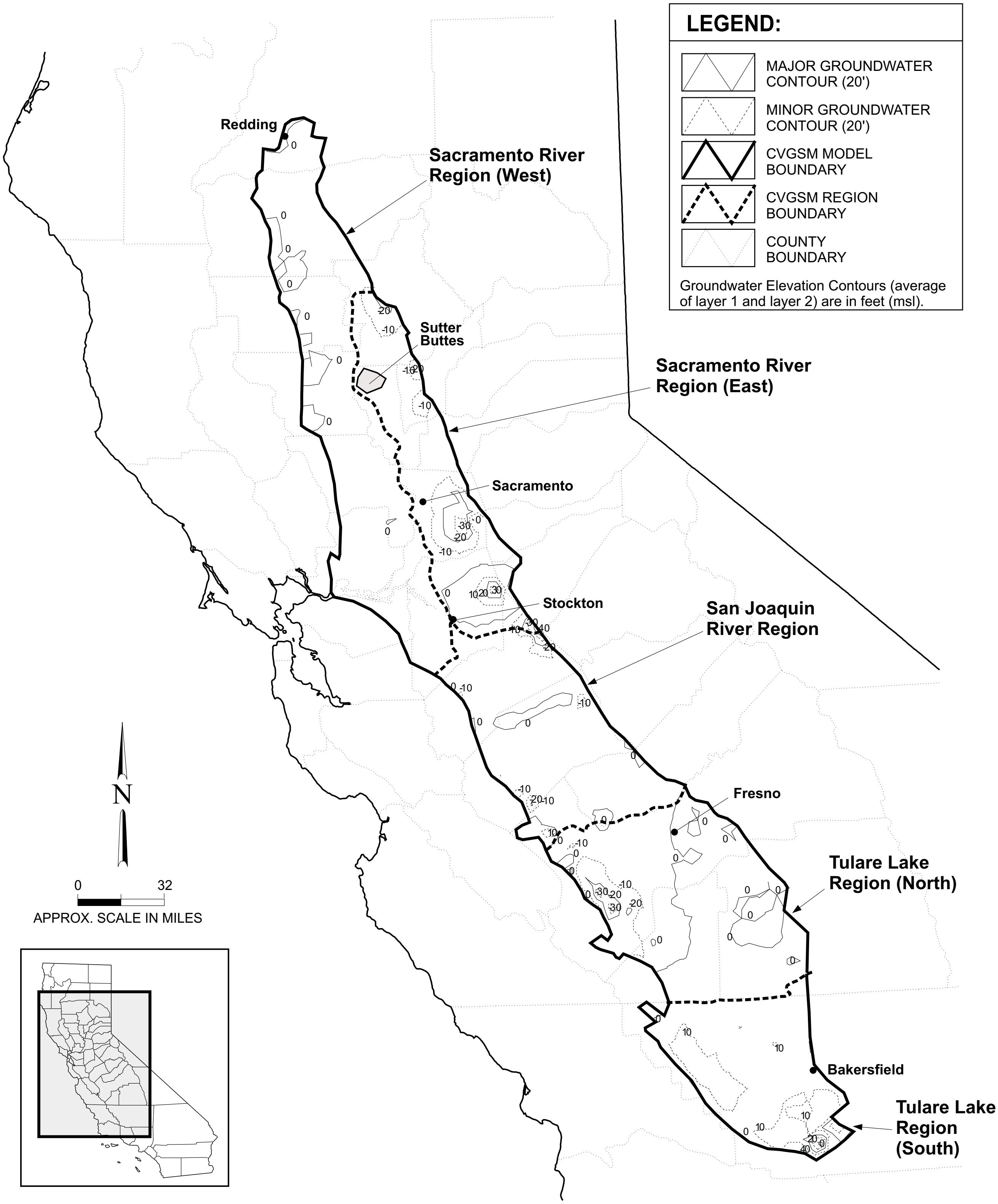


FIGURE IV-26

DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR ALTERNATIVE 3 AS COMPARED TO NO-ACTION ALTERNATIVE

No additional land subsidence or changes in groundwater quality, agricultural drainage, or seepage-induced waterlogging impacts would occur in the Sacramento River Region in comparison to the No-Action Alternative.

Groundwater conditions for the San Joaquin River Region would be similar to those described for Alternative 2, for different reasons however. In comparison to Alternative 2, Alternative 3 indicates less deep percolation from conveyance seepage. This is a result of reduced deliveries associated with water acquisitions. In contrast, Alternative 3 exhibits more recharge from stream seepage and subsurface flow from adjacent regions to the northeast, both a result of higher flows on streams with acquired water.

Long-term groundwater levels for the Tulare Lake Region would be lower in comparison to the No-Action Alternative along the west side, with differences exceeding 30 feet. This is primarily due to increased groundwater pumping in response to a reduction in imported CVP supplies. However, the decline in groundwater levels in this area would be smallest under this alternative in comparisons to all other alternatives because of the assumption that acquired water passing through the Delta can be repumped, which results in greater surface water deliveries to this area, and a reduction in groundwater pumping as compared to all other alternatives. This assumption is also responsible for the higher groundwater levels observed in the southern end of Tulare Lake Region in comparison to the No-Action Alternative. SWP deliveries to this area would increase under Alternative 3. These higher groundwater levels could possibly hinder agricultural subsurface drainage in this area relative to the No-Action Alternative. The groundwater budget for Tulare Lake Region (North) shows groundwater storage conditions are similar to the No-Action Alternative; however, groundwater levels are lower on the west side. The Tulare Lake Region (South) shows a decrease in recharge, but a larger decrease in pumping, which would result in an increase in groundwater storage, as compared to the No-Action Alternative.

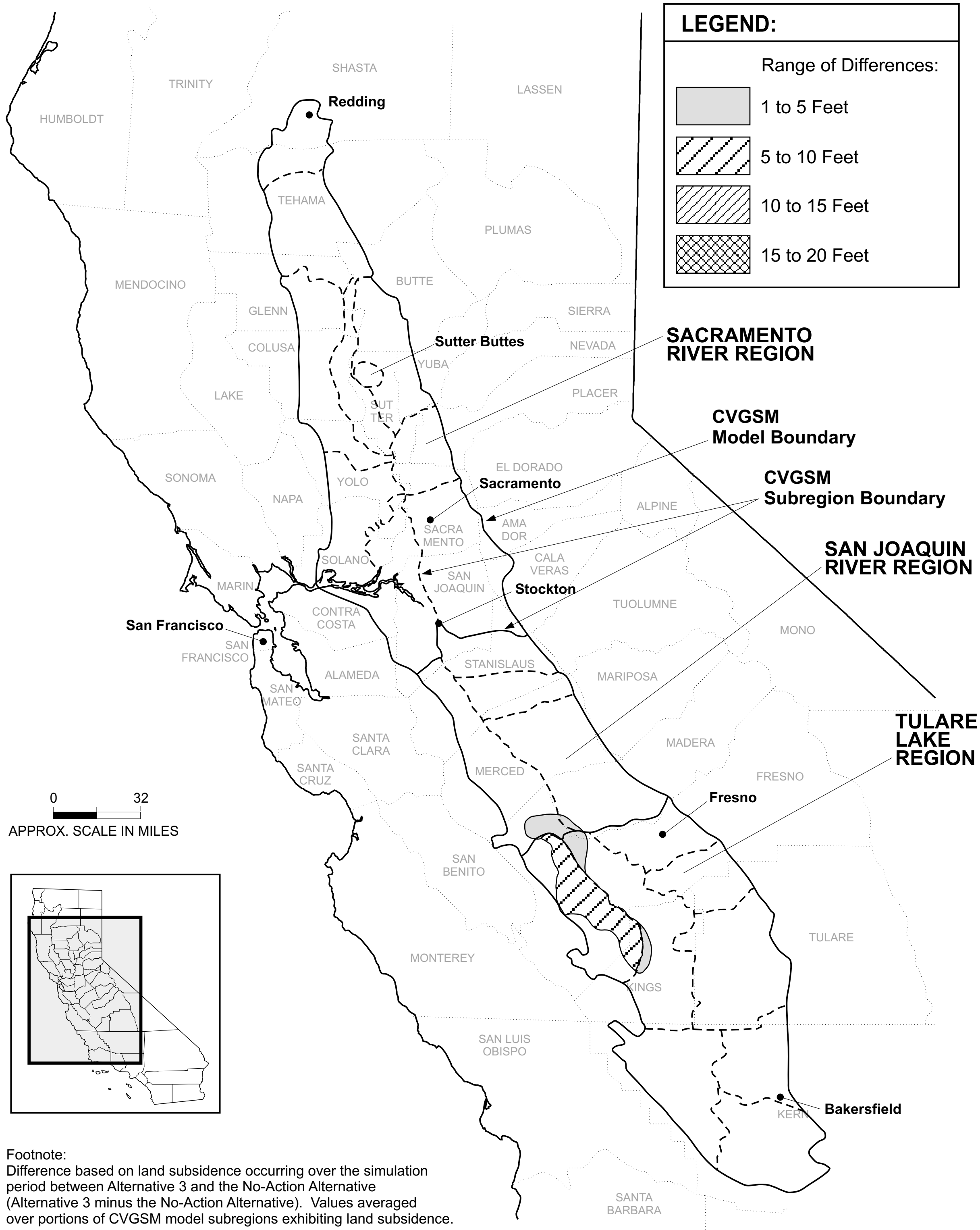
Additional land subsidence in comparison to the No-Action Alternative is shown in Figure IV-27. The area of land subsidence surrounds major conveyance facilities including the Delta-Mendota Canal and the California Aqueduct; however the smaller groundwater level declines in this area would lead to a smaller area of these aqueducts being subject to land subsidence damage. Changes to groundwater quality, agricultural subsurface drainage, and seepage-induced waterlogging would be similar to Alternative 1.

San Francisco Bay Region

CVP deliveries to the San Francisco Bay Region would be 10,000 acre-feet less than deliveries under the No-Action Alternative. Impacts on groundwater resources as compared to the No-Action Alternative would be similar to those described for Alternative 1.

ALTERNATIVE 4

Alternative 4 combines the effects of using dedicated water to meet a portion of AFRP Delta outflow requirements assumed in Supplemental Analysis 1a with the elements of acquired water from willing sellers assumed in Alternative 3. However, as in Alternative 2, the acquisition water was not allowed to be repumped as exports once reaching the Delta. Under this condition



Footnote:
Difference based on land subsidence occurring over the simulation period between Alternative 3 and the No-Action Alternative (Alternative 3 minus the No-Action Alternative). Values averaged over portions of CVGSM model subregions exhibiting land subsidence.

FIGURE IV-27

REGIONAL DIFFERENCES IN SIMULATED LAND SUBSIDENCE IN ALTERNATIVE 3 FROM NO-ACTION ALTERNATIVE

groundwater pumping would increase as CVP deliveries are reduced, as long as economically feasible. All remaining assumptions underlying this analysis are the same as those for Alternatives 1, 2, and 3.

Central Valley Region

Differences in the groundwater levels for the end of the 69-year simulation for Alternative 4 are shown in Figure IV-28. Groundwater conditions for the Sacramento River Region would be similar to those described under Alternative 3. For the San Joaquin River Region groundwater levels in the north half of the region would be similar to those described under Alternative 3. In the southern half of the region, groundwater levels under Alternative 4 would be lower than under the No-Action Alternative by approximately 5 feet regionally, and by 10 feet in several locations in central Madera County and northwestern Fresno County. These additional declines would occur in response to increased groundwater pumping and increased subsurface flow south toward declining groundwater levels in the Tulare Lake Region. Groundwater level declines in Madera County would possibly result in migration of poor-quality groundwater, reported to contain elevated levels of nitrates in this area, into areas of better-quality groundwater.

In areas of the northern Tulare Lake Region dependent on CVP deliveries, increases in groundwater pumping would occur in comparison to the No-Action Alternative. Groundwater storage in the Tulare Lake Region (North) declines an additional 30 percent relative to the No-Action Alternative. This is the largest decline in groundwater storage of all the alternatives. In the South Tulare Lake Region, groundwater pumping would decrease, resulting in a rise in groundwater levels in comparison to the No-Action Alternative.

The potential for additional land subsidence in comparison to the No-Action Alternative is similar to that under Alternative 1. It is likely that a small increase in the area affected by land subsidence would occur. Changes in agricultural subsurface drainage, groundwater quality, and seepage-induced waterlogging would be similar to Alternative 1.

San Francisco Bay Region

CVP deliveries to the San Francisco Bay Region would be similar to those described for Alternative 1. Impacts on groundwater resources as compared to the No-Action Alternative would be similar to those described for Alternative 1

FISHERY RESOURCES

The fisheries impact assessment presented in this chapter qualitatively describes the changes in ecosystem conditions affecting fish species that are expected to occur with adoption of each of the alternatives. These changes are always compared with conditions under the No-Action Alternative.

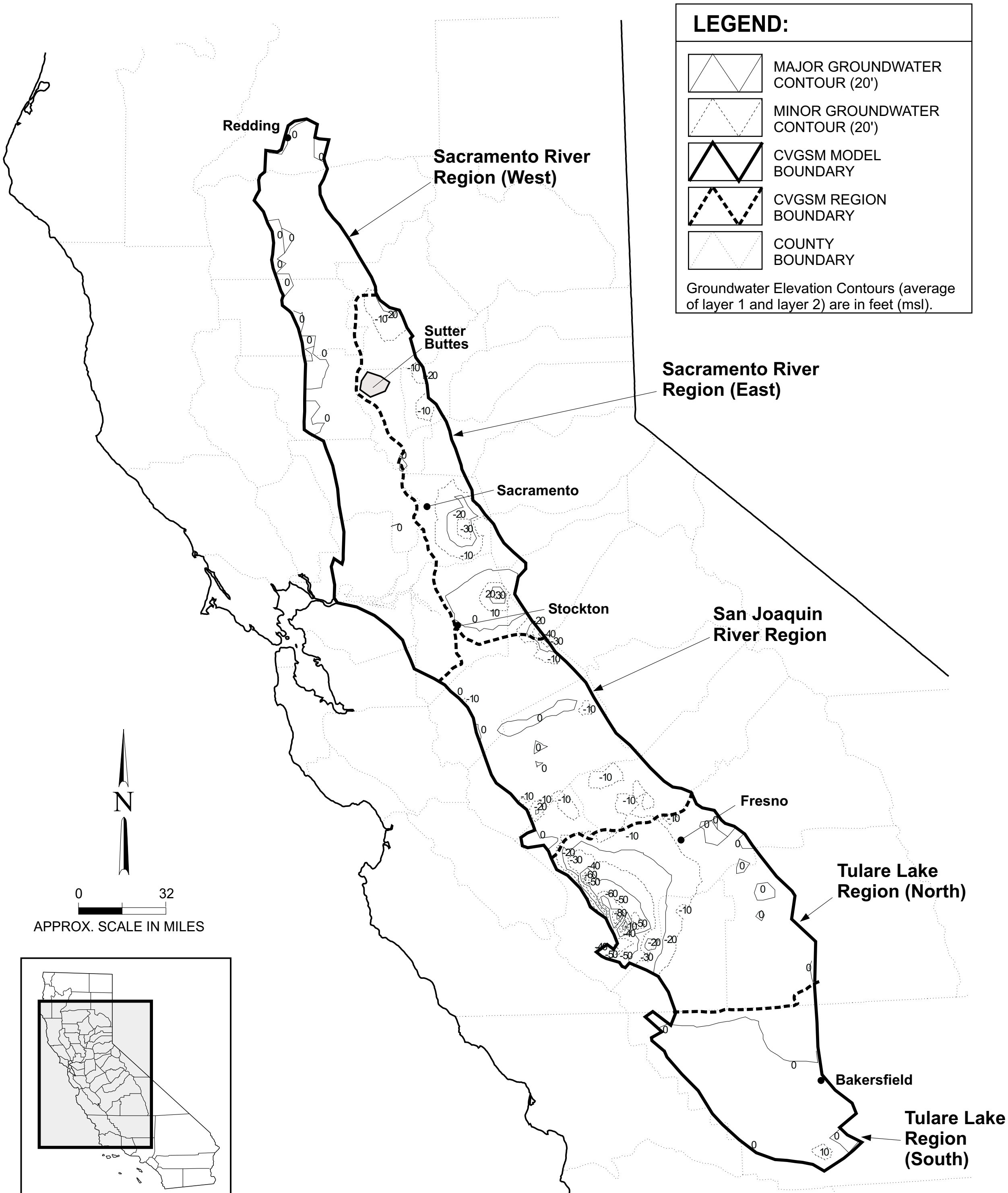


FIGURE IV-28

DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR ALTERNATIVE 4 AS COMPARED TO NO-ACTION ALTERNATIVE

Flow-related actions included under the alternatives consist of:

- changing reservoir operations and
- changing the timing and quantity of water diversions.

Structure-related actions include:

- relocating and consolidating water diversions,
- constructing and operating fish barriers,
- constructing and improving fish screens, and
- operating multilevel reservoir release structures to adjust water temperature downstream.

Habitat-related actions include:

- improving water quality (e.g., implementing programs to address contamination from wastewater discharge and urban and agricultural runoff), and

- restoring physical habitat (e.g., implementing watershed management programs and restoring riparian zones, meander belts, and spawning and rearing habitats).

Species management actions include modifying management of fish hatcheries.

A summary of the assumptions associated with each of the alternatives is presented in Table IV-11. Table IV-12 presents a summary of the impact assessment for fisheries resources.

Some of the CVPIA actions have not yet been defined in enough detail to allow even a general qualitative assessment. For that reason, the following actions are not assessed in this PEIS: measures to reduce illegal fishing, management of ocean and river fishing, and changes in artificial production (i.e., rehabilitation and expansion of Coleman National Fish Hatchery, striped bass pen rearing, and hatchery programs) (Service, 1995a, 1995b). All of these actions potentially affect natural production and may need to be evaluated in site-specific documents.

Harvest includes commercial fishing, sport fishing, and illegal fishing activities that cause or contribute to the mortality of individuals in a species population. Artificial production is the human-aided production of a species in a facility isolated to some degree from the natural ecosystem (e.g., fish hatchery, rearing pen). Exclusion of harvest and artificial production from this impact assessment (although both processes are mentioned briefly under “Cumulative Impacts”) does not imply that harvest and artificial production have minimal effects on species populations or that harvest and artificial production would not affect the outcome of implementing CVPIA actions. CVPIA actions that could affect harvest and artificial production have not yet been clearly defined and are not included in the PEIS analysis.

TABLE IV-11

SUMMARY OF ASSUMPTIONS FOR FISHERY RESOURCES

Assumptions Common to All Alternatives and Supplemental Analyses
Continued CVP operations under CVP-operations criteria and plan, October 1992. Regulatory operational criteria provided in D-1422, Bay-Delta Plan Accord and WR 95-01. Winter-Run Biological Opinion as amended in 1995. Shasta Temperature Control Device in operation. Continued annual installation of a barrier at the head of Old River in late summer and removal in late fall to improve water quality in the Stockton ship channel. Changes in reservoir operations, river flows, and diversions based on Surface Water Supplies and Facilities Operations analyses.

Alternative or Supplemental Analysis	**Assumptions Specific to the Alternative or Supplemental Analysis**
No-Action Alternative	Common assumptions only.
1	CVP reoperation and (b)(2) Water Management toward increased implementation of AFRP actions relating to target flows for CVP-controlled streams (Attachment G, PEIS). Increased Trinity River instream fishery flow. Full implementation of AFRP actions relating to structures (Attachment F, PEIS). Full implementation of AFRP actions relating to habitat restoration (Attachment F, PEIS).
1a	
1b	Alternative 1 assumptions, plus: Georgiana Slough fish barrier that operates in conjunction with Delta Cross Channel facility (Sacramento River). Seasonal operation during April and May of the Old River barrier (San Joaquin River).
1c	Same as Alternative 1 plus: Some of the non-delivered CVP water would increase instream flows and Delta outflow.
1d	Same as Alternative 1.
1e	Same as Alternative 1 plus: Conveyance of transferred water in a manner to avoid impacts to fisheries.
1f	Same as Supplemental Analyses 1e.
1g	Same as Alternative 1.

TABLE IV-11. CONTINUED

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
1h	Same as Alternative 1.
1i	Same as Alternative 1.
2	Alternative 1 assumptions, plus: Use acquired water to improve flows in the Stanislaus, Tuolumne, and Merced Rivers.
2a	Alternative 2 assumptions plus: Georgiana Slough fish barriers that operate in conjunction with Delta Cross Channel facility (Sacramento River). Seasonal operation during April and May of the Old River barrier (San Joaquin River).
2b	Same as Alternative 2 plus: Conveyance of transferred water in a manner to avoid impacts to fish.
2c	Same as Supplemental Analyses 2b.
2d	Same as Alternative 2 plus: Some of the non-delivered CVP water would increase instream flows and Delta outflow.
3	Alternative 1 assumptions, plus: Use acquired water to improve flows on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers. Acquired water may be exported by Delta pumping facilities.
3a	Same assumptions as Alternative 3 plus: Conveyance of transferred water in a manner to avoid impacts to fisheries.
4	Alternative 1 assumptions, plus: Implement (b)(2) Water Management actions in the Delta in addition to Bay-Delta Plan Accord. Use acquired water to improve flows on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers. Acquired water may not be exported by Delta pumping facilities.
4a	Same as Alternative 4 plus: Conveyance of transferred water in a manner to avoid impacts to fisheries.
Revised No-Action Alternative	Common assumptions only.
Preferred Alternative	Alternative 1 assumptions only. Use acquired water to improve flows on the Stanislaus, Tuolumne, and Merced Rivers and on tributary creeks of the upper Sacramento River to improve instream and Delta inflows. A portion of the acquired water would be managed for increased flows through the Delta.

TABLE IV-12

SUMMARY OF IMPACT ASSESSMENT FOR FISHERY RESOURCES

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Improved downstream temperature conditions in the Sacramento River due to operation of the Shasta Temperature Control Device which provides increased flexibility in the maintenance and use of the cold water pool in Shasta Lake.
Changes Compared to the No-Action Alternative	
1	Stream flow improvements, due to (b)(2) Water Management, combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would improve environmental conditions such as river temperature (except in Sacramento River), diversion entrainment, short-term fluctuations in river level, increased flows providing better movement and habitat quality and quantity, and food web support. These environmental conditions would benefit all life stages of representative fish species including chinook salmon, steelhead trout, sturgeon, American Shad and striped bass. Increases in the Trinity River fishery flow pattern would increase transport for salmon and steelhead trout. Increases in river flows and structural actions would improve passage and access to previously unavailable or under used stream habitats in Clear Creek and in the American and Stanislaus rivers for adult, egg, and juvenile life stages of representative species. Conditions related to downstream fish movement would decline in the Sacramento River as a result of decreased flows and lower exports from the Trinity River basin. Structural actions would provide improved passage to previously unavailable or under used stream habitats in the minor tributaries to the Sacramento, Yuba, and San Joaquin rivers, and the Delta for adult, egg, and juvenile life stages of representative species. Fish screen construction or improvements on the Sacramento, Feather, Yuba, Bear, American, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, and the Delta would benefit juvenile and adult life stages of representative species. Reductions in Delta exports in April through September would decrease entrainment mortality losses of juvenile and adult life stages of representative species. Increased Delta exports in October through February could increase entrainment mortality, but improved fish screens would reduce entrainment mortality for screenable life stages of representative species. Juvenile chinook salmon and steelhead that use the Delta for temporary residence and estuarine species residing in the Delta would benefit from a change in entrainment mortality.
Changes Compared to the No-Action Alternative	
1	Reductions in the frequency of short-term charges in river surface levels in the Sacramento, Yuba, American, Tuolumne, Merced rivers and the Delta would reduce redd dessication, stranding, and risk to mortality for egg, larval, and juvenile life stage chinook salmon and steelhead trout. Increased flows and/or restoration of riparian vegetation that increases stream shading would decrease river water temperatures on Clear Creek, minor tributaries to the Sacramento River, and the Yuba and Stanislaus rivers. Reduced summer flows on the American River during June through September would increase water temperatures and adversely affect rearing juvenile steelhead trout. Actions to reduce predation at diversion facilities and limit predator habitat would improve survival of juvenile life stages of representative species in the Sacramento River and its minor tributaries, and the Yuba, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers , as well as in the Delta. Increased temperatures in upper Sacramento River could adversely impact winter-run chinook salmon.

TABLE IV-12. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	The combined effects of increased instream flows, lower instream water temperatures, habitat restoration, and structural improvements would collectively improve habitat quality and quantity for representative species in all study area rivers except the Merced River.
	Restoration of riparian vegetation and instream habitat would increase the input of nutrients and food organisms and provide improved food web support for representative species in all study area rivers.
Changes Compared to Alternative 1	
1a	Further reductions in exports at Delta pumping facilities during April and May would decrease entrainment mortality of representative species. Juvenile chinook salmon and steelhead trout that use the Delta for temporary residence and estuarine species residing in the Delta would benefit from a decrease in entrainment mortality.
	Increases in Delta outflow in January through June would improve movement from less productive habitat in the central and south Delta toward more productive habitat near Suisun Bay for egg, larval, and juvenile life stages of representative species during temporary residence in the Delta. Increases in Delta outflow would also improved survival conditions for representative species in the Delta.
	Increased Delta outflow, reduced exports, and extension of X2 (2 ppt isohaline) farther downstream during April and May would increase Delta habitat quality and quantity for representative species during temporary residence in the Delta.
Changes Compared to Alternative 1	
1b	A decrease in flow into the central Delta from the Sacramento River would reduce juvenile life stage diversion-related losses and improve downstream movement of fish in the Sacramento River. Representative species would be transported towards more productive habitat near Suisun Bay, rather than entering the central Delta.
	The Old River barrier facility would reduce exposure to SWP and CVP pumping facilities and assist the successful outmigration of juvenile salmon from the San Joaquin River.
	Closure of the DCC barrier would increase the losses of striped bass and delta smelt rearing in the north and central Delta.
1c	Use of non-delivered CVP water is not determined at this time.
	Potential changes in surface water operations and the affect on fisheries resources will require further site-specific analyses.
1d	Conditions would be similar to Alternative 1.
1e	Conditions would be similar to Alternative 1, except in dry years when site specific transfer operations could affect reservoir operations, river flows, and Delta exports.
1f	Conditions would be similar to Supplemental Analysis 1e.
1g	Conditions would be similar to Alternative 1.
1h	Conditions would be similar to Alternative 1.
1i	Red Bluff Diversion Dam gates would no longer be closed during the summer, thereby reducing mortality of juvenile chinook salmon and steelhead trout that migrate downstream to rear.
	Restoration of the river reach affected by Lake Red Bluff would create additional spawning and rearing habitat, and reduce predation losses.

TABLE IV-12. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
Changes Compared to the No-Action Alternative	
2	General benefits to fisheries as a result of (b)(2) Water Management, increased Trinity River flows, structural actions, and habitat restoration would provide general benefits to fisheries through improved habitat quality and quantity, passage to under used habitat, improved survival through fish screen improvements, and improved instream and riparian habitat conditions that would improve survival conditions for all life stages of representative species. These flow, structural, and habitat restoration actions would be similar to Alternative 1, plus:
	Improved flows during April through June on the Tuolumne, Merced, and Stanislaus rivers would improve water temperature conditions and provide improved survival conditions for juvenile chinook salmon and steelhead trout and life stages of other species using these streams.
	Increased river flows in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers would improve downstream movement of juvenile life stages of representative species in these rivers.
	Greater flows from the San Joaquin River toward Suisun Bay would further improve Delta flow conditions, reduce diversion-related losses, and facilitate the movement of organisms into more productive habitat located near Suisun Bay.
	The combined effects of the flow, structural, and habitat restoration actions in Alternative 2 would further improve habitat quality and quantity in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers.
	The combined effects would also provide further improvement in food web support in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers.
Changes Compared to Alternative 2	
2a	The decrease in flow into the central Delta from the Sacramento River would reduce juvenile life stage diversion-related losses and improve downstream movement of egg, larval, and juvenile life stages of representative species. Representative species would be transported toward more productive habitat near Suisun Bay, rather than less productive habitat in the central Delta.
	The Old River barrier facility would assist the outmigration of juvenile chinook salmon and steelhead trout from the San Joaquin River. Old River barrier would also reduce exposure of representative species to SWP and CVP pumping facilities.
	Closure of the DCC barrier would increase losses of striped bass and delta smelt rearing in the north and central Delta.
2b	Conditions are similar to Alternative 2, except in dry years when site specific transfer operations may affect reservoir operations, river flows, and Delta exports.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Use of non-delivered CVP water is not determined at this time.
	Potential changes in surface water operations and the effect on fisheries resources will require further site specific analyses.
Changes Compared to the No-Action Alternative	
3	(b)(2) Water Management, increased Trinity River flows, structural actions, and habitat restoration would provide general benefits to fisheries through improved habitat quality and quantity, passage to under used habitat, improved survival through fish screen improvements, and increase instream and riparian habitat conditions that would improve survival conditions for all life stages of representative species. These flow, structural, and habitat restoration actions would be similar to Alternative 1, plus:
	Increased spring stream flows in combination with habitat restoration actions would further improve temperature conditions on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers and benefit rearing fry and juvenile chinook salmon and steelhead trout.

TABLE IV-12. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Reduced diversions on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers would benefit migrating juvenile chinook salmon and steelhead trout. Increased Delta outflow would further improve overall conditions affecting diversion-related losses of representative species in the Delta, even though there would be increased Delta exports of acquired water in August through May. Reduced flow fluctuations on the Yuba and Mokelumne rivers would reduce stranding and benefit egg, fry, and juvenile life stages of chinook salmon and steelhead trout. Pulse flows on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and San Joaquin rivers would primarily benefit outmigration of fall-run juvenile chinook salmon.
Change Compared to Alternative 3	
3a	Conditions would be similar to Alternative 3, except in dry years when site- specific transfer operations may affect reservoir operations, river flows, and Delta exports.
Changes Compared to the No-Action Alternative	
4	(b)(2) Water Management, increased Trinity River flows, structural actions, and habitat restoration would provide general benefits to fisheries through improved habitat quality and quantity, passage to under used habitat, improved survival through fish screen improvements, and increase instream and riparian habitat conditions that would improve survival conditions for all life stages of representative species. These flow, structural, and habitat restoration actions would be similar to Alternative 3, plus: The combination of actions would reduce Delta exports and increase Delta outflow which would shift the distribution of Delta species downstream into more productive habitat and away from the influence of Delta diversions. The Delta Cross Channel would be closed during November through January of wetter years to facilitate the outmigration of juvenile chinook salmon and steelhead trout down the Sacramento River. This structural action would improve survival and reduce the movement of these species into less productive habitat located in the central Delta, and expose these species to increased diversions and predation. Increased Delta outflow in all months would shift estuarine salinity downstream and increase habitat quality and quantity for Sacramento splittail, delta smelt, longfin smelt, and striped bass. Decreased diversions in the Delta would reduce the entrainment of food web organisms and nutrients, thereby increasing food web support in the Delta. Also, the downstream shift in estuarine salinity would increase production of prey organisms and benefit rearing life stages of all representative species.
Changes Compared to Alternative 4	
4a	Conditions would be similar to Alternative 4, except in dry years when site-specific transfer operations may affect reservoir operations, river flows, and Delta exports.

TABLE IV-12. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Improved downstream temperature conditions in the Sacramento River due to operation of the Shasta Temperature Control Device which provides increased flexibility in the maintenance and use of the cold water pool in Shasta Lake, and due to improved flows under the Bay-Delta Plan Accord.
Preferred Alternative Changes as compared to No-Action Alternative	Stream flow improvements combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would benefit all life stages of representative fish species including chinook salmon, steelhead trout, sturgeon, American shad, and striped bass. Increases in the Trinity River fishery flow pattern would increase transport for salmon and steelhead trout. Increases in river flows and/or structural actions would improve passage and access to previously unavailable or under-used stream habitats. Conditions for downstream fish movement would decline in the Sacramento River due to decreased flows as a result of lower diversions from the Trinity River Basin. Structural actions would provide improved passage to previously unavailable or under-used stream habitats for adult, egg, and juvenile life stages of representative species in Clear Creek, the minor tributaries to the Sacramento, Yuba, and San Joaquin rivers, and the Delta. Fish screen construction or improvements would benefit representative species on the Sacramento, American, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, and in the Delta. Combined effects of increased instream flows, lower instream water temperatures, habitat restoration, and structural improvements would improve food web and habitat quantity and quality in these rivers. Decreases in river water temperatures in Clear Creek, minor tributaries to the Sacramento River that support spring-run chinook salmon, and Stanislaus, Tuolumne, and Merced rivers. Increase in water temperatures on the American River in June through September, due to reduced summer flows, would adversely affect steelhead trout. Increases in river water temperatures in Sacramento River would adversely affect winter-run chinook salmon. Reductions in diversions on the Stanislaus, Tuolumne, and Merced rivers would benefit migrating juvenile chinook salmon and steelhead trout. Overall conditions affecting diversion losses in the Delta would further improve due to increased Delta outflow, even though there are increased Delta exports. Pulse flows on the Stanislaus, Tuolumne, and Merced, and San Joaquin rivers would primarily benefit outmigration of fall-run juvenile chinook salmon. Further increases in spring and summer net Delta channel flows toward Suisun Bay would increase movement of larval and juvenile striped bass, delta smelt, longfin smelt, and juvenile chinook salmon and steelhead trout toward more productive habitat. The combined effects of the actions would further improve habitat quality and quantity in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers.

TABLE IV-12. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	The combined effects would also provide further improvement in food web support in the Bay-Delta and in the Stanislaus, Tuolumne, Merced, and lower San Joaquin rivers. Reductions in Delta exports and the corresponding increase in Delta outflow, due to the Delta (b)(2) actions and acquired water, shift the distribution of Delta species downstream into more productive habitat and away from the influence of Delta diversions. Food web support in the Delta would increase due to reduced diversions that entrain food web organisms and nutrients. Also, the downstream shift in estuarine salinity would increase production of prey and benefit rearing life stages of all representative species.

IMPACT ASSESSMENT METHODOLOGY

This analysis qualitatively describes the beneficial and adverse impacts of each of the alternatives on the distribution and abundance of fish species. These effects are always determined by comparison of conditions that would occur under an alternative to the conditions that would occur under the No-Action Alternative.

Each of the CVPIA alternatives consists of proposed actions. These actions, either individually or in combination, would affect one or more environmental conditions. For the purposes of this analysis, environmental conditions are defined as aspects of the aquatic ecosystem that may change in response to implementing the actions contained in the alternatives, and that may in turn cause beneficial or adverse effects on representative aquatic species. Assessment relationships are used that describe how changes in environmental conditions lead to responses by the representative species, as depicted in Figure IV-29. The specific relationships used in the assessment are applicable to each species and life stage based on geographic and monthly occurrence.

For example, a CVPIA action (install or improve fish screens) would cause a change in an environmental condition (diversion conditions). A specific assessment relationship (installation of fish screens decreases entrainment losses for species life stages that are too large to pass through the screen) leads to a change in the ecosystem condition (reduced fish mortality at certain diversions), resulting in benefits to individual species (reduced entrainment loss of specific life stages of specific species). In more complex situations, one action may affect several environmental conditions (for instance, reoperation of a reservoir may affect river temperature, diversion conditions, and physical habitat), or one environmental condition may be affected by several actions (diversion conditions may be affected by changes in flow and installation of fish screens).

Table IV-13 summarizes the environmental ecosystem conditions assessed to determine impacts on and benefits to representative species. Detailed definitions of environmental conditions and specific assessment relationships are provided in the Fisheries Technical Appendix.

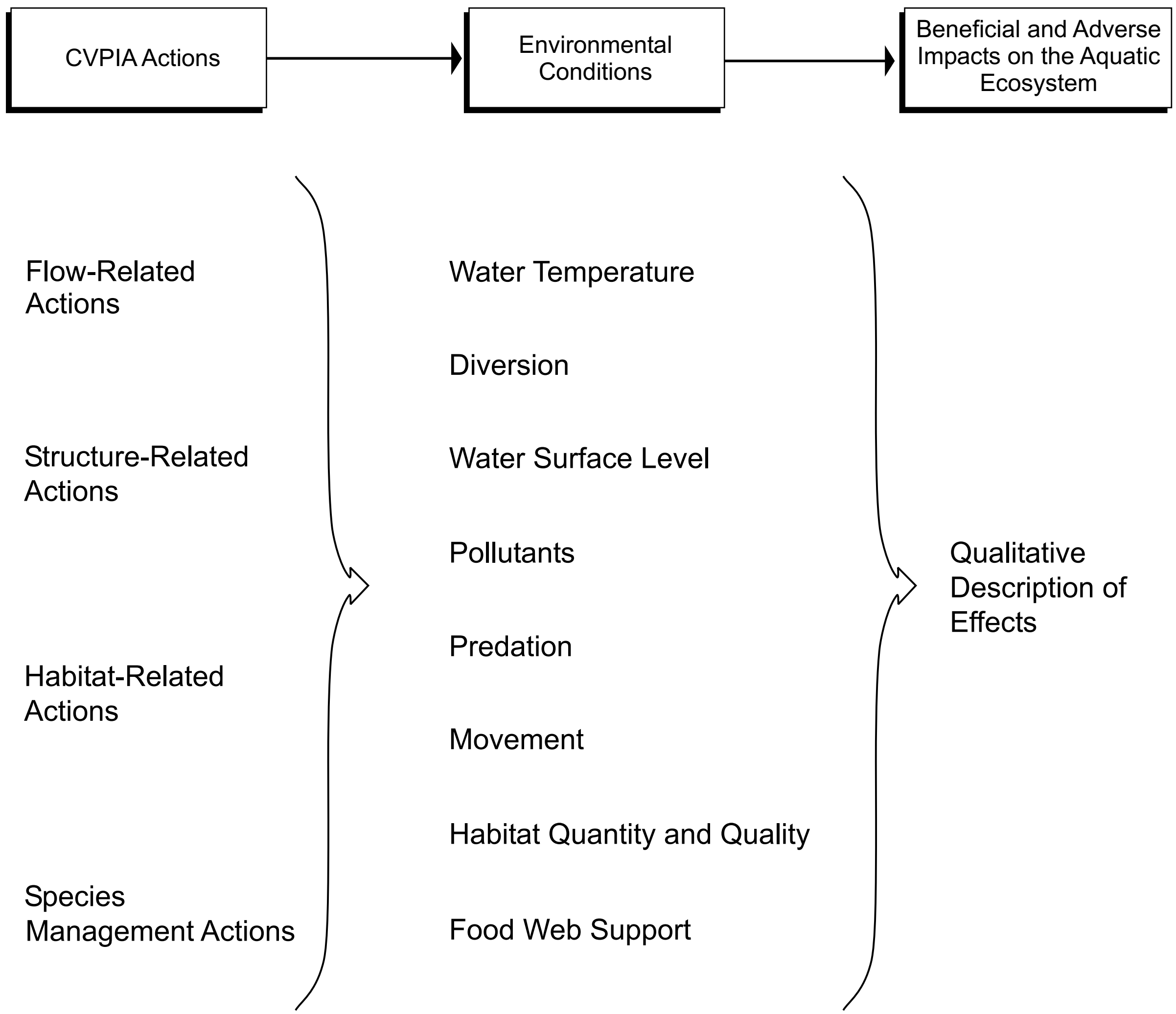
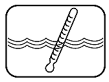
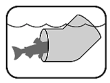
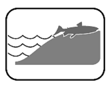
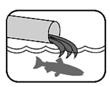
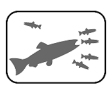
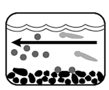
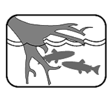


FIGURE IV-29

LINKAGE OF CVPIA ACTIONS TO BENEFICIAL AND ADVERSE IMPACTS

TABLE IV-13

DEFINITIONS OF ENVIRONMENTAL CONDITIONS

Condition		Definition
Water temperature		Water temperature that exceeds the metabolic tolerances of a species causes or contributes to mortality. Water temperature is primarily a concern for chinook salmon and steelhead trout.
Diversion		Diversions cause fish mortality through entrainment (removal from the ecosystem), impingement on fish screens, abrasion, stress from handling, and increased predation. Diversion is a concern for all representative fish species.
Change in water surface level		Change in water surface level may cause mortality by exposing nests, stranding individuals, and reducing or eliminating cover. The effects of changes in water surface levels are assessed for representative species in rivers and reservoirs.
Pollution		Pollution includes the entry of substances into the aquatic ecosystem that cause the death of organisms. Increased flow, reduced use of potential pollutants, and actions to clean up pollutant sources reduce the effect of pollution on aquatic organisms.
Predation		Predation is a natural ecosystem function; however, predation may increase to adverse levels through changes in ecosystem structure that increase prey vulnerability or increase predator feeding efficiency.
Movement		Movement, both active and passive, includes the transport of planktonic eggs and larvae and migration to habitat essential for completing an organism's life cycle. Movement is a concern for all representative species.
Habitat quantity and quality		Habitat quantity and quality relate to physical, chemical, and biological conditions that support essential organism activities, including spawning, feeding, respiration, assimilation, predator avoidance, and resting. Habitat quantity and quality are critical in maintaining and increasing all fish populations.
Food web support		Food web support includes nutrient availability, food production, and food availability. Organisms that provide the food base for fish species are affected by the same habitat and ecosystem processes critical to the maintenance and restoration of fish populations. Food web support is essential to maintain all species populations.

Representative Species

The assessment method is applied to those life stages of all representative species that are present in each river reach during the months when the actions would apply. The selection of representative species allows the analysis to be focused while representing ecosystem responses to the full range of changing conditions. The representative species and populations were selected because they depend on ecological processes and habitats throughout the ecosystem and are sensitive to an important cross-section of affected environmental conditions. Species represented in the analysis are distributed over a range of habitats potentially affected by CVPIA actions. Anadromous species specifically identified in the CVPIA are:

- chinook salmon (*Oncorhynchus tshawytscha*), including fall, late fall, winter, and spring runs
- steelhead trout (*Oncorhynchus mykiss*)
- sturgeon (both green sturgeon [*Acipenser medirostris*] and white sturgeon [*A. transmontanus*])
- American shad (*Alosa sapidissima*)
- striped bass (*Morone saxatilis*)

Representative species for the Bay-Delta estuary (in addition to the anadromous species identified in the CVPIA) are:

- delta smelt (*Hypomesus transpacificus*)
- longfin smelt (*Spirinchus thaleichthys*)
- Sacramento splittail (*Pogonichthys macrolepidotus*)

Representative species for reservoirs are:

- spotted bass (*Micropterus punctulatus*)
- largemouth bass (*M. salmoides*)

The geographic distribution of the representative species throughout the study area is shown in Figure IV-30.

Programmatic Level of Detail

The assessment method provides enough information to allow a general and qualitative description of ecosystem conditions potentially affecting the representative species under each alternative. CVPIA actions and potential effects on environmental conditions are described at a level of detail consistent with the needs of a programmatic document. Furthermore, although the direction of a species' response to changes in environmental conditions is generally supported by available species-specific information for most ecosystem conditions, available information is not sufficient to quantify such changes.

Benefits that will occur to fishery resources in the Trinity River are being addressed in a separate environmental document.

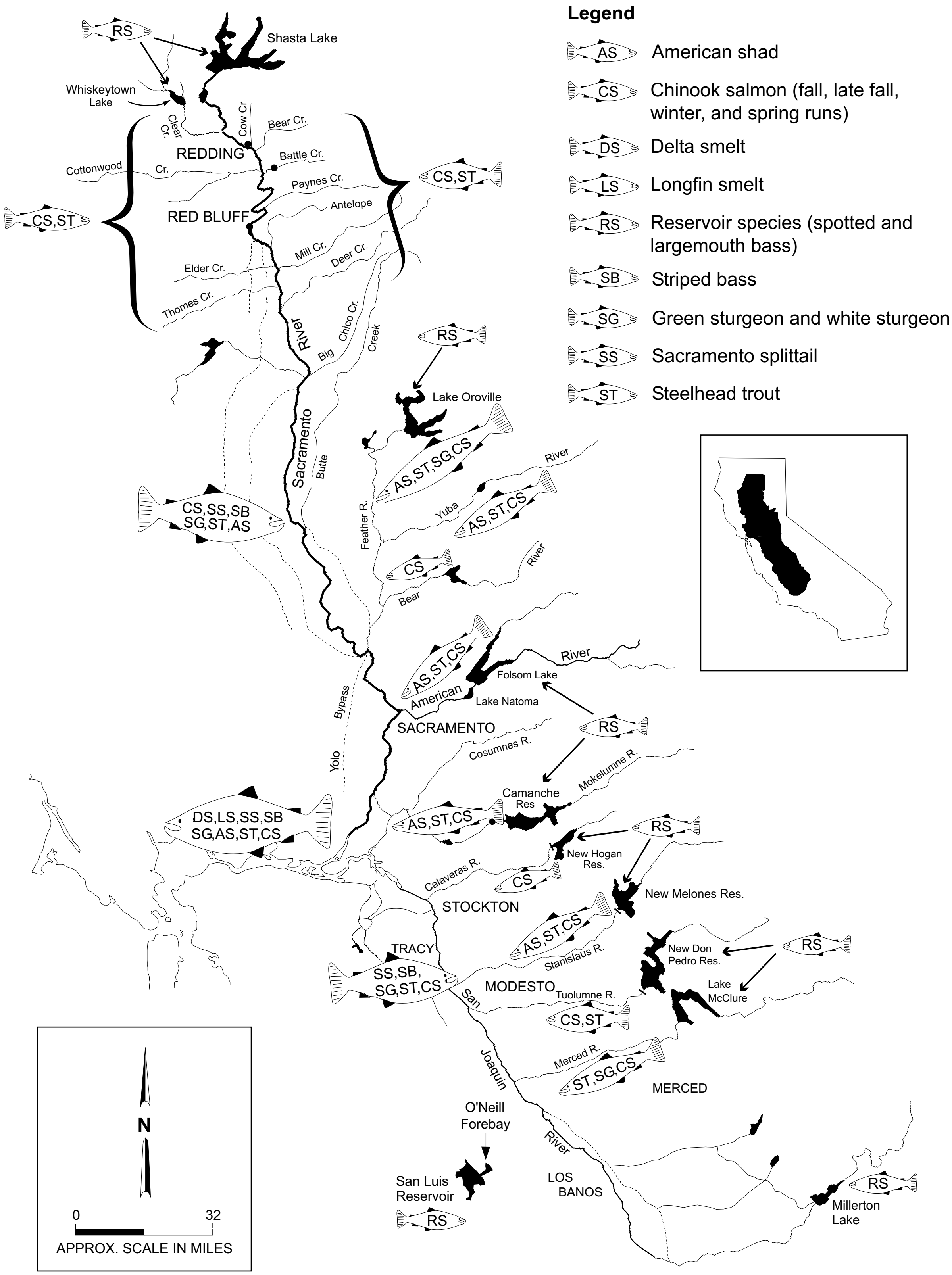


FIGURE IV-30

POTENTIAL AND EXISTING DISTRIBUTION OF FISH SPECIES ANALYZED IN THE PEIS

NO-ACTION ALTERNATIVE

The No-Action Alternative represents conditions in the future without implementation of the CVPIA. However, the No-Action Alternative does incorporate those provisions of the CVPIA that have been identified previously as necessary to protect winter-run chinook salmon (a species listed as endangered).

Under the No-Action Alternative, water temperature in the upper Sacramento River (below Shasta Lake) would be maintained by the temperature control structure on Shasta Dam in compliance with the 1993 Winter-Run Chinook Salmon Biological Opinion. This management action would benefit all runs of chinook salmon and steelhead trout.

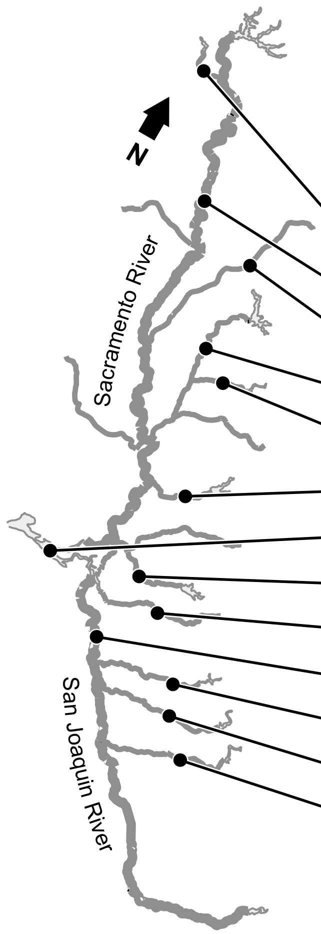
Under the No-Action Alternative, modifying the operation and structure of the ACID dam, the RBDD, and the Keswick Reservoir stilling basin to protect winter-run chinook salmon should help improve conditions affecting entrainment in diversions, predation, and essential movement for all chinook salmon runs, steelhead trout, and sturgeon. Changes in operation of the ACID and RBDD diversion structures may also improve access to upstream habitat for chinook salmon and sturgeon. Improvements in fish screens and bypass flows are also expected to occur under the No-Action Alternative at the RBDD and the ACID and GCID diversions, providing additional protection for winter-run chinook salmon and reducing entrainment losses of other chinook salmon runs and steelhead trout.

ALTERNATIVE 1

Compared with the No-Action Alternative, actions that would be implemented under Alternative 1 (indicated in Figure IV-31 and discussed in Chapter II) would clearly benefit all of the representative species in riverine and estuarine habitats of the Central Valley. These actions would improve ecosystem conditions, including increasing habitat availability and improving habitat quality (Figure IV-32). The improved ecosystem conditions would benefit most representative species compared with conditions under the No-Action Alternative (Figure IV-33).

Changes in reservoir operation under Alternative 1 would have minimal effects on reservoir habitat and associated species compared with the No-Action Alternative. Monthly and annual variability in reservoir surface elevation would be substantial under the No-Action Alternative, reflecting a response to weather conditions and water storage and flood control operations. Because Alternative 1 would involve little change in reservoir operation and resulting habitat conditions relative to the No-Action Alternative, effects on reservoir species are not described here; the Fisheries Technical Appendix provides additional information on the effects of the alternatives on reservoir species.

The effects of actions that would be implemented under Alternative 1 are discussed below for each ecosystem condition defined in Table IV-13.



	Structure		Habitat Improvements			Flow			Species Interactions
Watershed	Fish Screens	Improved Passage	Instream	Riparian	Water Quality	Increased Flow	Reduced Fluctuation	Reduced Diversion	Predator Control
Clear Creek		■	■	■	■	■	■		
Sacramento R.	■		■	■	■	■	■		
*Minor Tributaries	■	■	■	■	■	■			
Feather R.	■	■	■			■			
Yuba River	■	■	■	■			■		
American R.	■		■	■		■	■		
Bay-Delta	■		■	■	■	■			
Mokelumne R.	■	■	■	■	■				
Calaveras R.	■	■							
San Joaquin R.	■	■		■	■	■			
Stanislaus R.	■		■	■		■			■
Tuolumne R.	■		■	■	■		■		■
Merced R.	■	■	■	■	■		■		■

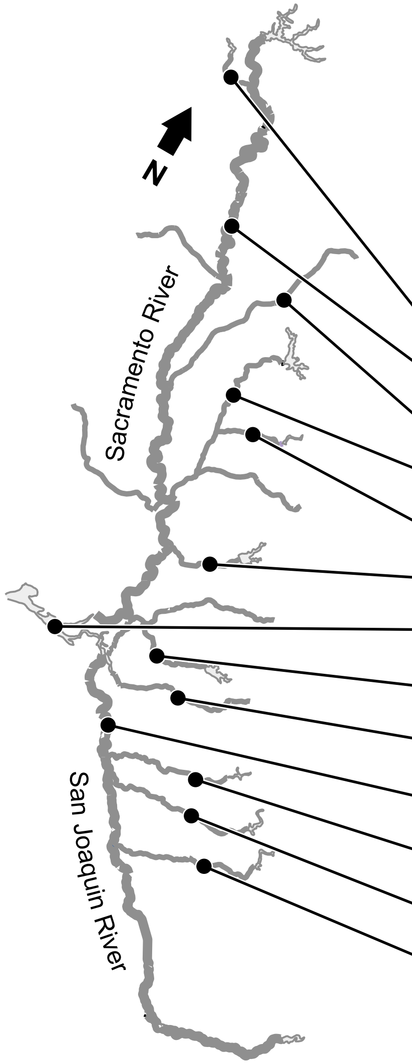
■ = Action implemented under Alternative 1

No Symbol = No action implemented

*Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-31

CVPIA ACTIONS IMPLEMENTED TO BENEFIT FISH AND AQUATIC RESOURCES UNDER ALTERNATIVE 1



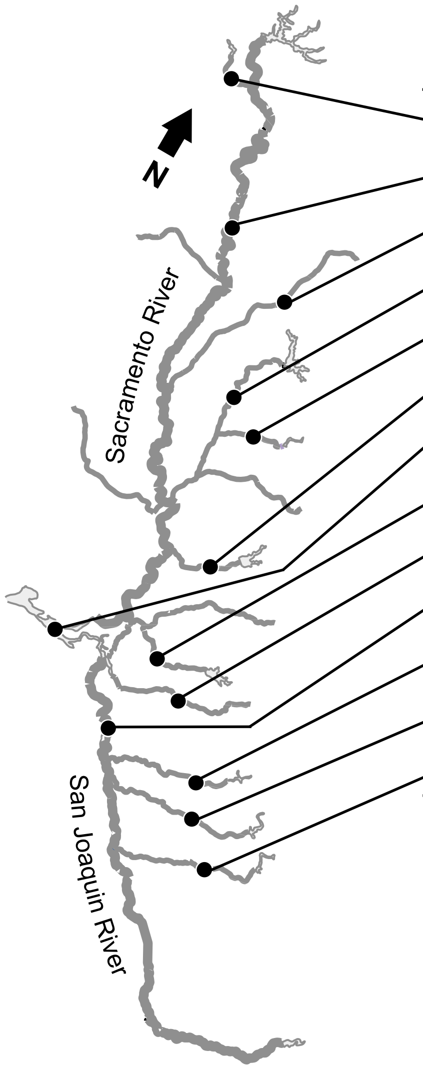
Watershed	River Water Temperature	Diversion	River Surface Level Changes	Pollutants	Predation	Movement	Habitat Quality and Quantity	Food Web Support
Clear Creek	✓	✓	✓			✓	✓	✓
Sacramento R.		✓	✓	✓	✓	✗	✓	✓
*Minor Tributaries	✓	✓			✓	✓	✓	✓
Feather R.		✓					✓	✓
Yuba River	✓	✓			✓	✓	✓	✓
American R.	✗	✓	✓			✓	✓	✓
Bay-Delta		✓		✓	✓	✓	✓	✓
Mokelumne R.		✓		✓	✓		✓	✓
Calaveras R.		✓					✓	✓
San Joaquin R.		✓		✓	✓	✓	✓	✓
Stanislaus R.	✓	✓			✓	✓	✓	✓
Tuolumne R.		✓	✓	✓	✓		✓	✓
Merced R.	✗	✓	✓	✓	✓		✗	

✓ = New benefit compared to the No-Action Alternative
No Symbol= No change
✗= Adverse change compared to the No-Action Alternative

*Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-32

CHANGES IN ENVIRONMENTAL CONDITIONS AFFECTING FISH POPULATIONS UNDER ALTERNATIVE 1 COMPARED TO THE NO-ACTION ALTERNATIVE



Watershed	Chinook Salmon	Steelhead Trout	Sacramento Splittail	Sturgeon	Striped Bass	American Shad	Delta Smelt	Longfin Smelt
Clear Creek	✓	✓	--	--	--	--	--	--
Sacramento R.	✓	✓	✓	✓	✗ [1]	✗ [1]	--	--
*Minor Tributaries	✓	✓	--	--	--	--	--	--
Feather R.	✓	✓	--	--	--	✓	--	--
Yuba River	✓	✓	--	--	--	✓	--	--
American R.	✓	✗ [2]	--	--	--	✗ [1]	--	--
Bay-Delta	✓	✓	✓	✓	✓	✓	✓	✓
Mokelumne R.	✓	--	--	--	--	--	--	--
Calaveras R.	✓	--	--	--	--	--	--	--
San Joaquin R.	✓	--	✓	--	--	--	--	--
Stanislaus R.	✓	--	--	--	--	--	--	--
Tuolumne R.	✓	--	--	--	--	--	--	--
Merced R.	✗ [2]	--	--	--	--	--	--	--

✓ = New benefit compared to the No-Action Alternative
✗ = Adverse change compared to the No-Action Alternative
-- = Species does not occur or occurrence is minor

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

1) Adverse conditions are a result of degraded flow conditions affecting movement of eggs and larvae. See text for discussion.

2) Adverse conditions are a result of degraded temperature conditions and habitat quality and quantity. See text for discussion.

FIGURE IV-33

BENEFICIAL AND ADVERSE CHANGES TO FISH SPECIES UNDER ALTERNATIVE 1 COMPARED TO THE NO-ACTION ALTERNATIVE

Water Temperature

Although modeling was not performed for all rivers, it is considered likely that temperature conditions would improve survival, growth, and reproductive success for steelhead trout and all chinook salmon runs in most rivers affected by the CVPIA actions. Several actions that may be implemented under Alternative 1 could affect water temperatures: changing reservoir operations; installing or modifying multilevel release shutters; restoring riparian areas, meander belts, and watersheds; and controlling and relocating agricultural return flows.

The effect of water project operations on water temperature conditions was determined by simulation of water temperatures in Clear Creek and the Sacramento, Feather, American, and Stanislaus rivers. Potential temperature-related effects of reservoir operations and flow, riparian restoration, and reduced agricultural return flow are evaluated qualitatively for other rivers.

Riparian restoration actions are identified in the CVPIA for the Sacramento River and its minor tributaries; for the Yuba, American, and Mokelumne rivers; and for the Delta (Figure IV-31). Restoration of riparian vegetation could shade and cool minor tributaries (Figure IV-32). Watershed restoration actions and actions to control or relocate agricultural return flow could reduce warm-water inflow to the Sacramento and San Joaquin rivers and some tributary streams.

In the Sacramento River, protective water temperature criteria stipulated in the 1993 Biological Opinion minimize changes in simulated water temperatures and associated temperature conditions during all life stages of fall-, late fall-, winter-, and spring-run chinook salmon and steelhead trout. Temperature conditions in the Sacramento River under Alternative 1 would be greater than temperature conditions under the No-Action Alternative (Figure IV-32).

In Clear Creek, water temperatures would generally be lower under Alternative 1 than under the No-Action Alternative because of increased flow. Lower temperatures would benefit fall-, late fall-, and spring-run chinook salmon and steelhead trout (Figures IV-32 and IV-33). For the Yuba River, reservoir operations and use of the multilevel release shutter would improve temperature conditions for fall-run chinook salmon and steelhead trout.

On the American River, simulated water temperatures under Alternative 1 increase during October (in wetter and cooler years) and November compared with conditions under the No-Action Alternative due to reduced reservoir storage in Folsom Lake, indicating potential adverse impacts on fall-run chinook salmon spawning. Elevated water temperatures are also indicated between June and September, and these conditions would adversely affect steelhead trout (Figure IV-32 and Figure IV-33). An adverse impact on temperature conditions is identified. However, actions for reoperating or reconfiguring the multilevel release shutters may be implemented at Folsom Dam, and these could improve water temperatures compared with conditions indicated by the simulation. During most years, including drier and warmer years, water temperature during October is reduced compared with temperature under the No-Action Alternative, indicating a potential benefit to spawning fall-run chinook salmon. Overall, water conditions would generally improve and, in combination with improvements to other habitat conditions, would result in benefits to fall-run chinook salmon (Figure IV-33).

For the Stanislaus River, the temperature simulation indicates that lower water temperatures would benefit juvenile fall-run chinook salmon during April and May. During October and November, slightly higher temperatures could lead to increased mortality during fall-run spawning and incubation. However, because the change is relatively small, it may be possible to operate the reservoir to meet the AFRP target of 56 degrees Fahrenheit on October 15, improve overall temperature conditions, and provide benefits to fall-run chinook salmon (Figures IV-32 and IV-33).

Reduced flows in the Merced River during April and May under Alternative 1 may occur because of additional groundwater pumping souther of the Merced River. The additional pumping may reduce groundwater accretions into the Merced River. The reduced flows would increase water temperatures and adversely affect fall-run chinook salmon by increasing the mortality of rearing juveniles (Figure IV-32). In October, lower simulated flows and lower amounts of reservoir storage (in drier years) indicate a potential water temperature increase and adverse effects on the spawning success of fall-run chinook salmon compared with conditions under the No-Action Alternative. The degraded temperature conditions would cause adverse impacts on fall-run chinook salmon (Figure IV-33).

Under Alternative 1, water temperature conditions in the Feather, Mokelumne, Calaveras, San Joaquin, and Tuolumne rivers resulting from reservoir operations would be similar to those under the No-Action Alternative (Figure IV-32).

Diversion

Diversions cause fish mortality through entrainment, impingement on fish screens, abrasion, stress from handling, and increased predation. Under Alternative 1, diversion conditions would improve throughout the Sacramento and San Joaquin river basins (Figure IV-32). Actions implemented under Alternative 1 that would improve diversion conditions include constructing and improving fish screens, redesigning the diversion facility to discourage predation, reducing diversion volumes, and increasing flows to maintain estuarine salinity downstream of the Delta (thereby shifting the distribution of species vulnerable to entrainment in Delta diversions downstream and away from diversion intakes).

Fish screens would benefit the juvenile and adult life stages of the representative species but would provide little or no benefit to planktonic egg and larval life stages. Under Alternative 1, fish screens would be constructed or improved for diversions on the Sacramento, Feather, Yuba, Bear, American, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, and San Joaquin rivers and in the Sacramento-San Joaquin Delta estuary (Figure IV-31). In addition, constructing or improving fish screens on diversions in the minor tributaries to the Sacramento River, including Clear, Cow, Butte, Big Chico, and Battle creeks, would benefit fall- and spring-run chinook salmon and steelhead trout. Actions to reduce predation at Woodbridge Dam on the Mokelumne River would primarily benefit fall-run chinook salmon.

Compared with the No-Action Alternative, Alternative 1 would result in less water being diverted from the Delta (primarily through the CVP and SWP pumping facilities) from April through September, and more water being diverted from October through February. Lower diversions from April through September would reduce entrainment loss of striped bass eggs, larvae, and juveniles; delta smelt adults, larvae, and juveniles; longfin smelt adults, larvae, and juveniles; American shad eggs, larvae, and juveniles; juvenile steelhead trout; juvenile chinook salmon from all runs; juvenile sturgeon; and juvenile and adult Sacramento splittail.

Higher diversions from October through February could increase entrainment losses, but most fish present would be small enough to benefit from installation of new, improved fish screens that would reduce entrainment. The species and life stages affected include juvenile striped bass; juvenile and adult delta smelt; adult longfin smelt; juvenile American shad; juvenile steelhead trout; and juvenile late fall-, winter-, and spring-run chinook salmon in the central and south Delta.

Water Surface Level

In rivers, a primary cause of fish mortality is short-term (e.g., hourly, daily) changes in water surface level that may strand fish and dry up redds. Changes in water surface level may cause mortality of egg, larval, and juvenile life stages of chinook salmon and steelhead trout. Sacramento splittail spawning, incubation, and larval life stages can also be affected by fluctuations in water surface level.

The CVPIA identifies the need to reduce water surface level fluctuations in the Sacramento, Yuba, American, Tuolumne, and Merced rivers (Figure IV-31). Under Alternative 1, the reoperation of reservoirs to minimize abrupt changes in water surface level would improve conditions related to water surface level (Figure IV-32) and reduce mortality during spawning, incubation, rearing, and adult life stages for steelhead trout and chinook salmon.

Pollutants

Reduced application of pesticides (e.g., as a result of reduced agricultural acreage) and actions that reduce input of pollutants are assumed to occur under Alternative 1 and could improve water quality conditions in rivers and streams compared with conditions under the No-Action Alternative (Figure IV-32). Although CVPIA actions addressing pollutant input and actual changes in pesticide application may be minimal, representative species would benefit to some extent.

Restoring riparian habitat and shallow water habitat on rivers and streams and in the Delta can, by restoring ecosystem functions that remove pollutants from the ecosystem, lead to improved water quality conditions and result in subsequent benefits to survival, growth, and reproduction of fish. Actions addressing erosion control in watersheds and at gravel mining sites may also reduce pollutant input. Potential actions on the Sacramento River address toxicant problems associated with metal sludge in Keswick Reservoir and discharge from the ACID canal.

Predation

Predation on some species may decrease if the ecosystem structure is changed to decrease those species' vulnerability to predation or to decrease predator feeding efficiency. CVPIA actions under Alternative 1 would reduce predation at diversion facilities and dams (see "Diversion" and "Movement") (Figure IV-32). Other CVPIA actions include modifying physical habitat to isolate ponds from the main channels of the Stanislaus, Tuolumne, and Merced rivers. The ponds support warm-water species that prey on juvenile fall-run chinook salmon. Under Alternative 1, actions to isolate ponds from the main river flow would reduce predator habitat and, therefore, reduce predation on juvenile fall-run chinook salmon.

Movement

Conditions that support passive and active movement, both of which are essential to organism survival, growth, and reproduction, are assessed in this section. Movement is affected by flow (including velocity, turbulence, and direction), diversion, barriers, water quality, and physical habitat conditions.

River flow over barriers and the predation associated with these barriers increase mortality during the downstream migration of juvenile chinook salmon and steelhead trout. CVPIA actions under Alternative 1 include removal of barriers on minor tributaries (e.g., Mill and Butte creeks) and modification of the spill structure at Daguerre Point Dam on the Yuba River (Figure IV-31). These actions would improve conditions affecting downstream movement (Figure IV-32) and benefit juvenile fall- and spring-run chinook salmon and juvenile steelhead trout.

This analysis assumes that constructing barriers that block adult migration to unproductive habitat would increase movement to productive habitat, increase survival, and improve reproductive success for chinook salmon and steelhead trout. CVPIA actions implemented under Alternative 1 would include constructing barriers on minor tributaries of the Sacramento River (Crowley Gulch on Cottonwood Creek, Grover Diversion Dam and Coleman Powerhouse on Battle Creek) and on the mainstem San Joaquin River upstream of its confluence with the Merced River (Figure IV-31). These barriers would have beneficial effects on movement to productive habitat (Figure IV-32) and increase spawning and rearing success of adult fall-run chinook salmon. On Battle Creek, barriers would benefit spring-run chinook salmon and steelhead trout.

Pulse flows provide cues for migration to downstream habitat, increasing survival of outmigrant juvenile chinook salmon. Under Alternative 1, increased flows pulse flows would be provided on Clear Creek and the American and Stanislaus rivers (Figure IV-31 and IV-32). These pulse flows would primarily benefit migration of juvenile fall-run chinook salmon, although ecosystem processes that maintain habitat conditions for other life stages and species may also improve.

Striped bass spawn in the Sacramento River during late April, May, and June. Under Alternative 1, Sacramento River flow during April through June would be reduced. Reduced flow (Figure IV-31) would slow the movement of eggs toward the Delta and adversely affect survival of striped bass eggs and larvae (Figures IV-32 and IV-33) compared with conditions under the No-Action Alternative. Sacramento River flows would be lower under Alternative 1 primarily because less water would be exported from the Trinity River basin to the Sacramento River.

American shad spawn from May through July. As with striped bass, reduced Sacramento River flows during May and June would adversely affect movement (Figure IV-32) and therefore adversely affect the survival of American shad eggs and larvae (Figure IV-33). Compared with the No-Action Alternative, Alternative 1 results in simulated American River flows that are lower during June and July, potentially slowing movement and adversely affecting egg and larval survival in the American River.

In the Delta, outmigrating juvenile chinook salmon, juvenile steelhead trout, and striped bass eggs and larvae are assumed to enter the DCC and Georgiana Slough in the same proportion as flow from the Sacramento River. Organisms transported into the central Delta from the DCC and Georgiana Slough are exposed to additional diversions, adverse water temperature, and increased predation compared with organisms that continue down the Sacramento River. Under Alternative 1, the proportion of Sacramento River flow entering the DCC and Georgiana Slough is similar to the proportion under the No-Action Alternative except during June, July, and October. During October, migration of species susceptible to movement into the central Delta is minimal and effects of the change in flow division at the DCC and Georgiana Slough would be similar under Alternative 1 and the No-Action Alternative.

An increase in the proportion of flow entering the DCC and Georgiana Slough in June and July could transport juvenile fall-run and late fall-run chinook salmon and striped bass eggs and larvae into the central Delta and increase exposure to adverse habitat conditions. Increased movement through the DCC and Georgiana Slough, however, would be offset by improved conditions in the central Delta associated with reduced diversions (see “Diversion”) and increased flow out of the central Delta.

Net Delta channel flow toward Suisun Bay is assumed to provide cues that increase the movement of organisms toward the Bay and away from more adverse habitat conditions in the central Delta. As indicated by a higher QWEST from May through August, flow out of the central Delta would increase under Alternative 1 and could increase movement toward the Bay (Figure IV-32). Larval and juvenile striped bass and delta smelt, and juvenile chinook salmon and steelhead trout would benefit from conditions increasing movement out of the central and south Delta and toward Suisun Bay.

Improved conditions affecting movement of striped bass and delta smelt, however, would be moderated by an upstream shift in estuarine salinity in response to reduced Delta outflow during July, August, and September. The upstream shift in salinity could cause juvenile striped bass and delta smelt to remain in the Delta, where entrainment loss at diversions is higher.

Compared with the No-Action Alternative, Alternative 1 would result in lower QWEST, lower Delta outflow during October and November, and higher diversions from October through February, which could delay movement out of the central Delta and increase mortality of juvenile striped bass; delta smelt; American shad; steelhead trout; and late fall-, winter-, and spring-run chinook salmon. Movement out of the central Delta is most important during spring, however, because life stages vulnerable to entrainment are present in higher numbers. Increased flow toward the Bay from May through August would offset the adverse effects of reduced flow toward the Bay during October through February.

Habitat Quantity and Quality

In the Sacramento and San Joaquin river basins, habitat loss has been a factor in the decline of many species, and providing habitat is critical to maintain and increase current populations. Habitat quantity and quality in the Sacramento-San Joaquin river basin would increase and improve under Alternative 1 for several reasons. Actions affecting habitat quantity and quality include structural changes, such as constructing fish ladders and removing barriers; improving habitat through instream and riparian restoration; and increasing flow.

Nonflow Changes. Actions to improve access to upstream habitat would be implemented on Clear Creek and the minor tributaries to the Sacramento River, as well as on the Feather, Yuba, Mokelumne, and Calaveras rivers (Figure IV-31). A fish ladder would be constructed at McCormick-Saeltzer Dam on Clear Creek. On Battle Creek, passage at Coleman National Fish Hatchery and Eagle Canyon would be modified and improved. Dams on Mill and Butte creeks would be removed, a fish ladder and fishway would be installed at Iron Canyon and Lindo Channel on Big Chico Creek, and fish ladders would be installed on Butte Creek. Passage would also be improved at Daguerre Point Dam on the Yuba River and around diversion dams on the Calaveras River. On the Feather River, improved passage for sturgeon is an identified action under Alternative 1. All these actions would increase habitat quantity by increasing access to existing habitat and would benefit primarily chinook salmon and steelhead trout; however, sturgeon, American shad, and Sacramento splittail may also benefit.

In the Sacramento River, restoring spawning gravel would increase spawning habitat for chinook salmon and steelhead trout, thereby increasing habitat quantity (Figure IV-32).

The availability of rearing habitat for fry and juvenile fall-run and spring-run chinook salmon and steelhead trout in the tributaries to the Sacramento River would also be improved under Alternative 1. Restoring channel habitat on Antelope Creek; enhancing spawning gravel on Mill, Deer, and Big Chico creeks; and improving pool-cleaning procedures on Big Chico Creek would increase or improve habitat quantity and quality under Alternative 1. Spawning gravel and channel habitats would be restored and enhanced and erosion control measures initiated for Clear Creek and the adjacent watershed.

On the Feather River, enhancing spawning gravel would increase habitat quantity and benefit spring- and fall-run chinook salmon. Fall-run chinook salmon and steelhead trout would also benefit from actions implemented on the Yuba River, including purchasing land for conservation easements, restoring channels and riparian habitat, and creating secondary channels to increase the amount of spawning and rearing habitats. On the American River, the program to remove woody debris would be terminated, and channels and riparian habitat would be restored, including the creation of side channels. The spawning and rearing life stages of chinook salmon and steelhead trout would benefit from increased habitat availability and improved habitat quality.

Habitat quantity would also increase in the San Joaquin River and its tributaries (Figure IV-32). Restoration actions on the Merced, Tuolumne, Stanislaus, Mokelumne, and mainstem San

Joaquin rivers would include improving watersheds, restoring and protecting instream and riparian habitats, possibly restoring spawning gravels, preventing illegal stream alterations, and limiting future bank protection activities. These actions would benefit the spawning and rearing life stages of fall-run chinook salmon, American shad, sturgeon, and Sacramento splittail.

Delta and estuarine habitats are critical to all the representative species. Actions to restore habitats would include restricting dredging, restoring riparian vegetation, limiting bank protection, and restoring tidal shallow water habitat. Restoring shallow water habitat would increase the availability of rearing habitat for all species and the availability of spawning habitat for delta smelt, longfin smelt, and Sacramento splittail.

Flow Changes. For the purposes of the PEIS, increasing flow is assumed to increase habitat availability for chinook salmon, steelhead trout, striped bass, American shad, green sturgeon, white sturgeon, and Sacramento splittail. Site-specific analysis (e.g., ongoing instream flow studies on the American and Sacramento rivers) will be required, however, to determine specific flow needs and to address the specific impacts and benefits of meeting those needs.

In the Sacramento River, flows would be higher under Alternative 1 than under the No-Action Alternative during seven months of the year and lower than under the No-Action Alternative during the remaining months. Increased habitat quality and quantity would result from higher flows from October through April (Figure IV-32). More spawning habitat would be available for fall-, late fall-, and spring-run chinook salmon and steelhead trout and possibly also for Sacramento splittail and sturgeon. Higher flows may provide additional rearing habitat for all runs of chinook salmon, steelhead trout, sturgeon, and Sacramento splittail.

Reduced flows and higher water temperatures in the Sacramento River from May through September, compared with conditions under the No-Action Alternative, would reduce habitat availability for fall-, late fall-, winter-, and spring-run chinook salmon and steelhead trout. Higher water temperatures may reduce the downstream extent of habitat suitable for juvenile late fall- and spring-run chinook salmon and steelhead trout, particularly in reaches downstream of the RBDD. Because most fall-run chinook salmon outmigrate before mid-June, the fall run would be affected less than other runs by changes in rearing habitat availability.

Habitat availability in Clear Creek would improve greatly under Alternative 1 because of higher flows. This would apply particularly to rearing fry and juvenile fall- and spring-run chinook salmon and steelhead trout. Simulated flows are higher for all months compared with flows under the No-Action Alternative, increasing the availability of habitat.

Simulated data show little difference in flow between Alternative 1 and the No-Action Alternative for the Feather and Yuba rivers. In the American River, higher flows from October through March may provide more spawning and rearing habitats for fall-run chinook salmon and steelhead trout. Lower flows from June through September would primarily reduce the availability of rearing habitat for steelhead trout.

On the Tuolumne River, flows under Alternative 1 would be similar to those under the No-Action Alternative. On the Stanislaus River, higher flows from February through June would improve and increase rearing habitat, benefitting juvenile fall-run chinook salmon and possibly American shad. Higher flows in October may increase spawning habitat and benefit fall-run chinook salmon. On the Merced River, lower flows during April and May would reduce the availability of rearing habitat and increase water temperature, potentially reducing the downstream extent of habitat suitable for rearing juvenile fall-run chinook salmon (Figure IV-32). Lower flow during October may reduce spawning habitat and adversely affect fall-run chinook salmon (Figure IV-33).

Higher Delta outflows and the shift of estuarine salinity downstream of the Delta and into Suisun Bay would increase habitat quantity. Estuarine salinity would shift farther downstream during January, February, and March during low-outflow years and would increase spawning and early rearing habitat for Sacramento splittail, delta smelt, and longfin smelt. Habitat quality would also improve, primarily because of potential reductions in diversion-related mortality and increased food web support.

From July through September, Delta outflow under Alternative 1 would be less than outflow simulated for the No-Action Alternative and estuarine salinity would shift upstream. These upstream salinity shifts would reduce habitat availability and quality for striped bass and delta smelt.

Food Web Support

Organisms that provide the food base for fish species are affected by the same ecosystem functions that affect the representative fish species discussed previously. Restoring riparian habitat, creating secondary channels, terminating the program to remove woody debris, improving watersheds, restoring and protecting instream habitat, and limiting future bank protection activities would increase food web support for representative species in the Sacramento River and its tributaries under Alternative 1 (Figures IV-31 and IV-32). These actions would increase the input of nutrients, organic carbon, and food organisms to the aquatic ecosystem. In addition, reducing pollutant input to the system would increase food organism survival and food web support for riverine species.

Food web support would also increase for representative species in the Delta. CVPIA actions to restore habitat, including actions that may restrict dredging, restore riparian vegetation, limit bank protection, and restore tidal shallow water habitat would increase the input of nutrients, organic carbon, and food organisms to the Delta and would increase food web support for representative species. In addition, upstream restoration actions described previously would increase the input of nutrients, organic carbon, and food organisms to the Delta. Food web support in the Delta would also benefit from reduced pollutant input from the Sacramento and San Joaquin rivers and their tributaries that drain to the Delta.

Reduced entrainment in diversions under Alternative 1 would affect food web support in the Delta. Compared with conditions under the No-Action Alternative, diversions from the Delta (primarily through the CVP and SWP pumping facilities) under Alternative 1 would be lower from April through September and higher from October through February. Because of their small size, food web organisms would generally not benefit from installation of new or improved fish screens, but decreased diversions would reduce entrainment of food web organisms, nutrients, and organic carbon. Reduced diversions during April through September generally coincide with the main period of primary productivity in the Delta.

Compared with the No-Action Alternative, estuarine salinity under Alternative 1 would shift farther downstream during January through March of low-outflow years. The downstream shift in estuarine salinity may increase food web support for species geographically associated withspecific salinity levels because productivity is generally higher in the shallow shoal habitats of Suisun Bay than in the Delta. Food web support would increase for Sacramento splittail, delta smelt, and longfin smelt. From July through September, simulated Delta outflow would be less under Alternative 1 than under the No-Action Alternative, and estuarine salinity would shift upstream. The upstream shift would affect production of food organisms that require specific salinity conditions and would reduce food web support for striped bass, delta smelt, and other species.

ALTERNATIVE 2

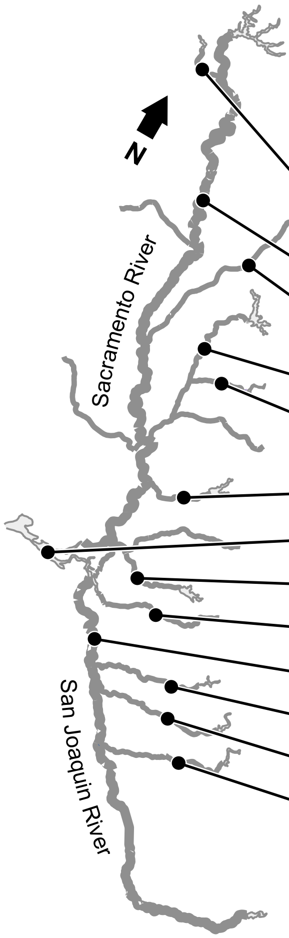
Alternative 2 includes all Alternative 1 actions and would provide similar benefits associated with those actions (Figure IV-34). Flow acquisition on the San Joaquin River tributaries provides additional benefits not discussed for Alternative 1. Increased flows in the San Joaquin River Region would occur in Alternative 2. The combination of actions (structures, habitat, and flow improvements) and species interactions would improve ecosystem conditions, including increased habitat quantity and quality (Figure IV-35). The improved ecosystem conditions would benefit most representative species compared with conditions under the No-Action Alternative (Figure IV-36).

Water Temperature

Several actions implemented under Alternative 2 could affect water temperatures: changing reservoir operations; changing flows; installing or modifying multilevel release shutters; restoring riparian areas, meander belts, and watersheds; and controlling and relocating agricultural return flows (Figure IV-34). The benefits of all of these actions are discussed for Alternative 1. This section discusses only the additional benefits provided by the changes in reservoir operations and flow on San Joaquin River tributaries.

Alternative 2 should improve water temperature conditions compared with Alternative 1 and the No-Action Alternative (see discussion of Alternative 1). Increased flow in the Stanislaus, Tuolumne, Merced, and San Joaquin rivers should improve water temperature conditions and benefit rearing fall-run chinook juveniles and fry.

For the Stanislaus River, the temperature simulation indicates that reduced water temperatures would benefit juvenile fall-run chinook salmon during April and May. During October and November, slightly higher temperatures could lead to increased mortality during spawning and incubation of the fall run. However, because this change is relatively small, it may be possible that actual reservoir operations could be refined to meet the AFRP target of 56 degrees



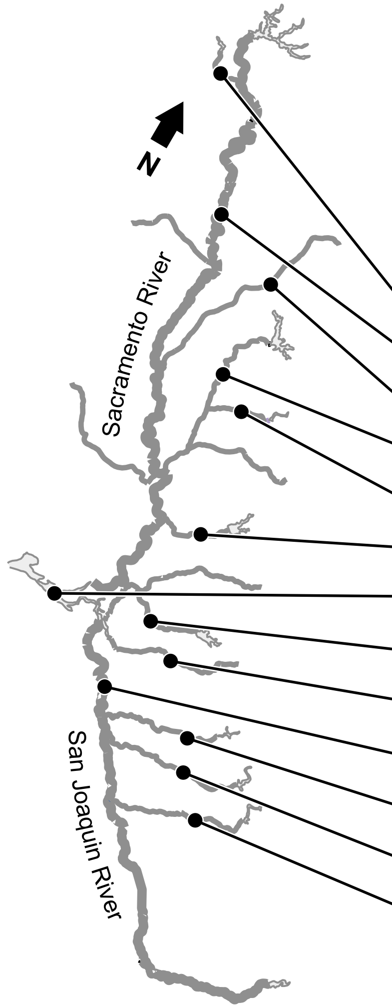
Watershed	Structure		Habitat Improvements			Flow			Species Interactions
	Fish Screens	Improved Passage	Instream	Riparian	Water Quality	Increased Flow	Reduced Fluctuation	Reduced Diversion	Predator Control
Clear Creek		☐	☐	☐	☐	☐	☐		
Sacramento R.	☐		☐	☐	☐	☐	☐		
*Minor Tributaries	☐	☐	☐	☐	☐	☐			
Feather R.	☐	☐	☐			☐			
Yuba River	☐	☐	☐	☐			☐		
American R.	☐		☐	☐		☐	☐		
Bay-Delta	☐		☐	☐	☐	☐			
Mokelumne R.	☐	☐	☐	☐	☐				
Calaveras R.	☐	☐							
San Joaquin R.	☐	☐		☐	☐	■			
Stanislaus R.	☐		☐	☐		■			☐
Tuolumne R.	☐		☐	☐	☐	■	☐		☐
Merced R.	☐	☐	☐	☐	☐	■	☐		☐

■ = Actions in addition to those under Alternative 1
☐ = Action implemented under Alternative 1
No Symbol = No action implemented

*Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-34

CVPIA ACTIONS IMPLEMENTED TO BENEFIT FISH AND AQUATIC RESOURCES UNDER ALTERNATIVE 2



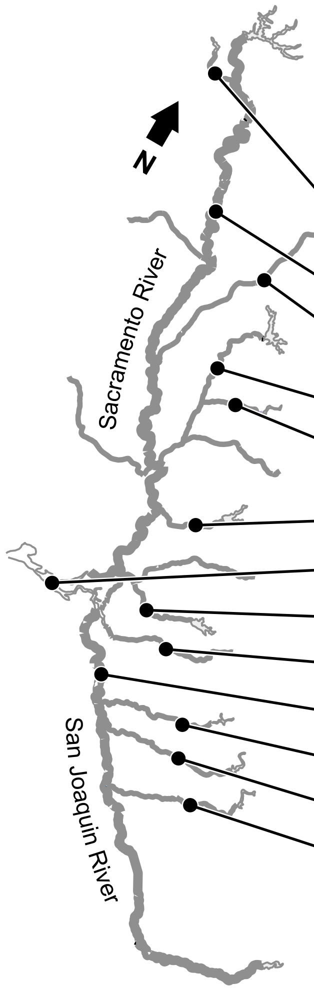
Watershed	River Water Temperature	Diversion	River Surface Level Changes	Pollutants	Predation	Movement	Habitat Quality and Quantity	Food Web Support
Clear Creek	✓	✓	✓			✓	✓	✓
Sacramento R.		✓	✓	✓	✓	✠	✓	✓
*Minor Tributaries	✓	✓			✓	✓	✓	✓
Feather R.		✓					✓	✓
Yuba River	✓	✓			✓	✓	✓	✓
American R.	✠	✓	✓			✓	✓	✓
Bay-Delta		★		✓	✓	★	★	★
Mokelumne R.		✓		✓	✓		✓	✓
Calaveras R.		✓					✓	✓
San Joaquin R.		✓		✓	✓	★	★	★
Stanislaus R.	★	✓			✓	★	★	★
Tuolumne R.	✔	✓	✓	✓	✓	✔	★	★
Merced R.	✔	✓	✓	✓	✓	✔	✔	✔

★ = Greater benefit compared to Alternative 1
✔ = New benefit compared to Alternative 1
✓ = Equivalent to benefit shown for Alternative 1
No Symbol = No change
✠ = Adverse change compared to the No-Action Alternative, but not greater than under Alternative 1

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-35

CHANGES IN ENVIRONMENTAL CONDITIONS AFFECTING FISH POPULATIONS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 1



Watershed	Chinook Salmon	Steelhead Trout	Sacramento Splittail	Sturgeon	Striped Bass	American Shad	Delta Smelt	Longfin Smelt
Clear Creek	✓	✓	--	--	--	--	--	--
Sacramento R.	✓	✓	✓	✓	✗	✗	--	--
*Minor Tributaries	✓	✓	--	--	--	--	--	--
Feather R.	✓	✓	--	--	--	✓	--	--
Yuba River	✓	✓	--	--	--	✓	--	--
American R.	✓	✗	--	--	--	✗	--	--
Bay-Delta	★	★	★	★	★	★	★	★
Mokelumne R.	✓	--	--	--	--	--	--	--
Calaveras R.	✓	--	--	--	--	--	--	--
San Joaquin R.	★	--	★	--	--	--	--	--
Stanislaus R.	★	--	--	--	--	--	--	--
Tuolumne R.	★	--	--	--	--	--	--	--
Merced R.	✔	--	--	--	--	--	--	--

★ = Greater benefit compared to Alternative 1
✔ = New benefit compared to Alternative 1
✓ = Equivalent to benefit shown for Alternative 1
✗ = Adverse change compared to the No-Action Alternative, but not greater than Alternative 1
-- = Species does not occur or occurrence is minor

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-36

BENEFICIAL AND ADVERSE CHANGES TO FISH SPECIES UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 1

Fahrenheit on October 15, whereas modeled reservoir operations could not. Similar benefits and effects are likely on the Merced and Tuolumne rivers.

Diversion

Actions implemented under Alternative 2 that may improve diversion conditions include constructing and improving fish screens, redesigning facilities to discourage predation, reducing diversion volume, and improving flow conditions toward Suisun Bay. Alternative 2 includes all actions from Alternative 1 that affect mortality attributable to diversion structure and operation. Diversion volumes under Alternative 2 are similar to Alternative 1 levels. However, the greater flow toward Suisun Bay under Alternative 2 would provide additional benefits in the Delta relative to conditions described under Alternative 1 (Figure IV-35).

Greater flows from the San Joaquin River and tributaries would improve flow conditions in the Delta, reducing exposure to diversions. Exposure to diversions is higher in the central and southern portions of the Delta and, therefore, species entering and using Delta habitat would benefit from flow conditions favoring movement to Suisun Bay. Increased QWEST from March to August would facilitate the movement of organisms out of the central and southern Delta toward Suisun Bay (see “Movement”), resulting in reduced entrainment losses for egg and larval striped bass, American shad, delta smelt, and longfin smelt. Reduced QWEST from October to December would reduce movement toward Suisun Bay and increase exposure to entrainment losses. However, fish present in the Delta at that time would be large enough to benefit from fish screen improvements.

Changes in Water Surface Level

Alternative 2 would include implementation of all Alternative 1 actions addressing changes in water surface level (Figure IV-34) and would provide benefits similar to those described under Alternative 1 (Figure IV-35).

Pollutants

Reduced application of pesticides (e.g., as a result of reduced agricultural acreage) and actions that reduce input of pollutants under Alternative 2 would improve water quality conditions in rivers and streams (Figure IV-34). Although CVPIA actions addressing pollutant input and actual changes in pesticide application may be minimal, representative species would benefit to some extent. Benefits would be similar to those identified for Alternative 1 (Figure IV-35).

In addition, increased flows in the Stanislaus, Tuolumne, Merced, and San Joaquin rivers, although small relative to flows under Alternative 1 (see Chapter II), would dilute toxicant concentration levels, thus possibly providing an additional benefit relative to conditions described for Alternative 1.

Predation

The CVPIA actions affecting predation under Alternative 2 and their benefits are the same as those described for Alternative 1.

Movement

Conditions that support passive and active movement, both of which are essential to organism survival, growth, and reproduction, are similar to conditions discussed for Alternative 1 (Figure IV-35).

In addition to the beneficial and adverse effects discussed for Alternative 1, Alternative 2 actions would increase flows in the Stanislaus, Tuolumne, and Merced rivers (Chapter II). Simulated flows increase under Alternative 2 on the Stanislaus River in October and from January to June; on the Tuolumne River from April to October; on the Merced River in October, April, and May; and on the lower San Joaquin River in October and from January through June. Hence, outmigration of juvenile fall-run chinook salmon could be facilitated by increasing flow to the Delta. Flows would decrease on the lower San Joaquin River during August and September, but fall- and late fall-run juvenile chinook salmon do not migrate during that period.

As indicated by increased QWEST from March to August, conditions affecting movement out of the central Delta under Alternative 2 could increase survival of larval and juvenile striped bass, delta smelt, and longfin smelt and juvenile chinook salmon and steelhead trout. Similar to conditions under Alternative 1, however, improved conditions affecting movement of striped bass and delta smelt under Alternative 2 would be moderated by an upstream shift in estuarine salinity in response to reduced Delta outflow during July, August, and September. The upstream shift in salinity could cause juvenile striped bass and delta smelt to remain in the Delta, where entrainment loss in diversions is higher.

Provision of Habitat

Alternative 2 incorporates all Alternative 1 actions that would affect habitat and provides additional habitat benefits through greater flows on San Joaquin River tributaries. Greater flows into the Delta from the San Joaquin River could shift estuarine salinity downstream, resulting in greater habitat availability in the Delta (Figures IV-34 and IV-35).

The quantity of habitat on the San Joaquin River and tributaries would increase with the provision of higher flows in the Stanislaus River during October and from January to June; in the Tuolumne River from April to October; in the Merced River during October and from April to May; and in the lower San Joaquin River in October and from January through June. Increased flows would benefit rearing fall-run chinook fry and juveniles through greater habitat availability.

In addition, spawning and rearing habitat for Delta species may increase because of higher flows in the San Joaquin River under Alternative 2. Compared with conditions under the No-Action Alternative, estuarine salinity under Alternative 2 would shift downstream from January through June and would increase the availability and quality of spawning and early rearing habitat for

Sacramento splittail, delta smelt, striped bass, American shad, and longfin smelt. As under Alternative 1, Delta outflow under Alternative 2 would be less than outflow simulated for the No-Action Alternative from July through September and estuarine salinity would shift upstream. Upstream shifts in estuarine salinity would reduce the availability and quality of habitat for striped bass and delta smelt. Habitat quality is related to shallow water habitat availability, potential entrainment losses in diversions, and food web support.

Food Web Support

Under Alternative 2, changes in conditions affecting food web support would be similar to conditions described for Alternative 1. Increased flow in the Stanislaus, Tuolumne, Merced, and San Joaquin rivers would increase habitat area for prey organisms. Increased Delta outflow and a downstream shift in estuarine salinity may increase food web support for rearing life stages of all the representative species by increasing production of food web organisms.

ALTERNATIVE 3

Alternative 3 would incorporate all of the actions described for Alternatives 1 and 2 and would provide similar benefits. In addition, Alternative 3 would build on Alternatives 1 and 2 through assumed acquisition of additional water, primarily on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers (Figure IV-37; also see Chapter II). Flows in the minor tributaries could also be increased. Consequently, Alternative 3 would provide increased flow-related benefits not discussed for Alternatives 1 and 2 (Figure IV-38) and would provide additional benefits to representative species in some watersheds (Figure IV-39).

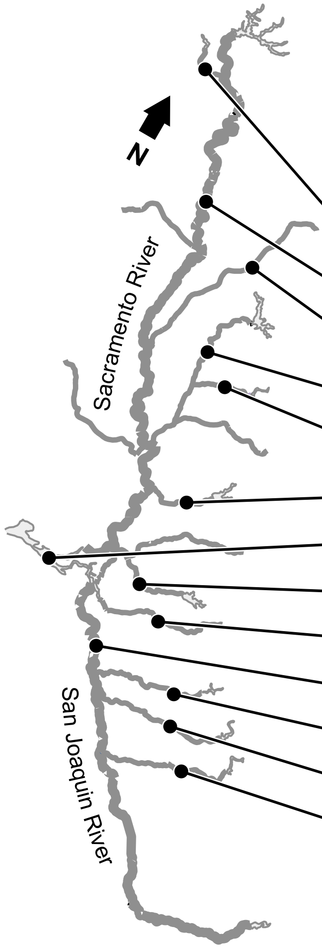
Water Temperature

Most actions assumed to be implemented under Alternative 3 have already been discussed for Alternatives 1 and 2. This section discuss only the additional benefits that would be provided by the changes in reservoir operations and flow on Sacramento and San Joaquin river tributaries (Figure IV-37).

Under Alternative 3, water temperature conditions would improve compared with conditions described for Alternatives 1 and 2 and compared with the No-Action Alternative. Increased spring flows on the Yuba, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers should reduce water temperatures and benefit rearing juvenile and fry chinook salmon and steelhead trout. Temperature modeling indicates that water temperatures on the Stanislaus River would be similar to those under Alternative 1. Although not specifically modeled, it is expected that flows and water temperatures may also improve on the Bear, Mokelumne, and Calaveras rivers (see Chapter II), which would benefit fall-run chinook salmon.

Diversion

Actions implemented under Alternative 3 that may improve diversion conditions include constructing and improving fish screens, redesigning facilities to discourage predation, reducing diversion volume, and improving flow conditions toward Suisun Bay. Alternative 3 includes all



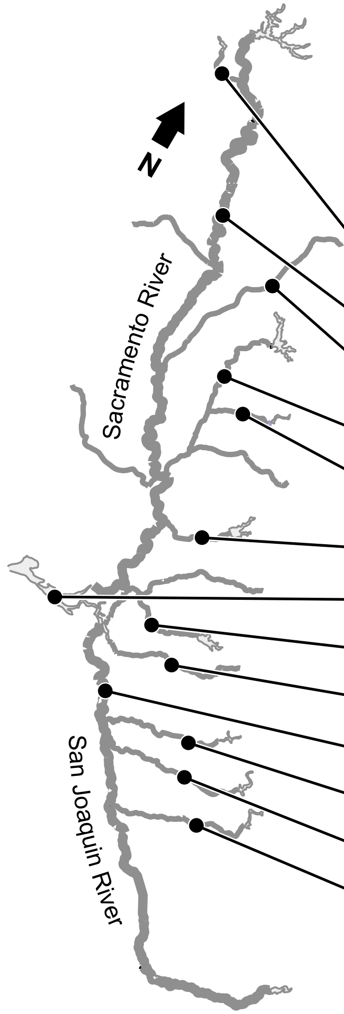
Watershed	Structure: Fish Screens	Structure: Improved Passage	Habitat Improvements: Instream	Habitat Improvements: Riparian	Habitat Improvements: Water Quality	Flow: Increased Flow	Flow: Reduced Fluctuation	Flow: Reduced Diversion	Species Interactions: Predator Control
Clear Creek		☐	☐	☐	☐	☐	☐		
Sacramento R.	☐		☐	☐	☐	☐	☐		
*Minor Tributaries	☐	☐	☐	☐	☐	■			
Feather R.	☐	☐	☐			☐			
Yuba River	☐	☐	☐	☐		■	■		
American R.	☐		☐	☐		☐	☐		
Bay-Delta	☐		☐	☐	☐	☐			
Mokelumne R.	☐	☐	☐	☐	☐	■	■		
Calaveras R.	☐	☐				■			
San Joaquin R.	☐	☐		☐	☐	■			
Stanislaus R.	☐		☐	☐		■			☐
Tuolumne R.	☐		☐	☐	☐	■	☐		☐
Merced R.	☐	☐	☐	☐	☐	■	☐		☐

■ = Actions in addition to those under Alternative 2
☐ = Action implemented under Alternatives 1 and 2
No Symbol = No action implemented

*Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-37

CVPIA ACTIONS IMPLEMENTED TO BENEFIT FISH AND AQUATIC RESOURCES UNDER ALTERNATIVE 3



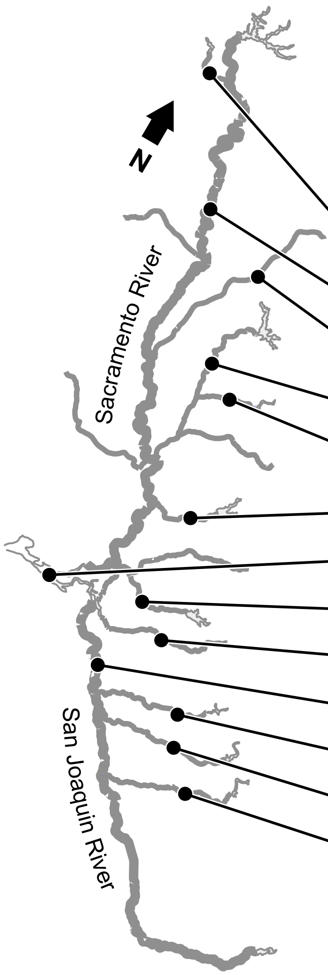
Watershed	River Water Temperature	Diversion	River Surface Level Changes	Pollutants	Predation	Movement	Habitat Quality and Quantity	Food Web Support
Clear Creek	✓	✓	✓			✓	✓	✓
Sacramento R.		✓	✓	✓	✓	✗	✓	✓
*Minor Tributaries	✓	✓			✓	✓	✓	✓
Feather R.		✓					✓	✓
Yuba River	★	✓	✔		✓	★	★	★
American R.	✗	✓	✓			✓	✓	✓
Bay-Delta		★		✓	✓	★	★	★
Mokelumne R.	✔	✓	✔	✓	✓	✔	★	★
Calaveras R.	✔	✓					✓	✓
San Joaquin R.		✓		✓	✓	★	★	★
Stanislaus R.	★	✓			✓	★	★	★
Tuolumne R.	★	✓	✓	✓	✓	★	★	★
Merced R.	★	✓	✓	✓	✓	★	★	★

★ = Greater benefit compared to Alternative 2
✔ = New benefit compared to Alternative 2
✓ = Equivalent to benefit shown for Alternative 2
No Symbol = No change
✗ = Adverse change compared to the No-Action Alternative, but not greater than under Alternative 2

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-38

CHANGES IN ENVIRONMENTAL CONDITIONS AFFECTING FISH POPULATIONS UNDER ALTERNATIVE 3 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 2



Watershed	Chinook Salmon	Steelhead Trout	Sacramento Splittail	Sturgeon	Striped Bass	American Shad	Delta Smelt	Longfin Smelt
Clear Creek	✓	✓	--	--	--	--	--	--
Sacramento R.	✓	✓	✓	✓	✗	✗	--	--
* Minor Tributaries	✓	✓	--	--	--	--	--	--
Feather R.	✓	✓	--	--	--	✓	--	--
Yuba River	★	★	--	--	--	✓	--	--
American R.	✓	✗	--	--	--	✗	--	--
Bay-Delta	★	★	★	★	★	★	★	★
Mokelumne R.	★	--	--	--	--	--	--	--
Calaveras R.	★	--	--	--	--	--	--	--
San Joaquin R.	★	--	★	--	--	--	--	--
Stanislaus R.	★	--	--	--	--	--	--	--
Tuolumne R.	★	--	--	--	--	--	--	--
Merced R.	★	--	--	--	--	--	--	--

★ = Greater benefit compared to Alternative 2
✔ = New benefit compared to Alternative 2
✓ = Equivalent to benefit shown for Alternative 2
✗ = Adverse change compared to the No-Action Alternative, but not greater than Alternative 2
-- = Species does not occur or occurrence is minor

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-39

BENEFICIAL AND ADVERSE CHANGES TO FISH SPECIES UNDER ALTERNATIVE 3 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 2

actions from Alternatives 1 and 2 that affect mortality attributable to diversion structure and operation, and would provide similar benefits (Figure IV-38). Diversion volumes under Alternative 3 are also similar to Alternative 1 levels. Diversions may be reduced in the Yuba, Mokelumne, and Calaveras rivers and increased in the Delta. Increased flow toward Suisun Bay under Alternative 3 would provide benefits related to diversion conditions in addition to those described for Alternatives 1 and 2 (Figure IV-38).

Although diversion volumes may be reduced on the Yuba, Mokelumne, and Calaveras rivers, new fish screens and fish screen improvements would provide the primary benefit for fish of the appropriate size, similar to the benefit described for Alternatives 1 and 2. Yuba River diversions would decrease from April to September, benefitting migrating juvenile fall-run chinook and steelhead. Mokelumne River diversions would decrease in October and December and from April to September, benefitting migrating fall-run chinook salmon in April and May.

Part of the acquired flow entering the Delta from the San Joaquin River under Alternative 3 would be exported from the Delta, increasing Delta diversions from August through May compared with diversions under the No-Action Alternative. Although increased diversions could have adverse effects on San Joaquin River chinook salmon, higher San Joaquin River inflow, increased QWEST, and higher Delta outflow would offset the effects of increased diversions on most species. Overall, conditions affecting diversion losses would improve for all species, and entrainment losses would be lower under Alternative 3 than under the No-Action Alternative (Figure IV-38).

Changes in Water Surface Level

Alternative 3 would include all Alternative 1 actions addressing changes in water surface level (Figure IV-37) and would provide benefits similar to those described for Alternative 1 (Figure IV-38). In addition, Alternative 3 would reduce flow fluctuations on the Yuba and Mokelumne rivers. Reduced flow fluctuations would reduce stranding and drying out of redds, providing benefits to egg, fry, and juvenile life stages of fall-run chinook salmon and steelhead trout (Figures IV-37 and IV-38).

Pollutants

Conditions affected by pollutants under Alternative 3 would be similar to those described for Alternatives 1 and 2 (Figure IV-38). In addition, increased flows in the Stanislaus, Tuolumne, Merced, and San Joaquin rivers (see Chapter II) would dilute pollutant concentration levels, thus providing a slight additional benefit relative to conditions described for Alternatives 1 and 2.

Predation Losses

Alternative 3 would involve implementing all actions affecting predation described for the previous alternatives and would have similar benefits (Figure IV-38).

Movement

Conditions that would support passive and active movement essential to organism survival, growth, and reproduction under Alternative 3 would be similar to those discussed for Alternatives 1 and 2 (Figure IV-37). Alternative 3 would include pulse flows on the Yuba, Mokelumne, Calaveras, and Stanislaus rivers and supplemental pulse flows on the Tuolumne and Merced rivers (see Chapter II). Pulse flows would primarily benefit outmigration of juvenile fall-run chinook salmon, although pulse flows may also benefit ecosystem processes that maintain habitat conditions for other life stages and species. Under Alternative 3, Yuba River flows would increase in October, November, June, and September and decrease in April, July, and August. Higher flows in June would improve transport of American shad eggs and larvae. However, reduced river flow in April and July could reduce transport and increase mortality of American shad eggs and larvae spawned in the Yuba River.

In the Delta, net channel flows toward Suisun Bay are assumed to provide cues that increase the movement of organisms out of the central Delta. As indicated by a higher QWEST compared with those under the previous alternatives, flow conditions under Alternative 3 may increase movement of larval and juvenile striped bass, delta smelt, and longfin smelt and juvenile chinook salmon and steelhead trout out of the central and southern Delta and toward Suisun Bay from December through August. Movement out of the central Delta would increase survival because of reduced diversion effects and increased productivity in Suisun Bay. Although reduced QWEST may reduce movement and increase mortality of some species in the central Delta during November, movement out of the central Delta is most important during spring and early summer because of the greater incidence of life stages vulnerable to entrainment in diversions.

Habitat Quantity and Quality

Alternative 3 includes all actions described for Alternatives 1 and 2 affecting habitat (Figure IV-37). In addition, implementing Alternative 3 actions would increase flows on minor tributaries to the Sacramento River and the Yuba, Mokelumne, Calaveras, San Joaquin, Stanislaus, Tuolumne, and Merced rivers (Figure IV-37). Increased river flow would contribute to increased Delta outflow and result in a downstream shift of estuarine salinity. The increased flows would increase habitat availability and quality and would benefit most of the representative species (Figures IV-38 and IV-39).

Yuba River flow would increase from September to November, potentially increasing habitat availability for spawning and incubation life stages of fall-run chinook salmon and fry and juvenile rearing life stages of steelhead. However, Yuba River flow would decrease in June and July, reducing habitat availability for steelhead fry and juvenile rearing life stages. Under Alternative 3, channel restoration on the Yuba River would increase habitat availability and offset the habitat reduction that may be attributable to decreased flows.

Mokelumne River flow would increase from December to April, increasing habitat availability for fall-run chinook salmon, and decrease from May to September, potentially reducing habitat availability for the juvenile fall-run chinook salmon rearing life stage during June. Alternative 3 also would include habitat restoration actions discussed for Alternative 1 on the Mokelumne River, thus offsetting habitat losses attributable to reduced flow from May through September.

Under Alternative 3, Calaveras River flow would increase from October to April compared with levels under the No-Action Alternative, thus increasing habitat availability for fall- and winter-run chinook salmon. Flows from May to September would decrease and could affect habitat availability for winter-run chinook salmon. Management of Calaveras River flows, however, would require site-specific evaluations to address the needs of applicable species.

Stanislaus River flow would increase from September to June compared with conditions under the No-Action Alternative, increasing habitat availability for fall-run chinook salmon. San Joaquin, Tuolumne, and Merced river flows would increase in all months compared with No-Action Alternative conditions, benefitting fall-run chinook salmon by increasing habitat availability. Although Merced River flows during June would decline compared with conditions under the No-Action Alternative, rearing juvenile chinook salmon are less likely to be present at that time than during the preceding months, and effects on survival and growth would be minimal.

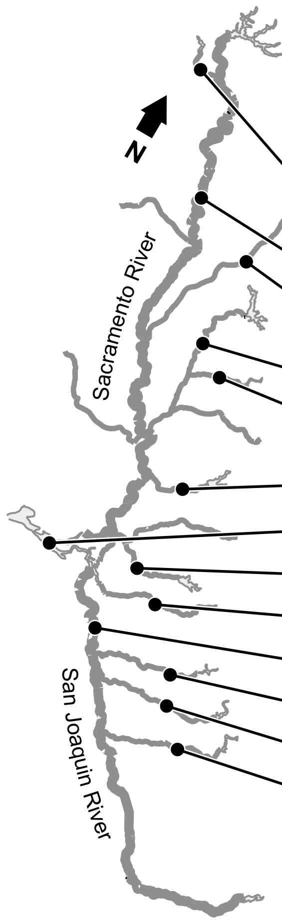
San Joaquin River inflow to the Delta would increase relative to inflow under the No-Action Alternative and Alternatives 1 and 2. Increased flows on the Merced, Tuolumne, and Stanislaus rivers contribute to increased Delta inflow. Although part of the inflow is exported (see "Diversions" above), increased Delta outflow under Alternative 3 would shift estuarine salinity farther downstream from November through June compared with conditions under the No-Action Alternative. The downstream shift in estuarine salinity would increase freshwater habitat availability and improve habitat conditions for Sacramento splittail, delta smelt, striped bass, American shad, and longfin smelt. The effects of reduced Delta outflow from July through September compared with outflow under the No-Action Alternative would be the same as described for Alternative 1.

Food Web Support

Under Alternative 3, changes in conditions affecting food web support would be similar to conditions described for Alternatives 1 and 2. Under Alternative 3, increased flow on the minor tributaries of the Sacramento River and on the Yuba, Mokelumne, Calaveras, San Joaquin, Stanislaus, Tuolumne, and Merced rivers would increase the quantity and quality of habitat available for prey organisms and increase food web support (Figure IV-38). Increased Delta outflow and a downstream shift in estuarine salinity may increase food web support for rearing life stages of all the representative species by increasing production of food web organisms.

ALTERNATIVE 4

Alternative 4 would include all actions described for Alternatives 1, 2, and 3 and would provide similar benefits. In addition, Alternative 4 would improve on Alternative 3 conditions by allowing water acquired upstream of the Delta to flow through the Delta to the Bay (Figure IV-40). Alternative 4 also wold modify DCC operations to provide additional benefits for Sacramento River system species. In general, flows allocated to fish habitat improvements in the



Watershed	Structure: Fish Screens	Structure: Improved Passage	Habitat Improvements: Instream	Habitat Improvements: Riparian	Habitat Improvements: Water Quality	Flow: Increased Flow	Flow: Reduced Fluctuation	Flow: Reduced Diversion	Species Interactions: Predator Control
Clear Creek		□	□	□	□	□	□		
Sacramento R.	□		□	□	□	□	□		
*Minor Tributaries	□	□	□	□	□	□			
Feather R.	□	□	□			□			
Yuba River	□	□	□	□		□	□		
American R.	□		□	□		□	□		
Bay-Delta	□	■	□	□	□	■		■	
Mokelumne R.	□	□	□	□	□	□	□		
Calaveras R.	□	□				□			
San Joaquin R.	□	□		□	□	□			
Stanislaus R.	□		□	□		□			□
Tuolumne R.	□		□	□	□	□	□		□
Merced R.	□	□	□	□	□	□	□		□

■ = Actions in addition to those under Alternative 3
□ = Action implemented under Alternatives 1, 2, and 3
No Symbol = No action implemented

*Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-40

CVPIA ACTIONS IMPLEMENTED TO BENEFIT FISH AND AQUATIC RESOURCES UNDER ALTERNATIVE 4

Delta would increase under Alternative 4 and provide additional benefits relative to conditions described under the No-Action Alternative and Alternatives 1, 2, and 3 (Figure IV-41). Implementation of Alternative 4 would have beneficial effects on all of the representative species occurring in the Delta (Figure IV-42).

Water Temperature

Alternative 4 would incorporate all actions from Alternatives 1, 2, and 3 affecting water temperature and would have the same benefits in habitats upstream of the Delta (Figures IV-40 and IV-41).

Diversion

Alternative 4 would include all actions affecting diversions described for Alternatives 1, 2, and 3. In the Delta, diversions would be reduced compared with diversions under the No-Action Alternative and Alternatives 1, 2, and 3 (Figure IV-40). Compared with the other alternatives and to the No-Action Alternative, reduced diversions under Alternative 4 would improve conditions affected by diversions in the Delta (Figure IV-41). All representative species would benefit (Figure IV-42).

In addition to the direct benefits of reduced diversions, more water would flow through and out of the Delta under Alternative 4 compared with conditions under the No-Action Alternative and Alternatives 1, 2, and 3. Increased outflow would shift the distribution of Delta species downstream, away from the influence of Delta diversions.

Changes in Water Surface Level

Alternative 4 would incorporate all actions addressing surface level fluctuations from Alternatives 1, 2, and 3 (Figure IV-40) and would provide similar benefits (Figure IV-41).

Pollution

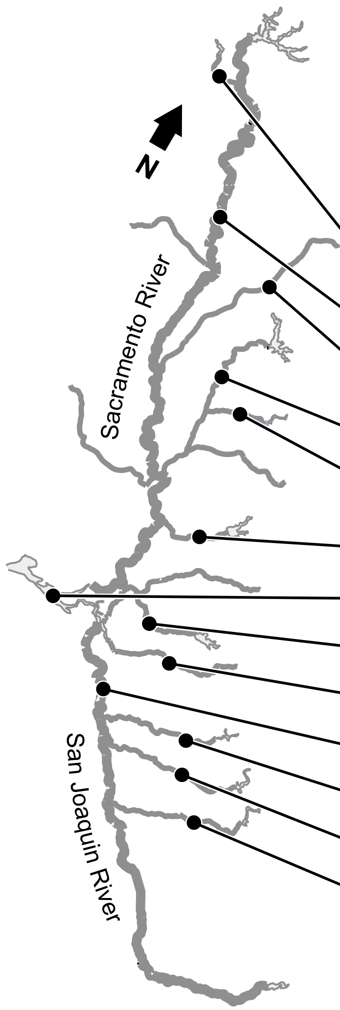
Alternative 4 would incorporate all actions described for Alternatives 1, 2, and 3 that address conditions affected by pollutants (Figure IV-40) and would provide similar benefits (Figure IV-41).

Predation

Alternative 4 would implement all actions affecting predation that have been described for Alternatives 1, 2, and 3 and would have similar benefits (Figures IV-40 and IV-41).

Movement

Conditions that support both passive and active movement essential to organism survival, growth, and reproduction in streams and rivers upstream of the Delta would be the same under Alternative 4 as those discussed for Alternative 3 (Figure IV-40). In the Delta, reduced



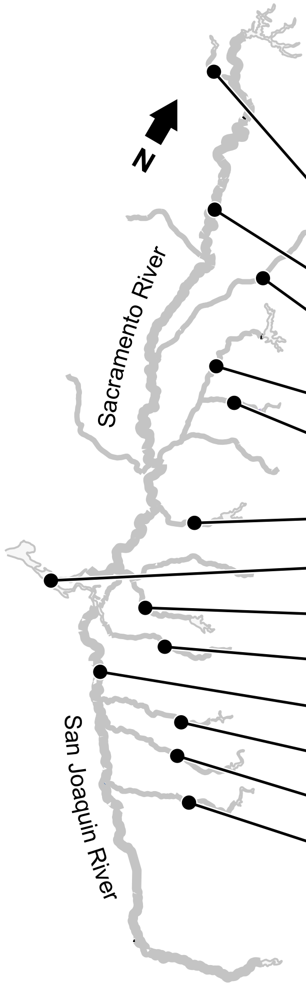
Watershed	River Water Temperature	Diversion	River Surface Level Changes	Pollutants	Predation	Movement	Habitat Quality and Quantity	Food Web Support
Clear Creek	✓	✓	✓			✓	✓	✓
Sacramento R.		✓	✓	✓	✓	✕	✓	✓
*Minor Tributaries	✓	✓			✓	✓	✓	✓
Feather R.		✓					✓	✓
Yuba River	✓	✓	✓		✓	✓	✓	✓
American R.	✕	✓	✓			✓	✓	✓
Bay-Delta		★		✓	✓	★	★	★
Mokelumne R.	✓	✓	✓	✓	✓	✓	✓	✓
Calaveras R.	✓	✓					✓	✓
San Joaquin R.		✓		✓	✓	✓	✓	✓
Stanislaus R.	✓	✓			✓	✓	✓	✓
Tuolumne R.	✓	✓	✓	✓	✓	✓	✓	✓
Merced R.	✓	✓	✓	✓	✓	✓	✓	✓

★ = Greater benefit compared to Alternative 3
✔ = New benefit compared to Alternative 3
✓ = Equivalent to benefit shown for Alternative 3
No Symbol = No change
✕ = Adverse change compared to the No-Action Alternative, but not greater than under Alternative 3

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-41

CHANGES IN ENVIRONMENTAL CONDITIONS AFFECTING FISH POPULATIONS UNDER ALTERNATIVE 4 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 3



Watershed	Chinook Salmon	Steelhead Trout	Sacramento Splittail	Sturgeon	Striped Bass	American Shad	Delta Smelt	Longfin Smelt
Clear Creek	✓	✓	--	--	--	--	--	--
Sacramento R.	✓	✓	✓	✓	✗	✗	--	--
*Minor Tributaries	✓	✓	--	--	--	--	--	--
Feather R.	✓	✓	--	--	--	✓	--	--
Yuba River	✓	✓	--	--	--	✓	--	--
American R.	✓	✗	--	--	--	✗	--	--
Bay-Delta	★	★	★	★	★	★	★	★
Mokelumne R.	✓	--	--	--	--	--	--	--
Calaveras R.	✓	--	--	--	--	--	--	--
San Joaquin R.	✓	--	✓	--	--	--	--	--
Stanislaus R.	✓	--	--	--	--	--	--	--
Tuolumne R.	✓	--	--	--	--	--	--	--
Merced R.	✓	--	--	--	--	--	--	--

★ = Greater benefit compared to Alternative 3
✔ = New benefit compared to Alternative 3
✓ = Equivalent to benefit shown for Alternative 3
✗ = Adverse change compared to the No-Action Alternative, but not greater than Alternative 3
-- = Species does not occur or occurrence is minor

* Minor tributaries include Elder, Thomes, Cottonwood, Paynes, Mill, Deer, Big Chico, Cow, Butte, Battle, and Antelope creeks and Bear River

FIGURE IV-42

BENEFICIAL AND ADVERSE CHANGES TO FISH SPECIES UNDER ALTERNATIVE 4 COMPARED TO THE NO-ACTION ALTERNATIVE AND ALTERNATIVE 3

diversions of inflow to the Delta would increase net channel flows toward Suisun Bay (Figure IV-4-0), which are assumed to provide cues that increase the movement of organisms out of the central Delta. In addition, the DCC would be closed more frequently than under the No-Action Alternative or under conditions described for Alternatives 1, 2, and 3, providing additional benefits.

Under Alternative 4, the proportion of Sacramento River flow entering the DCC would be similar to that described for the previous alternatives for most months. From November through January, the DCC would be closed and proportionately less Sacramento River water would enter the central Delta than under the No-Action Alternative. Closure of the DCC would facilitate movement of juvenile late fall-, winter-, and spring-run chinook salmon and steelhead trout down the Sacramento River and reduce their movement into the central Delta. Organisms moving down the Sacramento River, rather than into the central Delta, would benefit from reduced exposure to Delta diversions, reduced predation, and possibly other factors that affect survival during movement through the central Delta.

As indicated by increased QWEST compared with QWEST under the No-Action Alternative, increased net flows from February through September under Alternative 4 may increase movement of larval and juvenile striped bass, delta smelt, and longfin smelt and juvenile chinook salmon and steelhead trout out of the central and southern Delta and toward Suisun Bay. Movement out of the central Delta would increase survival because of reduced diversion effects and increased food web support in Suisun Bay.

Habitat Quantity and Quality

Alternative 4 would include all actions affecting habitat discussed for Alternatives 1, 2, and 3 (Figure IV-40). Habitat effects upstream of the Delta would be the same as those described for Alternative 3 (Figure IV-41). Delta outflow would increase during all months and would shift estuarine salinity downstream, which would increase habitat availability for Sacramento splittail, delta smelt, longfin smelt, and striped bass compared with conditions under the No-Action Alternative and Alternatives 1, 2, and 3 (Figure IV-41).

Food Web Support

The response of fish species to other aspects of Alternative 4 (as described in the preceding sections) generally applies to food web organisms as well. Alternative 4 would include all actions affecting food web support discussed for Alternatives 1, 2, and 3 (Figure IV-40). Effects on food web support upstream of the Delta would be the same as described for Alternative 3 (Figure IV-41).

In the Delta, food web support would increase under Alternative 4 (Figure IV-41). Reduced Delta diversions would reduce the entrainment of food web organisms, nutrients, and organic carbon. In addition, a downstream shift in estuarine salinity compared with conditions under the No-Action Alternative, in response to increased Delta outflow in all months, may increase production of prey and increase food web support for rearing life stages of all the representative species.

AGRICULTURAL ECONOMICS AND LAND USE

A number of CVPIA provisions can potentially affect agricultural economics and land use. These provisions include (b)(2) Water Management for fish and wildlife, water acquired for in-stream flow and refuges, tiered water pricing, restoration payments, conservation and water measurement provisions, land retirement, and water transfers. Assumptions used to assess potential impacts are summarized in Table IV-14.

TABLE IV-14

SUMMARY OF ASSUMPTIONS FOR AGRICULTURAL ECONOMICS AND LAND USE

Assumptions Common to All Alternatives and Supplemental Analyses	
For each Alternative or Supplemental Analysis, hydrology and water supplies are estimated in the corresponding analysis for Surface Water and Facilities Operations and Groundwater.	
Alternative or Supplemental Analysis	**Assumptions Specific to the Alternative or Supplemental Analysis**
No-Action Alternative	CVP water is priced at cost of service, subject to ability to pay limits. 2020 level of demand for crop production is assumed, based on DWR Bulletin 160-93 (1994). 45,000 acres of drainage-affected land are assumed to be retired, per Bulletin 160-93.
1	CVP water is priced using tiered rates, with cost of service for the first 80 percent of contract total, full cost rates for the last 10 percent tier, and the average of the two rates for the middle tier. Restoration charges and Friant surcharges are imposed. The ability-to-pay policy is maintained as applied to repayment of principal on capital and restoration charges. An additional 30,000 acres is assumed to be retired for drainage control.
1a	Assumptions are the same as Alternative 1.
1b	Assumptions are the same as Alternative 1.
1c	Assumptions are the same as Alternative 1, except that CVP water prices begin at the full cost rates for the first 80 percent of contract total, with delivery between 80 and 90 percent priced at 110 percent of full cost rates, and deliveries more than 90 percent priced at 120 percent of full cost rates.
1d	Assumptions are the same as Alternative 1.
1e	Assumptions are the same as Alternative 1, except that all CVP water is transferable subject to the charges and conditions specified in CVPIA.
1f	Assumptions are the same as Supplemental Analysis 1e, except an additional $50 per acre-foot fee is charged to any CVP water transferred.
1g	Assumptions are the same as Alternative 1, except that ability to pay is not used to limit CVP water prices.
1h	Assumptions are the same as Alternative 1.
1i	Assumptions are the same as Alternative 1.
2	Assumptions are the same as Alternative 1.

TABLE IV-14. CONTINUED

Assumptions Common to All Alternatives and Supplemental Analyses	
2a	Assumptions are the same as Alternative 1.
2b	Assumptions are the same as Supplemental Analysis 1e.
2c	Assumptions are the same as Supplemental Analysis 1f.
2d	Assumptions are the same as Supplemental Analysis 1c.
3	Assumptions are the same as Alternative 1.
3a	Assumptions are the same as Supplemental Analysis 1e.
4	Assumptions are the same as Alternative 1.
4a	Assumptions are the same as Supplemental Analysis 1e.
Revised No-Action Alternative	Assumptions are the same as No-Action Alternative.
Preferred Alternative	Assumptions are the same as Alternative 1.

Geographic areas for the assessment of agricultural impacts are shown in Figure IV-43, and include three Central Valley regions and the San Felipe CVP delivery area. Agricultural economics and land use impacts are assessed primarily by comparing irrigated acres, value of production (or gross revenue), net revenue, and irrigation water use. All prices and costs are measured in real, 1992 dollars. Additional impacts including irrigation efficiency, land values, farm financing, and risk are also noted.

Two sets of analyses are presented. The first set of results is for the alternatives without water transfers considered. These are the No-Action Alternative and Alternatives 1 through 4. Following Alternative 1 are summaries of results for the two water pricing Supplemental Analyses, 1c and 1g. The second set of results is for alternatives with water transfers, including a No-Action Alternative with non-CVPIA transfers (also called the Base Transfer Scenario) and Alternatives 1e, 1f, 2b, 2c, 3a, and 4a. Results for alternatives and Supplemental Analyses are summarized in Table IV-15. Results for Supplemental Analyses of water transfers are summarized in Table IV-16.

Results presented in this summary focus on average year conditions, with dry or wet year impacts described if they are notably greater or lesser than the average year conditions.

NO-ACTION ALTERNATIVE

The No-Action Alternative provides the basis for comparison for all of the other alternatives. Key assumptions used in this alternative include: 2020 level of demand for crop production, based on DWR's Bulletin 160-93 estimates; renewal of CVP water service contracts, with cost-of-service pricing of water; and the Bay-Delta Plan Accord.

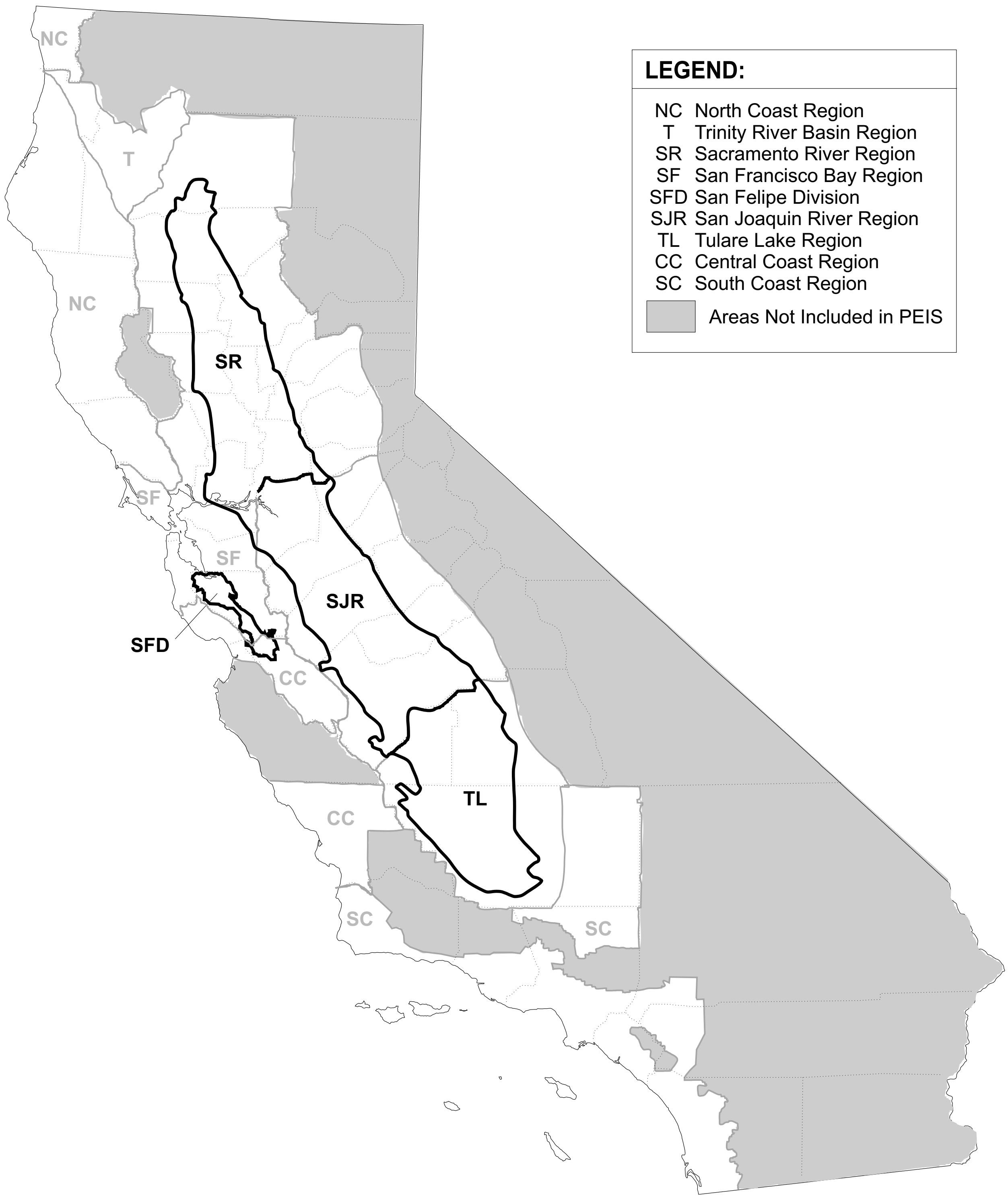


FIGURE IV-43

AGRICULTURAL ECONOMICS AND LAND USE STUDY AREA

TABLE IV-15

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITHOUT WATER TRANSFERS, AGRICULTURAL ECONOMICS AND LAND USE

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	6.6 million irrigated acres and $10.2 billion of gross revenue from irrigated acres in Central Valley and San Felipe Division.
	Changes Compared to the No-Action Alternative
1	Reduction of 57,000 acres of irrigated land and $76 million in annual gross revenue, due to Land Retirement Program and reduction in water delivery. Increase in annual CVP and groundwater cost of $46 million, due to water pricing changes and additional groundwater pumping. Increased financial risk due to reduced reliability of CVP water supply. Impacts are concentrated on CVP water service contractors, especially in the Delta export delivery areas.
	Changes Compared to Alternative 1
1a	Additional reduction in CVP water supply is replaced by additional 80,000 acre-feet of groundwater pumping in Central Valley, 2,000 acres of land fallowed in San Felipe Division, and about $4 million annual loss of agricultural net revenue.
1b	Conditions are similar to Alternative 1.
1c	Up to 570,000 acre-feet of CVP water could be unaffordable and not used. Impacts would include up to 56,000 acres of land out of production in Sacramento River Region, 337,000 acre-feet of additional groundwater pumped in the San Joaquin River and Tulare Lake regions, and a large aggregate increase in the cost of CVP water. All impacts would fall on CVP water service contractors.
1d	Reduced CVP delivery largely in the San Joaquin River Region, replaced by additional groundwater pumping.
1e	See summary of impacts of alternatives with water transfers.
1f	See summary of impacts of alternatives with water transfers.
1g	Up to 24,000 acre-feet of CVP water could be unaffordable and not used. Some land would go out of production in the Sacramento River Region, but most of the water would be replaced with additional groundwater pumping.
1h	Conditions are similar to Alternative 1.
1i	Conditions are similar to Alternative 1.

TABLE IV-15. CONTINUED

	Changes Compared to the No-Action Alternative
2	Impacts to CVP delivery areas are similar to Alternative 1. An additional 40,000 acres of irrigated land could be idled due to the purchase of (b)(3) water for instream flow and Level 4 refuge supply. Revenue received for water augments the sellers' farm income.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 1.
2b	See summary of impacts for alternatives with water transfers.
2c	See summary of impacts for alternatives with water transfers.
2d	Changes are similar to those described under Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Impacts to CVP delivery areas are less than those described under Alternative 1, due to pumping and delivery of some (b)(3) water to CVP contractors. A total of about 172,000 acres of irrigated land could be idled due to a combination of the Land Retirement Program, reduction in CVP water delivery, and purchase of (b)(3) water for refuges and instream flow. Revenue received for water augments the sellers' farm income.
	Changes Compared to Alternative 3
3a	See summary of impacts for alternatives with water transfers.
	Changes Compared to the No-Action Alternative
4	Impacts to CVP delivery areas are greater than those described under Alternative 1, due to the use of (b)(2) water for Delta restoration actions. A total of about 200,000 acres of irrigated land could be idled due to a combination of the Land Retirement Program, reduction in CVP water delivery, and purchase of (b)(3) water for refuges and instream flow. Revenue received for water augments the sellers' farm income.
	Changes Compared to Alternative 4
4a	See summary of impacts for alternatives with water transfers.
Revised No-Action Alternative	Same as No-Action Alternative.
Preferred Alternative Changes as compared to No-Action Alternative	Reduction of 54,000 acres of irrigated land and $74 million in annual gross revenue, due to Land Retirement Program and reduction in water delivery. Increase in annual CVP and groundwater cost of $33 million, due to water pricing changes and additional groundwater pumping. Increased financial risk due to reduced reliability of CVP water supply. Impacts are concentrated on CVP water service contractors, especially in the Delta export delivery areas.

TABLE IV-16

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITH WATER TRANSFERS AGRICULTURAL ECONOMICS AND LAND USE

Alternative or Supplemental Analysis	Impact Assessment
Base Transfer Scenario	A No-Action Alternative with non-CVPIA transfers was evaluated to provide a basis for estimating the incremental impacts of CVPIA on the opportunities for water transfers. Assumptions for this analysis are the same as for the No-Action Alternative, except that water transfers between regions are explicitly allowed. CVP water service and Exchange contract water are assumed to be not transferable. Transfers are limited by available facilities capacity. Only consumptive use or irrecoverable loss is transferred. For purposes of analysis, water is assumed to be provided by water conservation, crop changes, and fallowing irrigated land. Up to 150,000 acre-feet would be sold in an average year, primarily from the Tulare Lake Region. This would fallow about 40,000 acres and provide revenue to sellers of about $18 million. Under a dry condition, up to 1 million acre-feet could be transferred, with over half of this from the Sacramento River Region. Almost 300,000 acres would be fallowed, and sellers could receive up to $170 million in revenue.
	Changes Compared to the Base Transfer Scenario
1e	In an average year, quantities and locations of water sold are similar to the Base Transfer Scenario. The price of water, and the revenue to sellers, would decline slightly due to more CVP water available for transfer. In a dry condition, substantially less water would be sold from the Sacramento River Region and more from regions south of Delta, due to CVP water available for transfer. The price of water, and the revenue to sellers, would decline substantially due to the availability of CVP water for transfer.
1f	Results would be similar to 1e, except that non-CVP water would be purchased rather than CVP water, due to the additional $50 per acre-foot fee on CVP water transfers. In average condition, Restoration Fund revenues from transfers are lower than 1e. Local, within-region transfers of CVP water would likely be eliminated due to the $50 fee.
2b	Results are similar to those described under Supplemental Analysis 1e, except that (b)(3) water acquisition in the San Joaquin River Region would increase the price of water for transfer. Some water transfer purchases are shifted to Sacramento River and Tulare Lake Regions.
2c	Changes are similar to those described under Supplemental Analysis 1f.
3a	Changes are similar to those described under Supplemental Analysis 1e, except that water purchased is about 10 percent less than under Supplemental Analysis 1e. This occurs because higher CVP and SWP delivery in Alternative 3 results in a lower level of demand for transfers.
4a	Changes are similar to those described under Supplemental Analysis 1e, except that the price of water has been increased by the (b)(3) water acquisition and the greater demand for transfers due to the use of (b)(2) water in the Delta.

Dominant crops in the Sacramento River Region include rice, deciduous orchards, grains, and other field crops. The San Joaquin River Region includes a broad mix of crops, with cotton, deciduous orchards, and grapes having the largest acreage. The largest acreages in the Tulare Lake Region include cotton, deciduous orchards, and grapes. Alfalfa hay and grains show significant acreage in all three regions. Dominant crops in the San Felipe Division are vegetables and orchards. Figure IV-44 shows the percent crop mix by region estimated for the No-Action Alternative in an average water condition. Table IV-17 presents the crop acres estimated for the No-Action Alternative in the average year water condition. In general, dry year conditions show reductions in field crops and other annual crops compared to average conditions.

Gross revenue (value of production) by region and crop is presented for the average and condition in Table IV-18. Within the Central Valley, the Sacramento River Region accounts for just under 20 percent of the gross revenue, with Tulare Lake Region at about 38 percent and San Joaquin River Region at about 43 percent. Value of production shows the large influence of fruit and vegetable crops: truck crops, tomatoes, orchards, and vineyards especially. These crops account for over two thirds of the value of irrigated production valley-wide. Cotton and rice also produce significant revenue. Although the direct value of other crops such as hay and grains is relatively low, they support linked sectors such as dairies, other livestock, and food processing. San Felipe Division has a disproportionately large gross revenue due to the relatively high value of the predominant orchard and vegetable crops.

Estimates of net revenues associated with the irrigated crops are shown in Table IV-19. Sacramento River Region with about 30 percent of acreage produces less than 20 percent of valley-wide net income due to the crop mix, yields, and prices received. San Joaquin River and Tulare Lake Regions each produce about 40 percent of net income. San Felipe Division has a high per-acre gross and net revenue due to the crop mix, but total acreage is small in comparison to the Central Valley regions. Water use estimates for the No-Action Alternative are presented in Table IV-20 for the average water condition.

ALTERNATIVE 1

Provisions of CVPIA implemented in Alternative 1 that most affect crop production are the dedication of (b)(2) water, restoration payments, tiered water prices, and land retirement.

Irrigated Acres

Changes in irrigated acres from the No-Action Alternative are summarized by crop in Table IV-17, and summarized in Figure IV-45. The changes are largely determined by the assumed location of land included in the Land Retirement Program and by the location of water service areas most affected by the reallocation of project water. The San Joaquin River Region shows the largest estimated decline, about 1.2 percent of irrigated land, due to a combination of the Land Retirement Program and additional fallowing due to reduced CVP delivery. The predominance of cotton as the crop most affected is largely a result of the areas targeted for retirement and those losing CVP delivery: both of these occur in areas where cotton is the predominant field crop. A decline of 28,400 acres represents about 2.5 percent of Central Valley cotton acreage in the No-Action Alternative. Irrigated acreage in the Tulare Lake Region declines

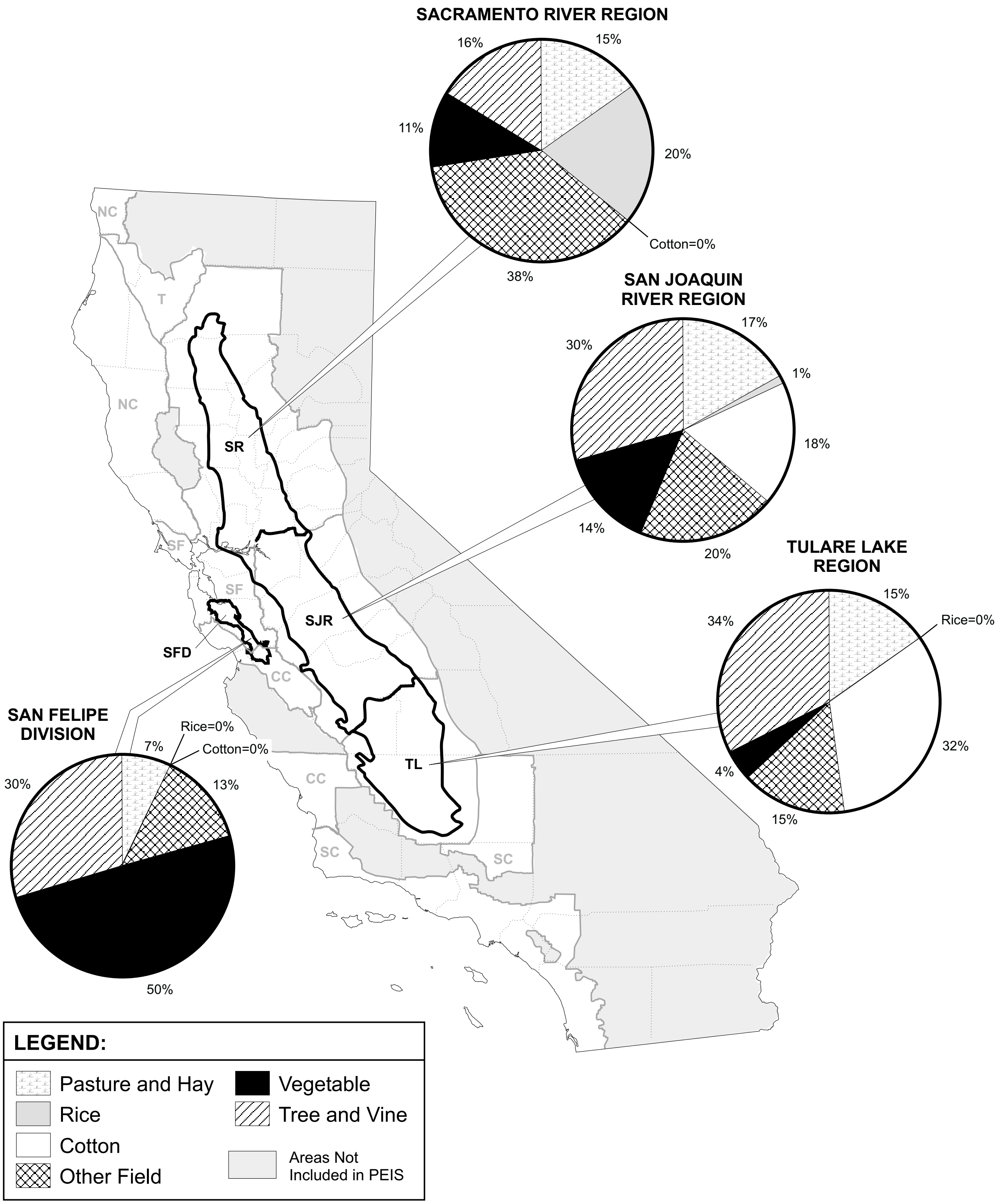


FIGURE IV-44

1990 AGRICULTURAL LAND USE IN THE CENTRAL VALLEY AND SAN FELIPE DIVISION

TABLE IV-17
IRRIGATED ACREAGE,
AVERAGE 1922-1990 CONDITION

Crop	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Changes Compared to No-Action Alternative			
Sacramento River Region					
Pasture and Hay	280	-0.3	0.3	-6.0	-5.6
Rice	473	-1.2	-4.3	-12.7	-12.6
Cotton	0.0	0.0	0.0	0.0	0.0
Other Field	615	-0.1	-1.8	-4.6	-4.6
Vegetable	250	0.0	-0.2	-0.2	-0.2
Tree and Vine	400	0.0	0.0	-0.3	-0.3
Subtotal	**2,020**	**-1.6**	**-6.0**	**-23.8**	**-23.3**
San Joaquin River Region					
Pasture and Hay	338	-3.9	-22.3	-67.0	-73.5
Rice	14	-0.1	-0.9	-3.0	-3.2
Cotton	465	-18.7	-25.5	-27.7	-37.2
Other Field	479	-5.5	-12.2	-25.8	-27.2
Vegetable	462	-2.4	-3.0	-2.9	-3.9
Tree and Vine	800	-0.2	-1.0	-3.3	-3.4
Subtotal	**2,558**	**-30.9**	**-64.9**	**-129.7**	**-148.5**
Tulare Lake River Region					
Pasture and Hay	191	-2.7	-2.4	-1.3	-3.6
Rice	0	0.0	0.0	0.0	0.0
Cotton	646	-9.7	-9.3	-9.2	-12.7
Other Field	304	-2.7	-1.9	-2.4	-1.9
Vegetable	211	-0.3	-0.3	-0.3	-0.2
Tree and Vine	657	-0.2	-0.2	-0.2	-0.3
Subtotal	**2,009**	**-15.6**	**-14.1**	**-13.4**	**-18.8**
San Felipe Division					
Pasture and Hay	2	-0.7	-0.7	-0.4	-0.7
Rice	0	0.0	0.0	0.0	0.0
Cotton	0	0.0	0.0	0.0	0.0
Other Field	3	-1.2	-1.2	-0.7	-1.3
Vegetable	12	-4.4	-4.4	-2.4	-4.9
Tree and Vine	8	-2.7	-2.7	-1.5	-2.9
Subtotal	**25**	**-9.0**	**-9.0**	**-5.0**	**-9.8**
Total	**6,611**	**-57.1**	**-94.0**	**-171.9**	**-200.3**

NOTE:
All values in thousands of acres.

TABLE IV-18

GROSS REVENUE, AVERAGE 1922-1990 CONDITION

Crop	No-Action Alternative	Changes Compared to No-Action Alternative: Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River Region					
Pasture and Hay	89	0.3	0.9	1.2	1.7
Rice	401	-1.0	-3.6	-10.4	-10.3
Cotton	0	0.0	0.0	0.0	0.0
Other Field	269	0.0	-0.7	-1.9	-1.9
Vegetable	615	0.4	0.2	0.0	0.2
Tree and Vine	455	0.0	0.1	0.1	0.2
Subtotal	**1,828**	**-0.3**	**-3.0**	**-10.9**	**-10.0**
San Joaquin River Region					
Pasture and Hay	145	-1.5	-7.4	-19.6	-22.3
Rice	12	-0.1	-0.7	-2.4	-2.6
Cotton	503	-20.5	-27.2	-29.3	-39.2
Other Field	276	-3.2	-7.4	-15.7	-16.8
Vegetable	2,095	-5.8	-7.2	-6.9	-8.5
Tree and Vine	1,405	-0.2	-1.1	-3.7	-3.8
Subtotal	**4,436**	**-31.3**	**-51.1**	**-77.6**	**-93.2**
Tulare Lake River Region					
Pasture and Hay	114	-1.2	-0.5	0.8	-0.2
Rice	0	0.0	0.0	0.0	0.0
Cotton	713	-9.6	-9.0	-8.8	-12.2
Other Field	186	-1.7	-1.2	-1.5	-1.2
Vegetable	1,265	-1.8	-1.6	-1.8	-1.0
Tree and Vine	1,616	-0.3	0.0	0.8	0.7
Subtotal	**3,893**	**-14.5**	**-12.4**	**-10.4**	**-13.9**
San Felipe Division					
Pasture and Hay	0	-0.1	-0.1	-0.1	-0.2
Rice	0	0.0	0.0	0.0	0.0
Cotton	0	0.0	0.0	0.0	0.0
Other Field	2	-0.7	-0.7	-0.4	-0.8
Vegetable	75	-26.6	-26.6	-14.6	-29.3
Tree and Vine	11	-3.8	-3.8	-2.1	-4.2
Subtotal	**88**	**-31.2**	**-31.2**	**-17.1**	**-34.4**
Total	**10,245**	**-77.3**	**-97.7**	**-116.1**	**-151.5**

NOTE:
All values in millions of 1992 dollars per year.

TABLE IV-19

CHANGE IN NET REVENUE, AVERAGE 1922-1990 CONDITION

Component	Sacramento River Region	San Joaquin River Region	Tulare Lake Region	San Felipe Division	Total
NO-ACTION ALTERNATIVE					
No-Action Alternative Net Revenue	268	558	522	8	1356
ALTERNATIVE 1 COMPARED TO NO-ACTION ALTERNATIVE					
Fallowed Land	0.6	-1.9	-0.4	-3.0	-4.8
Groundwater Pumping	-1.4	-18	2.1	0.0	-17.4
Irrigation Cost	-0.3	-3.8	-0.8	0.0	-4.8
CVP Water Cost	-0.3	-11.9	-16.5	-0.3	-29
Total Reduction	-1.4	-35.6	-15.6	-3.3	-56
Increase From Higher Crop Prices	1.1	1.6	1.2	0.0	3.9
Increase From Land Retirement	0.0	0.9	1.1	0.0	2.0
Increase From Water Sales	0.0	0.0	0.0	0.0	0.0
Combined Net Revenue Change	-0.3	-33.1	-13.4	-3.3	-50.1
ALTERNATIVE 2 COMPARED TO NO-ACTION ALTERNATIVE					
Fallowed Land	-0.7	-7.2	-1.8	-3.0	-12.7
Groundwater Pumping	-1.8	-20	0.5	0.0	-21.3
Irrigation Cost	-0.3	-3.7	-0.8	0.0	-4.7
CVP Water Cost	-0.3	-12.5	-16.5	-0.3	-29.6
Total Reduction	-3.1	-43.4	-18.6	-3.3	-68.4
Increase From Higher Crop Prices	1.7	3.1	2.4	0.0	7.2
Increase From Land Retirement	0.0	0.9	1.1	0.0	2.0
Increase From Water Sales	1.2	13.7	2.6	0.0	17.5
Combined Net Revenue Change	-0.2	-25.7	-12.5	-3.3	-41.7
ALTERNATIVE 3 COMPARED TO NO-ACTION ALTERNATIVE					
Fallowed Land	-2.4	-13.4	-1.6	-1.6	-19
Groundwater Pumping	-3.2	-14.2	3.8	0.0	-13.6
Irrigation Cost	-0.3	-3.7	-0.7	0.0	-4.7
CVP Water Cost	-0.3	-12.9	-16.5	-0.4	-30
Total Reduction	-6.2	-44.1	-15.0	-2.0	-67.4
Increase From Higher Crop Prices	4.0	5.7	4.1	0.0	13.7
Increase From Land Retirement	0.0	0.9	1.1	0.0	2.0
Increase From Water Sales	8.7	57.6	1.6	-2.0	67.9
Combined Net Revenue Change	6.5	20.1	-8.3	0.0	16.3
ALTERNATIVE 4 COMPARED TO NO-ACTION ALTERNATIVE					
Fallowed Land	-2.4	-15.6	-2.3	-3.3	-23.2
Groundwater Pumping	-3.9	-22.5	-2.0	0.0	-28.4
Irrigation Cost	-0.3	-3.7	-0.7	0.0	-4.7
CVP Water Cost	-0.3	-11.4	-16.3	-0.3	-28.3
Total Reduction	-6.8	-53.1	-21.3	-3.6	-84.6
Increase From Higher Crop Prices	4.5	6.5	4.9	0.0	15.9
Increase From Land Retirement	0.0	0.9	1.1	0.0	2.0
Increase From Water Sales	8.8	58.5	1.7	0.0	68.9
Combined Net Revenue Change	6.5	12.7	-13.6	-3.6	2.0

NOTE:
All values in millions of 1992 dollars per year.

TABLE IV-20

IRRIGATION WATER APPLIED, AVERAGE 1922-1990 CONDITION

Source	No-Action Alternative	Change Compared to No-Action Alternative			
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River					
Surface Water	4,524	-39	-72	-195	-194
Groundwater	2,603	25	38	80	82
Total Applied	7,127	-14	-34	-115	-112
San Joaquin River					
Surface Water	4,453	-302	-480	-697	-854
Groundwater	3,427	134	182	124	213
Total Applied	7,880	-168	-298	-573	-641
Tulare Lake					
Surface Water	2,761	-22	-39	26	-69
Groundwater	3,297	-44	-23	-83	-9
Total Applied	6,058	-66	-62	-57	-78
Total Central Valley					
Surface Water	11,738	-363	-591	-866	-1,117
Groundwater	9,327	115	197	121	286
Total Applied	21,065	-248	-394	-745	-831
San Felipe Division(1)					
CVP Water	71	-18	-18	-10	-20

Notes:
All volumes in thousands of acre-feet.
(1) Non-CVP supplies not estimated.

by about 0.8 percent due to the Land Retirement Program. Irrigated acreage in the Sacramento River Region would decline about 1,500 acres. Most of the decline is in rice, but is much less than 1 percent of total rice acreage. Total reduction in the Central Valley is about 48,000 acres, less than 1 percent of irrigated acreage.

Irrigated acres in the San Felipe Division are estimated to decline about 9,000 acres due to reductions in CVP water deliveries.

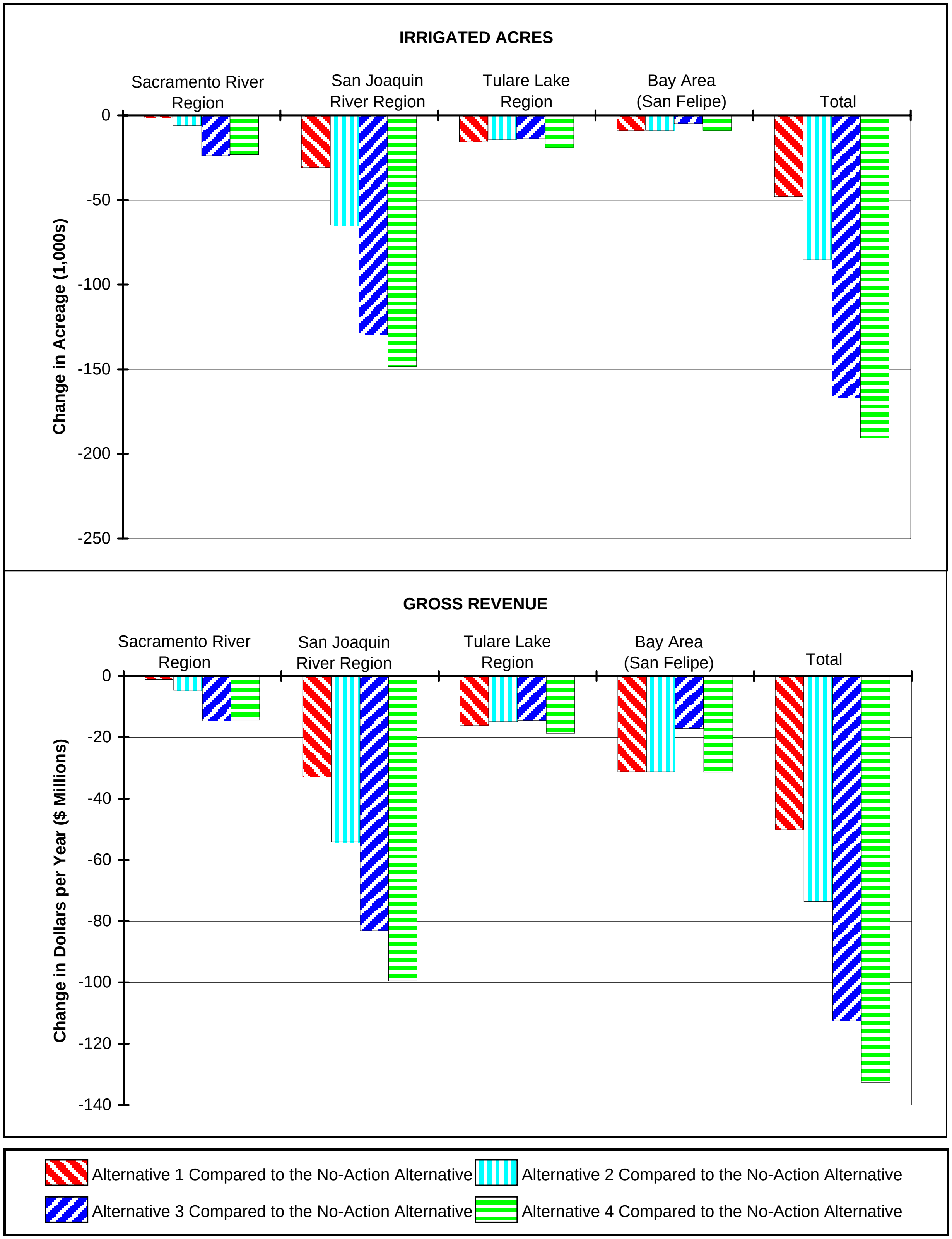


FIGURE IV-45
CHANGE IN IRRIGATED ACREAGE AND GROSS REVENUE FOR ALTERNATIVES 1 THROUGH 4 AS COMPARED TO THE NO-ACTION ALTERNATIVE

Impacts of CVPIA are not expected to result in significant idling or conversion of prime or unique farmlands. The Land Retirement Program specifically targets land with an existing salinity or drainage problem. Growers facing water reductions are likely to try to keep the most productive lands in irrigation and fallow the less productive lands.

Gross and Net Revenue

Central Valley gross revenue from irrigated farming declines about $46 million in an average water supply year. This estimate accounts for crop price increases expected to occur because production has declined. Without this price increase the value of production would decline another $3.9 million per year as compared to the No-Action Alternative. Most of the decline is in cotton, consistent with the change in acreage. The total decline in value represents less than one-half of one percent of the No-Action Alternative value. Similar values are estimated for dry and wet conditions. Table IV-18 shows estimated changes in gross revenue by region and crop, and Figure IV-45 summarizes the change from the No-Action Alternative. Loss in gross revenue in the San Felipe Division is estimated at about $31 million in an average water supply year, or about 7.5 percent of production revenue in San Benito, Santa Clara, and Santa Cruz counties.

Net farm income, or net revenue, changes are shown in Table IV-19. Reductions in net income fall into four categories: loss of net income from fallowed or retired land; increased cost of CVP water due to tiered pricing and restoration payments; increased cost of groundwater pumping; and increased cost of irrigation systems or management. Over half of the change is a result of increased CVP water cost. Another third is caused by the increased cost of groundwater pumping, and the remainder is split about evenly between net revenue loss from fallow or retired land and the cost of changes in irrigation methods. Approximately $2 million per year is received in payment for land retirement, split between the San Joaquin River and Tulare Lake regions.

Water Use and Efficiency

The net reduction in Central Valley surface water delivered to the field of 363,000 acre-feet includes an overall decline in CVP water application of about 385,000 acre-feet and an increase of about 21,000 acre-feet in SWP agricultural delivery in Tulare Lake Region. Of the net 363,000 acre-feet loss of surface water, about 155,000 acre-feet come from 48,000 acres of fallowed or retired lands; about 115,000 acre-feet are replaced from new groundwater pumping; and the remainder (about 93,000 acre-feet) comes from reduced irrigation losses due to improvements that will reduce tailwater and deep percolation. In the San Felipe Division, about 18,000 acre-feet less CVP water would be delivered under Alternative 1. Table IV-20 shows the changes in water use for the four regions.

Estimated irrigation efficiency changes induced by Alternative 1 would be modest, with an increase of about 0.6 percentage points in the San Joaquin River Region and essentially no change estimated in the other regions.

Impacts on Consumers and Farm Programs

Other economic impacts associated with Alternative 1 include losses to consumers of irrigated farm products. These losses are estimated at about $3.9 million per year, which includes only the surplus, or benefit, loss to direct consumers of irrigated farm commodities. Alternative 1 would decrease agricultural revenues from U.S. Department of Agriculture (USDA) farm programs by about $3.8 million per year because retired land would lose eligibility for farm program payments. These payments are counted as part of the gross and net revenue impacts to farmers, and also can be viewed as an expense to the Federal government. These reductions in program payments are also savings to the Federal treasury.

Water Supply Reliability and Risk

The CVPIA may affect economic costs to water users through effects on the reliability of water supplies. Variable surface water supplies can be a substantial economic problem in irrigated agriculture. Farmers often must make important investment, planting, and marketing decisions before knowing their water supply. Water supply variability adds to other risks imposed by crop price, yield, and production cost variability. The cost of additional groundwater pumping capacity provides one way to measure the cost of less reliable surface water supply. Using this approach, Sacramento River Region costs would be $0.6-0.7 million per year. San Joaquin River Region has by far the largest cost, $4-4.5 million annually. Tulare Lake Region is less than $0.5 million per year. These costs would occur every year to finance the investment, even though the additional capacity would only be used occasionally. This does not include the power and other variable costs of pumping the water.

Land Value

Value of irrigated land depends significantly upon the quantity and variability of the water supply available, and on the profitability of farming. The San Joaquin River Region has the largest potential reduction in land value. Its reduction in annual net income is estimated at $33.1 million per year spread over about 2.6 million acres, for a reduction in net income per acre of about $12.7 per year. A simple estimate of land value is to calculate the present value of the stream of profit earned on the land. Therefore, capitalizing this region’s stream of lost income using a real 4 percent interest rate, the average reduction in land value is about $320 per acre. The actual reduction could be greater in local areas most affected by higher water cost and reduced delivery, and land values could potentially increase in regions unaffected by reduced delivery or higher costs as a result of higher crop prices.

Credit and Financing

Availability of credit for farming depends largely on the expected profitability of production, the risk or variability of profitability, and the collateral available to secure the lender’s money. Changes in conditions that reduce profit, increase risk, or reduce the value of land have been documented as reducing lenders’ willingness to lend money or to increase the interest rate they charge (Archibald, 1992). Although quantitative estimates are not available, it is probable that similar impacts would occur due to Alternative 1 implementation.

Water Conservation and Measurement

Conservation and measurement costs may occur both at the farm and the district level. On-farm conservation costs are reflected in the irrigation cost estimates discussed above. District costs may result from either mandatory conservation requirements or use of discretionary conservation measures. For districts that do not currently measure delivery to each customer, the cost of achieving an acceptable accuracy of measurement could be significant. The estimated annual cost of the measurement hardware is $123 per turnout. The entire measurement program cost per turnout would be $470 to $670 per year. Depending on the acres served per turnout (typical areas are 20 to 200 acres), the cost per acre could range from $4 to $33 per year.

Localized Impacts

Impacts aggregated or averaged over large regions can mask more pronounced impacts in smaller areas. The largest economic impacts of CVPIA provisions in Alternative 1 focus on CVP water service contractors. For example, the entire $28 million loss due to higher water costs falls on CVP contractors, and none on other agricultural water users.

Water Pricing Supplemental Analyses

Supplemental Analysis 1c evaluates the additional impact of charging higher tiered water rates as described in Table IV-14. Changes from the main Alternative 1 are shown in Table IV-21. The imposition of full-cost-plus pricing is estimated to reduce total CVP water purchases by about 570,000 acre-feet on average. These reductions will lead to implementation of water conservation, crop changes, and land fallowing. Reductions are mostly in the Sacramento River and San Joaquin River regions. Some CVP water service contractors that receive water from the Tehama-Colusa, Delta-Mendota, and Friant-Kern canals and the New Melones Reservoir may be unable to afford some or all of their CVP water. Sacramento River Region reductions would be mainly met through land fallowing, while those in the San Joaquin River Region would be mostly from a shift to groundwater. San Joaquin River Region agriculture would experience a net revenue reduction of about 10 percent, due to higher groundwater pumping costs. Additional water cost in the San Felipe Division is large. The full-cost CVP water rate for much of the San Felipe delivery is over $190 per acre-foot. Assuming the water would still be purchased, then implementing full-cost-plus pricing would increase the cost of CVP water to San Felipe growers by almost $5 million in an average water year.

Ability-to-pay is a long-standing Reclamation policy that provides relief of all or part of capital repayment responsibility for CVP irrigation water users in cases where estimated farm income is insufficient to cover normal CVP irrigation water costs after allowance for returns to farm investment, production costs, and management. The CVPIA also provides relief for Restoration Charges if the same conditions are met. Supplemental Analysis 1g provides an analysis of the potential impact of eliminating the ability-to-pay relief. Results for average water year conditions are presented in Table IV-21. The table shows a direct comparison of the supplemental analysis results with the main Alternative 1.

TABLE IV-21

SUMMARY OF AGRICULTURAL ECONOMIC IMPACTS WATER PRICING SUPPLEMENTAL ANALYSES

Item/ Region	No-Action Alternative	Alternative 1	Change Compared to Alternative 1	
			1c	1g
Surface Water Use (taf)				
Sacramento	4,524	4,485	-199	-11.1
San Joaquin	4,453	4,151	-354	-13.3
Tulare Lake	2,761	2,739	-17	0.0
San Felipe	71	53	0	0.0
Total	11,809	11,428	-570	-24.4
Groundwater Use (taf)				
Sacramento	2,603	2,628	0	1.2
San Joaquin	3,427	3,561	320	12.8
Tulare Lake	3,297	3,253	17	0.0
San Felipe	na	na	na	na
Total	9,327	9,442	337	14.0
Irrigated Acreage (1,000 acres)				
Sacramento	2,020	2,018	-56	-1.8
San Joaquin	2,558	2,527	-6	0.0
Tulare Lake	2,009	1,993	0	0.0
San Felipe	25	16	0	0.0
Total	6,611	6,554	-62	-1.8
Gross Revenue ($ Million)				
Sacramento	1,828	1,828	-28	-0.2
San Joaquin	4,436	4,405	-2	0.0
Tulare Lake	3,893	3,878	0	0.0
San Felipe	88	57	0	0.0
Total	10,245	10,168	-30	-0.2
Net Revenue ($ Million)				
Sacramento	268	267	-3	-6.0
San Joaquin	558	525	-25	-1.0
Tulare Lake	522	509	-10	0.0
San Felipe	8	5	-4	0.0
Total	1,356	1,306	-42	-7.0

NOTES:
Non-CVP supplies not estimated for San Felipe Division.

Reductions in total demand for CVP water resulting from removal of the ability-to-pay policy are estimated to be about 25,000 acre-feet per year. These reductions would occur primarily in areas served by the Tehama-Colusa, Delta-Mendota, and Madera canals and New Melones Reservoir. Demand reductions in the Sacramento River Region would result in increased groundwater pumping and land fallowing, while those in the San Joaquin River Region would result primarily in increased groundwater pumping. Water costs to some agricultural water users, especially in the Sacramento River Region, would be substantially increased. Based on the regional estimates of payment capacity available, the Tulare Lake Region would not receive price relief from the ability-to-pay policy, and therefore its removal in this scenario has no impact. The cropping pattern in the San Felipe Division also indicates that its contractors are not constrained by payment capacity. The large increase in CVP water cost in the Sacramento River Region results in a $6 million per year decline in net revenue. Another $1 million reduction is estimated in the San Joaquin River Region, from a combination of higher CVP and groundwater cost.

ALTERNATIVE 2

Provisions of CVPIA implemented in Alternative 2 include all features of Alternative 1 plus the acquisition of water for instream flow and wildlife refuges. By assumption, water is acquired from willing agricultural sellers who would reduce acreage to provide water for sale.

Irrigated Acres

Changes in irrigated acreage from the No-Action Alternative are shown by crop and region in Table IV-17, and summarized in Figure IV-45. The changes are largely determined by the assumed location of land identified for the Land Retirement Program, by the location of water contractors most affected by the reallocation of project water, and by the areas identified for water acquisition. The San Joaquin River Region shows the largest estimated decline, about 65,000 acres in an average year (2.5 percent of irrigated land), followed by the Tulare Lake Region which declines about 14,000 acres (0.7 percent) due to the Land Retirement Program. Sacramento River Region shows a decline of about 6,000 acres (0.3 percent). Most of the decline is in rice, but is much less than 1 percent of rice acreage. Total reduction in the Central Valley would be about 85,000 acres, or about 1.3 percent of the No-Action Alternative's Central Valley irrigated acreage.

San Felipe Division impacts are similar to those described under Alternative 1.

Impacts of CVPIA are not expected to result in significant idling or conversion of prime or unique farmlands. The Land Retirement Program specifically targets land with an existing salinity or drainage problem. Growers facing water reductions are likely to try to keep the most productive lands in irrigation and fallow the less productive lands. Similarly, growers selling water to the (b) (3) acquisition program can be expected to fallow less productive land and continue farming the best land.

Gross and Net Revenue

Central Valley gross revenue from irrigated farming is estimated to decline about $66.5 million in an average water supply year. This estimate accounts for crop price increases expected to occur because of declines in production. Without this price increase the value of production would decline another $7.2 million per year. Most of the decline is in cotton, consistent with the change in acreage. The total decline in value represents less than one percent of the No-Action Alternative value. Similar reductions are estimated for dry conditions. Table IV-18 shows estimated changes in gross revenue by region and crop, and Figure IV-45 summarizes the change from the No-Action Alternative.

Net farm income, or net revenue, changes are shown in Table IV-19. Reductions in net income fall into four categories: loss of net income from fallowed or retired land; increased cost of CVP water due to tiered pricing and restoration payments; increased cost of groundwater pumping; and increased cost of irrigation systems or management. Increases in farm income offset some of these losses. Approximately $2 million per year is received in payment for land retirement, split between the San Joaquin River and Tulare Lake Regions. Sale of water to the acquisition program adds another $17.5 million to income in an average water year.

Losses in gross and net revenue in the San Felipe Division are similar to Alternative 1.

Water Use and Efficiency

Water use in non-acquisition areas is similar to conditions discussed in Alternative 1. Groundwater use increases somewhat more than in Alternative 1. This occurs because of a shift of acreage from the areas selling water for restoration (where groundwater substitution would not be allowed to replace acquired water), to areas not selling water, where Interior has no means to prevent additional groundwater pumping. Table IV-20 shows the estimated changes in water use for the four regions. Irrigation efficiency changes induced by Alternative 2 are similar to those described under Alternative 1. Water supply and use in the San Felipe Division are similar to those described under Alternative 1.

Impacts on Consumers and Farm Programs

Other economic impacts associated with Alternative 2 include losses to consumers of irrigated farm products. These losses are estimated at about $7.2 million per year, which measures only the surplus, or benefit, loss to direct consumers of irrigated farm commodities. Alternative 2 would decrease agricultural revenues from U.S. Department of Agriculture (USDA) farm programs by about $6 million per year because retired land would lose eligibility for farm program payments. These payments are counted as part of the gross and net revenue impacts to farmers, but also can be viewed as an expense to the Federal government. Reductions in program payments are therefore savings to the Federal treasury.

Water Supply Reliability and Risk

Most of the impacts to water supply reliability and risk are similar to those described under Alternative 1. Additional risk or uncertainty might occur due to water acquisition because land fallowing concentrated in a small area could threaten the infrastructure of suppliers, workers, and processors available to the remaining producers. Changes in the timing of streamflows and availability of irrigation return flows could also affect some growers’ pattern or costs of diversion.

Growers who sell water may be able to reduce financial risk. A steady income from water sales can combine with more variable crop revenues to provide a more stable overall income stream.

Revenue from water sold can also be used to finance other production costs that otherwise would be funded through borrowing.

Land Value

Land values in areas of higher water costs or losses of supply would be affected as in Alternative 1. Land values in areas selling water could increase if the right to sell the water is attached, or allocated, to the land.

Credit and Financing

Availability of credit for farming depends largely on the expected profitability of production, the risk or variability of profitability, and the collateral available to secure the lender's money. The same potential increases in risk and reduction in profit discussed in Alternative 1 also apply in Alternative 2. Growers able to sell water for restoration can potentially increase net income and reduce risk, which would increase credit worthiness.

Water Conservation and Measurement

Conservation and measurement costs would be similar to those discussed under Alternative 1.

Localized Impacts

Impacts on areas most affected by water cost increases or loss of supply are similar to those in Alternative 1.

Water Pricing Supplemental Analyses

The impacts of higher tiered water prices were also assessed relative to Alternative 2. Results are similar to those discussed for Supplemental Analysis 1c.

ALTERNATIVE 3

Provisions of CVPIA implemented in Alternative 3 include all features of Alternative 1 plus the acquisition of water for instream flow and wildlife refuges. More water is acquired, and on more streams, than in Alternative 2. By assumption, water is acquired from willing agricultural sellers who would reduce acreage to provide water for sale. In addition, Alternative 3 allows both (b)(2) and acquired water to be exported from the Delta for use by water contractors, subject to water quality and fishery constraints.

Irrigated Acres

Changes in irrigated acreage from the No-Action Alternative are shown by crop and region in Table IV-17, and summarized in Figure IV-45. The regional pattern of impacts is largely determined by the assumed location of land identified for the Land Retirement Program, by the location of water contractors most affected by the reallocation of project water, and by the areas identified for water acquisition. The San Joaquin River Region shows the largest estimated decline, about 130,000 acres in an average year (5 percent of irrigated land), followed by Sacramento River Region, which declines about 24,000 acres (1.2 percent), and Tulare Lake Region, which declines 13,400 acres (0.7 percent). Total reduction in the Central Valley would be about 167,000 acres, or about 2.5 percent of the No-Action Alternative irrigated acreage. San Felipe Division acreage would decline about 5,000 acres.

Impacts of CVPIA are not expected to result in significant idling or conversion of prime or unique farmlands. The Land Retirement Program specifically targets land with an existing salinity or drainage problem. Growers facing water reductions are likely to try to keep the most productive lands in irrigation and fallow the less productive lands. Similarly, growers selling water to the (b) (3) acquisition program can be expected to fallow less productive land and continue farming the best land.

Gross and Net Revenue

Central Valley gross revenue from irrigated farming is estimated to decline about $99 million in an average water supply year. This estimate accounts for crop price increases expected to occur because of declines in production. Without this price increase the value of production would decline another $13.2 million per year. Most of the decline is in the field crop categories, consistent with the change in acreage. The reduction in value produced from fruit and vegetable crops in the San Joaquin River Region is also notable even though the acreage decline is fairly small. The total decline in value represents less than one percent of the No-Action Alternative value. Similar reductions are estimated for dry conditions. Table IV-18 shows estimated changes in gross revenue by region and crop, and Figure IV-45 summarizes the change from the No-Action Alternative.

Estimated net revenue changes are shown in Table IV-19. Increased CVP water cost is the largest category of net income loss, followed by fallowed land. Increases in farm income would offset these losses over the entire study area, but gains and losses are not evenly distributed. In general, losses would occur in CVP service areas and are similar to Alternative 1 losses. Gains would occur primarily in the areas selling water for restoration purposes. Sale of water to the water acquisition program would add another $68 million to income in an average water year. Approximately $2 million per year is received in payment for land retirement, split between the San Joaquin River and Tulare Lake regions.

Losses in gross and net revenue in the San Felipe Division are smaller than in Alternatives 1 and 2 due to the additional CVP water exported and delivered to the region About $17 million in gross revenue and $2 million in net revenue is estimated to be lost compared to the No-Action Alternative.

Water Use and Efficiency

Water use estimates represent the net effect of reductions in CVP delivery, increases in SWP delivery in Tulare Lake Region, reductions due to water acquisition, and changes in groundwater use. The most important difference from Alternative 1 is the acquisition of water for restoration.

Some water is acquired in all three regions for Level 4 refuge water supply, and additional water is purchased for instream flow in the Sacramento River and San Joaquin River Regions. Because Alternative 3 allows expenditure for water acquisition beyond what is currently authorized in the Restoration Fund, substantially more water is acquired than in Alternative 2.

Groundwater use would increase slightly more in Alternative 3 than in Alternative 1 (122,000 acre-feet vs. 115,000 acre-feet). This occurs because of a shift of acreage from the areas selling water for restoration, where groundwater substitution is not allowed, to areas not selling water, where Interior has no means to prevent additional groundwater pumping. In the aggregate numbers reported, a portion of that shift is offset by the delta export of additional water, as allowed by Alternative 3 assumptions. This additional surface water exported to the westside and southern San Joaquin Valley displaces some groundwater pumping. Table IV-20 shows the estimated changes in water use for the four regions. Irrigation efficiency changes induced by Alternative 3 are similar to those described in Alternative 1.

Less surface water would be lost in the San Felipe Division than in Alternative 1 (about 10,000 acre-feet in an average water year vs. 18,000 acre-feet) because Alternative 3 allows delta export of acquired water.

Impacts on Consumers and Farm Programs

Other economic impacts associated with Alternative 3 include losses to consumers of irrigated farm products. These losses are estimated at about $13.6 million per year, which measures only the surplus, or benefit, loss to direct consumers of irrigated farm commodities. Alternative 3 would decrease agricultural revenues from U.S. Department of Agriculture (USDA) farm programs by about $10.2 million per year because retired land would lose eligibility for farm program payments. These payments are counted as part of the gross and net revenue impacts to farmers, but also can be viewed as an expense to the Federal government. Reductions in program payments are therefore savings to the Federal treasury.

Water Supply Reliability and Risk

Most of the impacts to water supply reliability and risk are similar to Alternative 1. Additional risk or uncertainty might occur due to water acquisition because land fallowing concentrated in a small area could threaten the infrastructure of suppliers, workers, and processors available to the remaining producers. Changes in the timing of stream flows and availability of irrigation return flows could also affect some growers' pattern or costs of diversion.

Growers who sell water may be able to reduce financial risk. A steady income from water sales can combine with more variable crop revenues to provide a more stable overall income stream. Revenue from water sales can also be used to finance other production costs that otherwise would be funded through borrowing.

Land Value

Land values in areas of higher water costs or losses of supply would be affected as in Alternative 1. Land values in areas selling water could increase if the right to sell the water is attached, or allocated, to the land.

Credit and Financing

Availability of credit for farming depends largely on the expected profitability of production, the risk or variability of profitability, and the collateral available to secure the lender's money. The same potential increases in risk and reduction in profit discussed in Alternative 1 also apply in Alternative 3. Growers able to sell water for restoration can potentially increase net income and reduce risk, which would increase credit worthiness.

Water Conservation and Measurement

Conservation and measurement costs would be similar to those discussed under Alternative 1.

Localized Impacts

Impacts on areas most affected by water cost increases or loss of supply are similar to those in Alternative 1.

ALTERNATIVE 4

Provisions of CVPIA implemented in Alternative 4 include all features of Alternative 1 plus the acquisition of water for instream flow and wildlife refuges. The same amount of water is acquired as in Alternative 3. By assumption, water is acquired from willing agricultural sellers who would reduce acreage to provide water for sale. In contrast to Alternative 3, Alternative 4 includes actions that use a portion of the (b)(2) water in the Delta, and does not allow acquired water to be exported from the Delta for use by water contractors.

Irrigated Acres

Changes in irrigated acres from the No-Action Alternative are shown by crop and region in Table IV-17, and summarized in Figure IV-45. The regional pattern of impacts is largely determined by the assumed location of land identified for the Land Retirement Program, by the location of water contractors most affected by the reallocation of project water, and by the areas identified for water acquisition. The San Joaquin River Region shows the largest estimated decline, about 149,000 acres in an average year (5.8 percent of irrigated land), followed by Sacramento River Region, which declines about 23,000 acres (1.2 percent), and Tulare Lake Region which declines 19,000 acres (0.9 percent). Total reduction in the Central Valley would be about 191,000 acres, or about 3 percent of the No-Action Alternative irrigated acreage. San Felipe Division acreage would decline about 10,000 acres in an average water year. Dry condition changes would be similar to those described for the average condition.

Impacts of CVPIA are not expected to result in significant idling or conversion of prime or unique farmlands. The Land Retirement Program specifically targets land with an existing salinity or drainage problem. Growers facing water reductions are likely to try to keep the most productive lands in irrigation and fallow the less productive lands. Similarly, growers selling water to the (b)(3) acquisition program can be expected to fallow less productive land and continue farming the best land.

Gross and Net Revenue

Central Valley gross revenue from irrigated farming is estimated to decline about $117 million in an average water supply year. This estimate accounts for crop price increases expected to occur because of declines in production. Without this price increase the value of production would decline another $15.4 million per year. Most of the decline is in the field crop categories, consistent with the change in acreage. The reduction in value produced from fruit and vegetable crops in the San Joaquin River Region is also notable even though the acreage decline is fairly small. The total decline in value represents less than one percent of the No-Action Alternative value. Similar reductions are estimated for dry conditions. Table IV-18 shows estimated changes in gross revenue by region and crop, and Figure IV-45 summarizes the change from the No-Action Alternative.

Net revenue changes are shown in Table IV-19. Increased CVP water cost is the largest category of net income loss, followed by fallowed land. Increases in farm income offset these losses over the entire study area, but gains and losses are not evenly distributed. In general, losses occur in CVP service areas and are similar to Alternative 1 losses. Gains are primarily in the areas selling water for the acquired water program. Sale of water to the acquisition program would add another $68 million to income in an average water year. Approximately $2 million per year would be received in payment for land retirement, split between the San Joaquin River and Tulare Lake regions.

Losses in gross and net revenue in the San Felipe Division would be larger than in Alternatives 1, 2, and 3. About $34 million in gross revenue and $3.3 million in net revenue are estimated to be lost compared to the No-Action Alternative.

Water Use and Efficiency

Water use estimates represent the net effect of reductions in CVP delivery, increases in SWP delivery in Tulare Lake Region, reductions due to water acquisition, and changes in groundwater use. Some water is acquired in all three regions for Level 4 refuge water supply, and additional water is purchased for instream flow in the Sacramento River and San Joaquin River regions. Acquisition quantities and sources are the same as those in Alternative 3.

Groundwater use in the Central Valley would increase substantially more in Alternative 4 than in Alternative 1 (286,000 acre-feet vs. 115,000 acre-feet). This occurs largely as replacement of additional losses of project water delivered south of the Delta, and to a smaller extent because of a shift of acreage from the areas selling water for restoration, as in Alternative 3. Table IV-20 shows the estimated changes in water use for the four regions. Irrigation efficiency changes induced by Alternative 4 would be similar to those described in Alternative 1.

More surface water would be lost in the San Felipe Division than in Alternative 1 (about 20,000 acre-feet in an average water year vs. 18,000 acre-feet) because of additional export limitations in Alternative 4.

Impacts on Consumers and Farm Programs

Other economic impacts associated with Alternative 4 include losses to consumers of irrigated farm products. These losses are estimated at about $15.6 million per year, which measures only the surplus, or benefit, loss to direct consumers of irrigated farm commodities. Alternative 4 would decrease agricultural revenues from U.S. Department of Agriculture (USDA) farm programs by about $11.6 million per year because retired land would lose eligibility for farm program payments. These payments are counted as part of the gross and net revenue impacts to farmers, but also can be viewed as an expense to the Federal government. Reductions in program payments are therefore savings to the Federal treasury.

Water Supply Reliability and Risk

Most of the impacts to water supply reliability and risk would be similar to those described under Alternative 1. Additional risk or uncertainty might occur due to water acquisition because land fallowing concentrated in a small area could threaten the infrastructure of suppliers, workers, and processors available to the remaining producers. Changes in the timing of streamflows and availability of irrigation return flows could also affect some growers' pattern or costs of diversion.

Growers who sell water may be able to reduce financial risk. A steady income from water sales can combine with more variable crop revenues to provide a more stable overall income stream. Revenue from water sales can also be used to finance other production costs that otherwise would be funded through borrowing.

Land Value

Land values in areas of higher water costs or losses of supply would be affected as in Alternative 1. Land values in areas selling water could increase if the right to sell the water is attached, or allocated, to the land.

Credit and Financing

Availability of credit for farming depends largely on the expected profitability of production, the risk or variability of profitability, and the collateral available to secure the lender's money. The same potential increases in risk and reduction in profit discussed in Alternative 1 also apply in Alternative 4. Growers able to sell water for restoration can potentially increase net income and reduce risk, which would increase credit worthiness.

Water Conservation and Measurement

Conservation and measurement costs would be similar to those discussed under Alternative 1.

Localized Impacts

Impacts on areas most affected by water cost increases or loss of supply are similar to those in Alternative 1.

ALTERNATIVES WITH WATER TRANSFERS

The potential impacts of CVPIA water transfers were assessed by implementing transfers as additional actions beyond the Base Alternatives without transfers. The reasons for this approach were: transfers are voluntary between buyer and seller, and therefore cannot be assumed to occur; the hypothetical nature of any assessment of impacts from transfers would potentially obscure the more directly assessed impacts of other CVPIA actions; and the quantitative analysis of hydrologic, water operations, and other impacts cannot be assessed at the same level of detail as the Base Alternatives without knowing the specific circumstances and locations of buyers and sellers.

Therefore, the analysis of water transfers should more properly be viewed as an analysis of the opportunities for water transfers and how implementation of CVPIA may affect those opportunities. None of the specific volumes of water sold that are displayed in this analysis should be viewed as predictions. They should be considered as reasonable representations of the potential water transfer market for purposes of describing impacts of CVPIA water transfers. In most cases, the estimated water volumes transferred are limited by market demand and supply rather than by physical or regulatory constraints, though regulatory requirements can increase the cost of transferring water.

Base Transfer Scenario (No-Action Alternative with Non-CVPIA Transfers)

The market for water transfers is expected to develop over time with or without CVPIA. In order to assess the incremental impact of CVPIA on this market, a Base Transfer Scenario is included that represents the potential for water transfers in the absence of CVPIA. Alternatives with water transfers are assessed as changes from the Base Transfer Scenario.

Estimates of water transfer opportunities in the Base Transfer Analysis are shown for the average condition in Table IV-22 and for the dry condition in Table IV-23. Estimates of water sold are largely determined by future demands of urban regions, as described in the Municipal Water Cost analysis. In the average condition, most water is sold from the Tulare Lake Region because of its proximity to urban demand. Due to conveyance losses and the assumption that only consumptive use or irrecoverable loss can be transferred, the purchase of over 150,000 acre-feet results in a net transfer of about 105,000 acre-feet. Under dry conditions, the Tulare Lake Region is deficient in water supply, so almost all of the additional water transferred comes from the Sacramento River and San Joaquin River regions. Due to higher conveyance losses and a Delta outflow

TABLE IV-22

**SUMMARY OF AGRICULTURAL IMPACTS
SUPPLEMENTAL ANALYSES OF ALTERNATIVES WITH WATER TRANSFERS,
1922-1990 AVERAGE CONDITION**

	Base Transfer Scenario	Changes Compared to Base Transfer Scenario			
		Supplemental Analysis 1e	Supplemental Analysis 2b	Supplemental Analysis 3a	Supplemental Analysis 4a
Sacramento River Region					
Water Sold	0	5	7	5	5
Land Fallowed	0	1	1	1	1
Revenue Received	$0.0	$0.3	$0.3	$0.4	$0.4
San Joaquin River Region					
Water Sold	6	8	-32	-16	-35
Land Fallowed	2	2	-2	-2	-5
Revenue Received	$0.3	$0.7	-$2.3	-$0.9	-$2.5
Tulare Lake Region					
Water Sold	148	-8	29	1	36
Land Fallowed	42	-3	7	-1	10
Revenue Received	$17.5	-$2.0	$3.7	-$0.5	$4.9
Total Central Valley					
Water Sold	154	5	4	-10	6
Land Fallowed	44	0	6	-2	6
Revenue Received	$17.8	-$1.0	$1.7	-$1.0	$2.8

NOTES:
Water is in thousand acre-feet. Land is in thousand acres. Revenue is in million $.
All values are annual and measured at the seller's location.
The San Joaquin River Region is a net buyer of water for agriculture in some alternatives.

requirement for transfers across the Delta, the purchase of over 1,000,000 acre-feet results in a net receipt of about 525,000 acre-feet by the buyer.

Supplemental Analysis 1e

Supplemental analysis 1e allows the transfer of CVP water service and exchange contract water, subject to the charges and conditions defined in CVPIA. Because it is a supplemental analysis of Alternative 1, it also imposes all other assumptions of Alternative 1, including management of (b)(2) water and Restoration charges. Compared with the Base Transfer Scenario, average year transfers are slightly higher due to increased transfer demand by CVP contractors. Estimated dry year transfers, however, are about 100,000 acre-feet lower than those for the Base Transfer Scenario. This is a result of the availability of CVP water closer to the point of urban demand, which reduces conveyance losses and water contributed to Delta outflow. Estimated changes are summarized in Tables IV-22 and IV-23.

Land fallowing as a result of water transfers in an average year is estimated to be about the same as in the Base Transfer Scenario, and is less than 1 percent of irrigated acreage in the Central

TABLE IV-23

SUMMARY OF AGRICULTURAL IMPACTS
SUPPLEMENTAL ANALYSES OF ALTERNATIVES WITH WATER TRANSFERS
1928-1934 DRY CONDITION

	Base Transfer Scenario	Changes Compared to Base Transfer Scenario			
		Supplemental Analysis 1e	Supplemental Analysis 2b	Supplemental Analysis 3a	Supplemental Analysis 4a
Sacramento River Region					
Water Sold	561	-293	-260	-336	-161
Land Fallowed	150	-88	-89	-101	-60
Revenue Received	$83.7	-$64.1	-$60.9	-$67.1	-$48.6
San Joaquin River Region					
Water Sold	276	27	-12	-63	-70
Land Fallowed	71	11	-1	-5	-13
Revenue Received	$54.5	-$16.4	-$19.0	-$21.5	-$25.7
Tulare Lake Region					
Water Sold	184	159	173	217	180
Land Fallowed	72	40	49	57	20
Revenue Received	$31.7	$27.8	$32.5	$42.0	$36.8
Total Central Valley					
Water Sold	1,021	-107	-99	-182	-51
Land Fallowed	293	-37	-41	-49	-53
Revenue Received	$169.9	-$52.7	-$47.4	-$46.6	-$37.5

NOTES:
Water is in thousand acre-feet. Land is in thousand acres. Revenue is in million $.
All values are annual and measured at the seller's location.
The San Joaquin River Region is a net buyer of water for agriculture in some alternatives.

Valley. Higher demands for transferred water in dry years increases the land fallowing to about 255,000 acres, or about 4 percent. This is a reduction in land fallowed compared to the Base Transfer Scenario. In general, crop lands idled by transfers are pasture, hay, grain, field crops, rice, and cotton.

Anticipated change in net revenues to agricultural water users has been estimated by combining net revenue loss due to crop fallowing, the cost of the water, and the income from water sales. As expected for transactions among willing buyers and sellers, in all cases sellers would benefit from water transfers. Gains range from $10.7 million ($40-70 per acre-foot sold) in an average year to $90.7 million ($45-130 per acre-foot sold) in a dry year, when urban buyers would bid up water prices to make up for shortfalls in supplies from their normal water sources. These estimates are lower than in the Base Transfer Scenario because, with the provision for CVP water transfers, more water would be available for transfer, and more price competition would occur among sellers. The estimates of gains to sellers do not include any cost of tilling, weed control, etc. that may be needed for temporarily fallowed land. Significant variation in selling price and gains from sales can be expected within a region and between regions.

The estimates above focus on interregional transfers. Local transfers within a region are not counted in these estimates, but would not have the system-wide implications and impacts of interregional transfers.

Supplemental Analysis 1f

Supplemental Analysis 1f also evaluates the effect of CVP water transfers, but also assumes an additional $50 per acre-foot fee on CVP water transferred. The purpose of this additional transfer fee would be to increase the Restoration Fund.

Impact of the fee on transfers to M&I buyers is primarily to discourage purchase of CVP water. In an average year, almost all purchases shift to non-CVP sources, resulting in up to a $1 million per year reduction in Restoration Fund revenue compared to Alternative 1e. The average unit cost of water purchased by M&I buyers is estimated to be about 5-10 percent higher than Alternative 1e due to more expensive alternative sources and the additional CVP transfer fee.

The impacts of the fee on agriculture are small as estimated by the water transfer analysis, because little water is purchased by agricultural users from other regions. However, the transfer analysis focuses on interregional transfers. Many transfers between agricultural buyers and sellers are likely to occur within a region, where transport and transactions costs are small. A $50 per acre-foot fee on these kinds of transactions would virtually eliminate them, because additional groundwater pumping or non-CVP surface water would be lower cost options for the potential buyers.

Supplemental Analysis 2b

The impacts of Supplemental Analysis 2b are presented in Tables IV-22 and IV-23. Total water transfers in an average year are similar to the Base Transfer Scenario, but the acquisition of water in the San Joaquin River Region for instream flow and refuges induces a shift in the location of water purchased for transfers. More water is purchased from the Tulare Lake Region, and agriculture in the San Joaquin River Region replaces some of the water sold for instream flow Changes in the dry condition are similar.

Total land fallowed as a result of water transfers in an average year is estimated to be similar to the Base Transfer Scenario, or less than 1 percent of the total irrigated acreage in the Central Valley. Higher demand for transferred water increases the land fallowing to about 250,000 acres, or 4 percent in dry years. In general, crop lands idled by transfers are pasture, hay, grain, field crops, rice, and cotton. Regional changes in land fallowing follow the same pattern described for water purchases.

Anticipated change in net revenues to agricultural water users has been estimated by combining net revenue loss due to crop reductions, the cost of any water purchased, and the income from water sales. In all cases sellers are expected to benefit from water transfers. Gains range from

$14.7 million ($35-80 per acre-foot sold) in an average year to $94.9 million ($60-135 per acre-foot sold) in a dry year, when urban users bid up water prices to make up for shortfalls in supplies from their normal water sources. The average gains in Supplemental Analysis 2b are slightly higher than those reported in 1e because the acquisition of water would reduce the supply of water for sale and raise the price. The estimates of gains to sellers do not include any cost of tilling, weed control, etc. that may be needed for temporarily fallowed land. Significant variation in selling price and gains from sales can be expected within a region and between regions.

The estimates above focus on interregional transfers. Local transfers within a region are not counted in these estimates, but would not have the system-wide implications and impacts of interregional transfers.

Supplemental Analysis 2c

The impacts of Supplemental Analysis 2c would be similar to those discussed under Supplemental Analysis 1f.

Supplemental Analysis 3a

The impacts of Supplemental Analysis 3a would be similar to those discussed under Supplemental Analysis 2b, except that water purchased is about 10 percent less. This occurs because higher CVP and SWP delivery in Alternative 3 results in a lower level of demand for transfers. Impacts are summarized in Tables IV-22 and IV-23.

Supplemental Analysis 4a

The impacts of Supplemental Analysis 4a would be similar to those discussed under Supplemental Analysis 2b, except that the price of water has been driven up by the (b)(3) water acquisition and the greater demand for transfers due to the use of (b)(2) water in the Delta. Impacts are summarized in Tables IV-22 and IV-23.

MUNICIPAL AND INDUSTRIAL LAND USE AND DEMOGRAPHICS

Projected Municipal and Industrial (M&I) land use areas for 1990 and 2020, are based on DWR projections, as shown on Table IV-24. As indicated on this table, M&I land use areas are projected to increase between 25 percent in the San Francisco Bay Region, and 48 percent in the Tulare Lake Region as compared to the Affected Environment. The overall projected increase in M&I land use throughout the four regions is approximately 34 percent.

Projected changes in regional population from 1990 to 2020 are shown in Table IV-25. The 1990 population estimates were obtained from the 1990 Census, published by the Department of Commerce. The 2020 projected population estimates were obtained from State of California official population projections, published in April 1993. These estimates were projected from a baseline developed from the 1990 Census. The 1990 level data presented in that report are

TABLE IV-24

PROJECTED REGIONAL CHANGE IN M&I LAND USE IN THE NO-ACTION ALTERNATIVE

Year	Sacramento River Region	San Joaquin River Region	Tulare Lake Region	San Francisco Bay Region
Total Area	17,254	10,208	10,573	2,816
M&I Area - 1990	396	138	229	656
M&I Area - 2020	616	234	440	871
Percent Increase	36	41	48	25
Percent of Total Area - 1990	2.3	1.4	2.2	23.3
Percent of Total Area - 2020	3.6	2.3	4.2	30.1

NOTE:
All areas in 1,000s of acres.
SOURCE:
DWR Bulletin 160-93.

adjusted for a census population in mid-year, rather than on April 1, as reported by the Department of Commerce. Therefore, the baseline used to develop 2020 projections was slightly different from the 1990 populations shown on Table IV-25.

Under Alternatives 1, 2, 3, 4 and all associated Supplemental Analyses, deficiencies in deliveries of CVP water supplies to M&I users in the Central Valley and San Francisco Bay Regions would periodically occur, as presented in the Surface Water Supplies and Facility Operations Technical Appendix. The extent of the deficiencies would not be greater than historically encountered. It is anticipated that conservation efforts that would be implemented during years with CVP deficiencies under the No-Action Alternative would also be implemented during years of similar water contract deficiency under all alternatives. Therefore, M&I land uses and population conditions under all the alternatives would not change as compared to the No-Action Alternative.

TABLE IV-25

PROJECTED REGIONAL POPULATION

Year	Sacramento River Region	San Joaquin River Region	Tulare Lake Region	San Francisco Bay Region
1990	2,583	1,880	957	5,184
2020	4,803	4,232	2,162	6,679

NOTES:
All population data shown in thousands. Projections reflect the No-Action Alternative
SOURCES:
U.S. Department of Commerce, 1990 Census Report. California Department of Finance, 2020 Population Projections.

VEGETATION AND WILDLIFE RESOURCES

This section describes projected conditions for vegetation and wildlife resources under the No-Action Alternative, followed by a comparison of the impacts of Alternatives 1 through 4 with the No-Action Alternative. Implementation of the CVPIA may result in changes in land uses, agricultural practices, and operation of CVP facilities and other water delivery systems. These changes could affect vegetation and wildlife. The impact analysis focused on changes in habitat rather than changes in population sizes of individual species. Population sizes were not evaluated because they can be affected by factors beyond the control of CVP (such as the condition of waterfowl breeding habitat in Canada), because the CVPIA actions are often defined too generally to be able to determine specific effects, and because consistent population models were not available for all species in all affected areas. A summary of the assumptions associated with each of the alternatives is presented in Table IV-26

Impact mechanisms and assumptions are described for natural and terrestrial agricultural habitats, riparian and wetland habitats, river and reservoir habitats, waterfowl and shorebirds, and special-status species. Detailed, site-specific cause-and-effect relationships were not evaluated. Rather, data from existing models were used to evaluate general relationships and trends. A summary of the impact assessment for each alternative is presented in Table IV-27.

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, approximately 1.75 million acres of land would be in agricultural production, 2.07 million acres would be non-irrigated land, and 498,300 acres would be developed for urban uses in the Sacramento River Region. In the Delta Region, approximately 422,600 acres of land would be in agricultural production, 301,100 acres would be non-irrigated lands, and 70,500 acres would be developed for urban uses. In the San Joaquin River Region, approximately 2.4 million acres of land would be in agricultural production, 1.60 million acres would be non-irrigated lands, and 477,000 acres would be developed for urban uses. In the Tulare Lake Region, approximately 2.01 million acres of land would be in agricultural production, 1.56 million acres would be non-irrigated lands, and 244,000 acres of urban development would occur.

Under the No-Action Alternative, approximately 45,000 acres of irrigated agricultural land would be retired to improve water quality and acquire water. Approximately 21,600 acres would be in the San Joaquin River Region, and approximately 23,400 acres would be in the Tulare Lake Region.

Under the No-Action Alternative, the upper and middle reaches of the Sacramento River support 14,800 acres of riparian habitat. On the lower reach of the Sacramento River (Colusa to the Delta), the acreage of riparian vegetation and abundance of common wildlife species are not expected to change by 2020. The extent and density of riparian communities along the Feather River may increase slightly by 2020. For the lower American River at Natoma, lower water levels in summer may result in a somewhat smaller extent of riparian vegetation, which may have

TABLE IV-26

SUMMARY OF ASSUMPTIONS FOR VEGETATION AND WILDLIFE RESOURCES

Assumptions Common to All Alternatives and Supplemental Analyses	
Land use per DWR Bulletin 160-93.	
Reservoir operations, river flows, and refuge deliveries based on Surface Water and Facilities Operations analysis. Acres of land fallowed based on Agricultural Land Use and Economics analysis.	
Alternative or Supplemental Analysis	**Assumption Specific to the Alternative or Supplement Analysis**
No-Action Alternative	Conservation Program implemented.
1	Retirement of up to 30,000 acres of lands with drainage problems, limited revegetation for erosion control. No conservation easements purchased on fallowed land. CVP provides Level 2 water supply to refuges, with maximum 25% shortages per Shasta Index. Implementation of AFRP physical habitat restoration actions. Approximately 80,000 acres of seasonal field flooding in winter. (b)(1) “other” program is implemented.
1a	Same assumptions as Alternative 1.
1b	Same assumptions as Alternative 1.
1c	Same assumptions as Alternative 1.
1d	Same assumptions as Alternative 1.
1e	Same assumptions as Alternative 1.
1f	Same assumptions as Alternative 1.
1g	Same assumptions as Alternative 1.
1h	Same as Alternative 1 plus: Retired land is restored to native habitats.
1i	Same assumptions as Alternative 1.
2	Same as Alternative 1 plus: Level 4 water supply for refuges acquired from willing sellers with shortages per water source
2a	Same assumptions as Alternative 2.
2b	Same assumptions as Alternative 2.
2c	Same assumptions as Alternative 2.
2d	Same assumptions as Alternative 2.

TABLE IV-26. CONTINUED

Alternative or Supplemental Analysis	Assumption Specific to the Alternative or Supplement Analysis
3	Same as Alternative 2 plus: Conservation easements may be purchased on up to 15% of land fallowed due to water acquisitions in the San Joaquin River Region. The value of 15% was selected because it appeared that about 15% of the fallowed land under this alternative would be adjacent to wetlands or refuge areas.
3a	Same assumptions as Alternative 3.
4	Same as Alternative 2 plus: Conservation easements may be purchased on up to 15% of land fallowed due to water acquisitions in the San Joaquin River Region. The value of 15% was selected because it appeared that about 15% of the fallowed land under this alternative would be adjacent to wetlands or refuge areas.
4a	Same assumptions as Alternative 4.
Revised No-Action Alternative	Same as No-Action Alternative.
Preferred Alternative	Same as Alternative 2 plus: Conservation easements may be purchased on up to 15% of land fallowed due to water acquisitions in the San Joaquin River Region. The value of 15% was selected because it appeared that about 15% of the fallowed land under this alternative would be adjacent to wetlands or refuge areas.

a minimal effect on common riparian plant species and wildlife species using riparian habitats. In the Delta Region, the extent of riparian vegetation is expected to remain approximately 7,000 acres. The extent of the riparian vegetation along the upper San Joaquin River is expected to be similar to or somewhat below the extent under existing conditions. For the San Joaquin River at Vernalis the abundance of common riparian plants and wildlife that use riparian habitats is not expected to change. The estimated 14,000 acres of riparian vegetation in the Tulare Lake Region along the Kings, Kaweah, Tule, and Kern rivers under the No-Action Alternative would be similar to existing conditions.

Under the No-Action Alternative, acreages of wetland communities in the Sacramento River, Delta, San Joaquin River, and Tulare Lake regions are expected to be the same or very similar to acreages under existing conditions. Salinity values on the southwestern end of the Delta at Chipps Island are projected to fall within the range associated with freshwater marsh habitat.

The availability of fish as prey for belted kingfishers, river otter, and other wildlife associated with riverine habitats is not expected to change in any of the study regions.

Under the No-Action Alternative, water deliveries to the boundaries of refuges in the Sacramento River Region, including Sacramento, Delevan, and Colusa NWRs, would total approximately

TABLE IV-27

SUMMARY OF IMPACT ASSESSMENT FOR VEGETATION AND WILDLIFE RESOURCES

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Conservation Program implemented, and will improve conditions for federally listed, proposed, and candidate species.
	Changes Compared to the No-Action Alternative
1	There are benefits for species through habitat acquisition, management, restoration, and studies in (b)(1) "other" program. 30,000 acres of retired agricultural land provide potential habitat for special-status species and other species associated with those sites. 18,000 acres of fallowed land provide potential habitat for some special-status species and other species. Riparian restoration on the Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species. Improved fisheries provide additional prey for fish-eating predators. Level 2 water deliveries improve wetland management for water birds and shorebirds but do not allow for optimal management. Up to 80,000 acres of agricultural fields are flooded to provide additional wetland habitat for migratory water birds and other wetland species.
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1.
1b	Conditions are similar to Alternative 1.
1c	Impacts could range from those similar to Alternative 1, to additional benefits for riparian vegetation and wildlife habitat near reservoirs and/or rivers in the Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta regions.
1d	Conditions are the same as Alternative 1, except for additional habitat provided for water birds during dry years at Federal and State refuges, and at the Grasslands Resource Conservation District.
1e	Conditions are similar to Alternative 1.
1f	Conditions are similar to Alternative 1.
1g	Conditions are the same as Alternative 1.
1h	Conditions are the same as Alternative 1, except for the restoration of some fallowed lands to natural habitats would benefit 27 special-status and other species.
1i	Conditions are the same as Alternative 1.

TABLE IV-27. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to the No-Action Alternative
2	Conditions are the same as Alternative 1, except: 55,000 acres of fallowed land provide potential habitat for some special-status species and other species. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat along the San Joaquin River near Vernalis. Further improvements in fisheries provide additional prey for fish-eating predators. Level 4 water deliveries allow optimal wetland habitat management.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	Conditions are similar to Alternative 2.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Conditions are similar to Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Conditions are the same as Alternative 2, except: 137,000 acres of fallowed land provide potential habitat for some special-status and other species. Conservation easements could be acquired on 15% of fallowed land in the San Joaquin River Region. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat along the San Joaquin River from the Merced River to Vernalis. Further improvements in fisheries provide additional prey for fish-eating predators.
3a	Conditions are similar to Alternative 3.
	Changes Compared to the No-Action Alternative
4	Conditions are the same as Alternative 3, except: 160,000 acres of fallowed land provide potential habitat for some special-status and other species. Conservation easements could be acquired on 15% of fallowed land in the San Joaquin River Region. Further improvements in fisheries provide additional prey for fish-eating predators.
4a	Conditions are similar to Alternative 4.

TABLE IV-27. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Conservation Program implemented, and will improve conditions for federally listed, proposed, and candidate species.
Preferred Alternative Changes as compared to No-Action Alternative	There are benefits for species through habitat acquisition, management, restoration, and studies in (b)(1) "other" program. 30,000 acres of retired agricultural land provide potential habitat for special-status species and other species associated with grassland and alkali desert scrub habitats. 45,000 acres of fallowed land provide potential habitat. Riparian restoration on the Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species. Improved fisheries provide additional prey for fish-eating predators. Level 2 water deliveries improve wetland management for water birds and shore birds but do not allow for optimal management. Increased spring flows on the tributaries to the San Joaquin River improve riparian habitat for riparian-dependent species along the San Joaquin River. Further improvements in fisheries provide additional prey for fish-eating predators.

128,000 acre-feet; deliveries to Delta Region refuges would be the same as described for existing conditions; refuges in the San Joaquin River Region and private wetlands would receive approximately 143,570 acre-feet of CVP water in normal and wet years; and refuges in the Tulare Lake Region (including Mendota WMA, Kern NWR, and Pixley NWR) would receive approximately 28,450 acre-feet of CVP water in normal and wet years. This level of water deliveries reflects the general conditions on the refuges prior to the implementation of the CVPIA in 1992. Water supplies available to many of these refuges under the No-Action Alternative would limit the flexibility of refuge managers to use adaptive management techniques to adjust the timing and location of water deliveries to wetland habitats to maximize benefits to wildlife.

The area of evaporation ponds in the San Joaquin River and Tulare Lake regions is projected to remain at current levels under the No-Action Alternative even with the retirement of some farmland.

ALTERNATIVE 1

Under Alternative 1, it was assumed that no new agricultural lands would be put into production, so no impacts on natural and terrestrial habitats would occur as a result of this mechanism. Similarly, no additional urban development would occur under Alternative 1 compared with the No-Action Alternative, so no impacts on vegetation and wildlife would occur as a result of urban development.

Subsidence would increase along the west side of the San Joaquin River Region. Localized flooding associated with subsidence may adversely affect several special-status species by inundating burrows. Implementation of the b(1) "other" Program would reduce this impact. Subsidence in the Tulare Lake Region would decrease compared to the No-Action Alternative. More detailed information concerning special status species is presented in the Vegetation and Wildlife Technical Appendix.

Approximately 18,000 acres more of agricultural land would be fallowed in the study area under Alternative 1 than under the No-Action Alternative. Approximately 1,600 acres would be in the Sacramento River Region, 10,000 acres would be fallowed in the San Joaquin River Region, and 6,400 acres would be fallowed in the Tulare Lake Region. For this analysis, it was assumed that these fallowed lands would be in small, isolated parcels distributed throughout each region and would provide low-quality habitat for vegetation and wildlife, including special-status plant species.

The scattered, isolated patches of ruderal and annual grass could provide low-quality habitat for Swainson's hawk in the Sacramento and San Joaquin River regions and habitat for San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and blunt-nosed leopard lizard in the San Joaquin River and Tulare Lake regions. Similarly, these patches would provide habitat for common wildlife species such as the house mouse, deer mouse, savannah sparrow, and western fence lizard.

An additional 30,000 acres of irrigated agricultural land would be retired under Alternative 1; 14,400 would be in the San Joaquin River Region and 15,600 in the Tulare Lake Region. If retired lands were allowed to be used for unirrigated grazing, populations of special-status plants occurring near retired lands could colonize the grazed areas, though colonization would be sporadic and would occur over a long time. If retired lands were restored to provide grassland and alkali desert scrub habitats, these areas would provide high-quality habitat for several common special-status species and may be used to implement conservation objectives for regional habitat conservation plans.

The fallowing and retirement of agricultural land under Alternative 1 would reduce the use of herbicides and pesticides and provide a small benefit to various common and one special-status species.

Changes in river flows would have little effect on riparian habitat and would not adversely affect habitat used by common or special-status species.

Restoration of riparian habitat along Clear, Cow, Cottonwood, Mill, Deer, and Big Chico creeks and the Sacramento, Yuba, lower American, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers would all have locally beneficial effects on the extent and condition of riparian habitat. Several common and special-status species would benefit from these actions.

No substantial changes in riparian vegetation extent or condition would occur as a result of reservoir drawdown at Folsom Lake under Alternative 1. Similar conclusions are anticipated for other reservoirs.

Changes in the extent and condition of wetland communities as a result of changes in hydrology would be minor and would not adversely affect habitat used by common and special-status species.

Freshwater, brackish water, and salt marshes in the Delta would not be affected by salinity changes, and no effects on common or special-status species associated with these habitats would occur.

Reservoir aquatic habitat quality would not change in the Sacramento River or San Joaquin River regions; nesting or wintering bald eagles would not be affected. However, increases in the availability of fish in the Sacramento and San Joaquin rivers and many of their tributaries would improve riverine habitat quality and benefit common waterbirds and bald eagles.

Full Level 2 water deliveries to refuges would result in an 18 percent increase in normal and wet years deliveries to Sacramento River Region refuges, a 65 percent increase to San Joaquin River Region refuges, and a 36 percent increase to Tulare Lake Region refuges. Relative indices indicate that the number of use-days for ducks, geese and other waterbirds could be 18 percent higher than under the No-Action Alternative at refuges in the Sacramento River Region, 65 percent higher at refuges in the San Joaquin River Region, and 36 percent higher at refuges in the Tulare Lake Region. Although these deliveries would result in increases in the acreage of wetland at refuges, and would represent a substantial benefit to migratory waterfowl and other waterbirds, inadequate water supplies would exist under this alternative for optimal wetland management.

Alternative 1 would result in approximately 80,000 acres of field flooding in the Sacramento River, Sacramento-San Joaquin Delta, and San Joaquin River regions. These new seasonal wetlands would offer major benefits for migratory waterfowl, shorebirds, and wading birds, including bother common and special-status species.

The area of evaporation ponds in the San Joaquin River and Tulare Lake regions is projected to remain the same under Alternative 1 as under the No-Action Alternative. Impacts on waterfowl and shorebirds would continue to occur. The magnitude of the impacts would depend on the design of individual evaporation ponds and the availability of alternative wetlands that would provide suitable waterfowl and shorebird habitat.

ALTERNATIVE 2

The impacts and benefits of Alternative 2 on vegetation and wildlife resources would be the same as those described under Alternative 1, with the following exceptions:

Approximately 55,000 acres more of agricultural land would be fallowed in the study area under Alternative 2 than under the No-Action Alternative. Approximately 6,100 acres would be in the Sacramento River Region, 300 acres would be fallowed in the Sacramento-San Joaquin Delta Region, 43,800 acres would be fallowed in the San Joaquin River Region, and 4,800 acres would be fallowed in the Tulare Lake Region. For this analysis, it was assumed that these fallowed lands would be in small, isolated parcels distributed throughout each region and would provide habitat for common species but would not provide high-quality habitat for special-status plant species.

Reductions in pesticide use would result from land retirement and fallowing. The amount of reduction would be slightly greater under Alternative 2 than under Alternative 1.

Higher spring flows under Alternative 2, compared with spring flows under the No-Action Alternative, would result in a higher level of reproduction of riparian species, especially during dry years on the Merced and San Joaquin rivers. The magnitude of this effect cannot be determined; however, this would beneficially affect several common and special-status plant and wildlife species. Similarly, changes in river flows on the San Joaquin River and some of its tributaries would improve wetland habitat in the riparian zones of these rivers and benefit common and several special-status plant and wildlife species.

Under Alternative 2, the restoration of riparian habitat and spawning gravel in rivers and streams in the Sacramento River, Delta, and San Joaquin River regions could increase populations of salmonid fish in these rivers and streams. The availability of additional fish would benefit the wildlife species that feed on fish.

Alternative 2 would deliver Level 4 water supplies to all affected refuges. This would result in the delivery of about 179,000 acre-feet of water to refuges in the Sacramento River Region, representing a 40 percent increase in normal and wet years compared with deliveries under the No-Action Alternative. Approximately 316,360 acre-feet of water would be delivered to refuges in the San Joaquin River Region, representing a 120 percent increase in normal and wet years compared with deliveries under the No-Action Alternative. Approximately 60,650 acre-feet of water would be delivered to refuges in the Tulare Lake Region, representing an increase of 113 percent in normal and wet years compared with deliveries under the No-Action Alternative.

These increased water deliveries to refuges would permit optimal management (Level 4) of existing and new wetlands to benefit migratory and breeding waterfowl and other waterbirds and wildlife. Relative indices indicate that the number of use-days for ducks, geese, and other waterbirds at refuges in the Sacramento River Region could be 35 percent higher under Alternative 2 than under the No-Action Alternative. At refuges in the San Joaquin River Region the number of use-days for ducks, geese, and other waterbirds could be more than 100 percent higher, and at refuges in the Tulare Lake Region the number of use-days could be more than 65 percent higher.

ALTERNATIVE 3

The impacts and benefits of Alternative 3 on vegetation and wildlife resources would be the same as those described under Alternative 1, with the following exceptions:

The level of subsidence in the western San Joaquin River Region would be greater under Alternative 3, than under Alternative 1.

Approximately 137,000 acres more of agricultural land would be fallowed in the study area under Alternative 3 than under the No-Action Alternative. Approximately 23,100 acres would be in the Sacramento River Region, 1,500 acres would be fallowed in the Sacramento-San Joaquin Delta Region, 108,100 acres would be fallowed in the San Joaquin River Region, and 4,100 acres would be in the Tulare Lake Region. It is assumed that approximately 15 percent of the land (18,375 acres) would be adjacent to wildlife refuges or SNAs, or that individual parcels would be large enough to provide potentially high-quality habitat. Where these lands are near existing wildlife refuges and SNAs, Federal conservation easements could be used to benefit common and special-status plants. Conservation easements could be acquired, and these parcels could be managed in ways that included vegetation and wildlife objectives. Many common and special-status species could benefit from habitat enhancement, including plant species in grassland, alkali desert scrub, and valley foothill hardwood habitats that are Federally listed or proposed for listing.

Reductions in pesticide use would result from land retirement and fallowing. The amount of reduction would be greater under Alternative 3 than under Alternative 1.

Under Alternative 3, increased spring stages would increase habitat for common and special-status species supported by riparian and wetland habitats in the San Joaquin River and Sacramento-San Joaquin Delta regions. This would beneficially affect many common and special-status plant and wildlife species.

Under Alternative 3, the restoration of riparian habitat and spawning gravel in rivers and streams in the Sacramento River, Delta, and San Joaquin River regions could increase populations of salmonid fish in these rivers and streams. The availability of additional fish would benefit the wildlife species that feed on fish.

Alternative 3 would deliver Level 4 water supplies to all affected refuges. This would result in the delivery of about 179,000 acre-feet of water to refuges in the Sacramento River Region, representing a 40 percent increase in normal and wet years compared with deliveries under the No-Action Alternative. Approximately 316,360 acre-feet of water would be delivered to refuges in the San Joaquin River Region, representing a 120 percent increase in normal and wet years compared with deliveries under the No-Action Alternative. Approximately 60,650 acre-feet of water would be delivered to refuges in the Tulare Lake Region, representing an increase of 113 percent in normal and wet years compared with deliveries under the No-Action Alternative.

These increased water deliveries to refuges would permit optimal management (Level 4) of existing and new wetlands to benefit migratory and breeding waterfowl and other waterbirds and wildlife. Relative indices indicate that the number of use-days for ducks, geese, and other waterbirds at refuges in the Sacramento River Region could be 35 percent higher under Alternative 3 than under the No-Action Alternative. At refuges in the San Joaquin River Region the number of use-days for ducks, geese, and other waterbirds could be more than 100 percent higher, and at refuges in the Tulare Lake Region the number of use-days could be more than 65 percent higher.

ALTERNATIVE 4

The impacts and benefits of Alternative 4 on vegetation and wildlife resources would be the same as those described under Alternative 1, with the following exceptions:

The level of subsidence in the western San Joaquin River Region would be greater under Alternative 4, than under Alternative 1.

Approximately 160,000 acres more of agricultural land would be fallowed in the study area under Alternative 4 than under the No-Action Alternative. Approximately 22,6300 acres would be in the Sacramento River Region, 1,600 acres would be fallowed in the Sacramento-San Joaquin Delta Region, 125,600 acres would be fallowed in the San Joaquin River Region, and 10,600 acres in the Tulare Lake Region. It is assumed that approximately 15 percent of the land (18,375 acres) would be adjacent to wildlife refuges or SNAs, or that individual parcels would be large enough to provide potentially high-quality habitat. Where these lands are near existing wildlife refuges and SNAs, Federal conservation easements could be used to benefit common and special-status plants. Conservation easements could be acquired, and these parcels could be managed in ways that included vegetation and wildlife objectives. Many common and special-status species could benefit from habitat enhancement, including plant species in grassland, alkali desert scrub, and valley foothill hardwood habitats that are Federally listed or proposed for listing.

Reductions in pesticide use would result from land retirement and fallowing. The amount of reduction would be greater under Alternative 4 than under Alternative 1.

Under Alternative 4, increased spring stages would increase habitat for special status-species supported by riparian habitat and associated wetlands in the San Joaquin River and Sacramento-San Joaquin Delta regions. This would beneficially affect several common and special-status plant and wildlife species. Similarly, changes in river flows would improve wetland habitat and benefit many common and special-status plant and wildlife species.

Under Alternative 4, the restoration of riparian habitat and spawning gravel in rivers and streams in the Sacramento River, Delta, and San Joaquin River regions could increase populations of salmonid fish in these rivers and streams. The availability of additional fish would benefit the wildlife species that feed on fish.

Alternative 4 would deliver Level 4 water supplies to all affected refuges. This would result in the delivery of about 179,000 acre-feet of water to refuges in the Sacramento River Region, representing a 40 percent increase in normal and wet years compared with deliveries under the No-Action Alternative. Approximately 316,360 acre-feet of water would be delivered to refuges in the San Joaquin River Region, representing a 120 percent increase over deliveries under the No-Action Alternative. Approximately 60,650 acre-feet of water would be delivered to refuges in the Tulare Lake Region, representing a 113 percent increase over deliveries under the No-Action Alternative.

These increased water deliveries to refuges would permit optimal management (Level 4) of existing and new wetlands to benefit migratory and breeding waterfowl and other waterbirds and wildlife. Relative indices indicate that the number of use-days for ducks, geese, and other waterbirds at refuges in the Sacramento River Region could be 35 percent higher under Alternative 4 than under the No-Action Alternative. At refuges in the San Joaquin River Region the number of use-days for ducks, geese, and other waterbirds could be more than 100 percent higher, and at refuges in the Tulare Lake Region the number of use-days could be more than 65 percent higher.

CENTRAL VALLEY PROJECT POWER RESOURCES

Currently, CVP power is marketed pursuant to Western's Marketing Plan that includes Contract 2948A, as described in the Affected Environment. This contract provides for the integrated operation of the CVP generation with the PG&E system. The contract expires at the end of 2004 and is not expected to be renewed. While the CVP has historically been operated, to the extent possible, to meet the requirements of this contract and to receive the benefits thereof, it is not expected to continue to be operated in a similar manner after contract termination in 2004. For the purposes of this study, it has been assumed that the CVP will be operated to meet authorized project purposes, which include providing water deliveries to water users, meeting fish and wildlife purposes, and power generation. Within given operating constraints, the CVP will be operated to maximize meeting load requirements of the CVP Project Use and Preference Customers.

A summary of the assumptions associated with the alternatives for power resources is presented in Table IV-28. Table IV-29 provides a summary of the impact assessment for each of the alternatives.

IMPACT ASSESSMENT METHODOLOGY

The impacts associated with each alternative were viewed from the perspective of the change in available CVP power production. The difference in power generation as well as the difference in monthly on- and off-peak Project Use capacity and energy, between the alternatives and the No-Action Alternative, was evaluated in order to estimate the impacts associated with each alternative.

TABLE IV-28

SUMMARY OF ASSUMPTIONS FOR CVP POWER RESOURCES

Assumptions Common to All Alternatives or Supplemental Analyses
CVP Generation Contract 2948A with PG&E would not be renewed. Shasta Temperature Control Device in operation. CVP power generation incidental to water operations. **CVP Project Use** Project Use load met at all times with CVP energy and from other resources. On- and off-peak definitions per 2948A. **CVP Market Value of Power** Energy available for sale based on long term (1922 - 1990) average. Capacity available for sale based on 90 percent exceedence synthetic dry year. Reservoir operation and project use based on Surface Water Supplies and Facilities Operations analyses.

TABLE IV-29

SUMMARY OF IMPACT ASSESSMENT FOR POWER RESOURCES

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	**CVP Generation** Average annual: 4935 GWh/yr. Average annual dry period (1929-1934): 2764 GWh/yr. Average monthly available capacity: 1597 MW. Average monthly dry period (1929-1934) capacity: 1380 MW. **CVP Project Use** Average annual: 1425 GWh/yr. Average annual dry period (1929-1934): 974 GWh/yr. Average monthly on-peak capacity: 184 MW. Average monthly dry period (1929-1934) on-peak capacity: 142 MW. **Market Value of Power** Average energy available for sale: 3511 GWh/yr. Average monthly capacity with energy for sale: 756 MW, based on 90 percent exceedence synthetic dry year. Average monthly capacity without energy for sale: 708 MW, based on 90 percent exceedence synthetic dry year.
	Changes Compared to the No-Action Alternative
1	**CVP Generation** Average annual reduction of 5.4 percent. Average annual dry period (1929-1934) reduction of 5.0 percent. Average monthly capacity reduction of 1.4 percent. Average monthly dry period (1929-1934) capacity reduction of 4.7 percent. **CVP Project Use** Average annual reduction of 10.3 percent. Average annual dry period (1929-1934) reduction of 10.7 percent. Average monthly on-peak capacity reduction of 8.1 percent. Average monthly dry period (1929-1934) on-peak capacity reduction of 8.9 percent.

TABLE IV-29. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Market Value of Power Reduction in average annual energy available for sale of 3.4 percent. Increase in average monthly capacity with energy for sale of 6.0 percent, based on 90 percent exceedence synthetic dry year. Reduction in average monthly capacity without energy for sale of 12.1 percent, based on 90 percent exceedence synthetic dry year. Increase in total average annual market value of 0.1 percent.
	Changes Compared to Alternative 1
1a	CVP power generation would be similar to Alternative 1. CVP Project Use would be reduced due to the decrease in CVP deliveries and Tracy Pumping Plant exports.
1b	Conditions are similar to Alternative 1.
	Changes Compared to Alternative 1
1c	Changes in power resources will depend of revised surface water operations. Use of non-delivered CVP water not determined at this time.
1d	Conditions are similar to Alternative 1.
1e	Conditions are similar to Alternative 1, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required.
1f	Conditions are similar to Supplemental Analysis 1e.
1g	Conditions are similar to Alternative 1.
1h	Conditions are the same as Alternative 1.
1i	Conditions are the same as Alternative 1.
	Changes Compared to the No-Action Alternative
2	**CVP Generation** Average annual reduction of 5.2 percent. Average annual dry period (1929-1934) reduction of 4.7 percent. Average monthly capacity reduction of 1.4 percent. Average monthly dry period (1929-1934) capacity reduction of 4.8 percent. **CVP Project Use** Average annual reduction of 10.2 percent. Average annual dry period (1929-1934) reduction of 10.6 percent. Average monthly on-peak capacity reduction of 7.9 percent. Average monthly dry period (1929-1934) on-peak capacity reduction of 9.3 percent. **Market Value of Power** Reduction in average annual energy available for sale of 3.2 percent. Increase in average monthly capacity with energy for sale of 2.8 percent, based on 90 percent exceedence synthetic dry year. Reduction in average monthly capacity without energy for sale of 8.4 percent, based on 90 percent exceedence synthetic dry year. Reduction in total average annual market value of 0.9 percent.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	Conditions are similar to Alternative 2, except in dry years when site- specific transfers may affect power operations. Further site-specific analyses will be required.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Changes in power resources will depend of revised surface water operations. Use of non-delivered CVP water not determined at this time.
	Changes Compared to the No-Action Alternative

TABLE IV-29. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
3	**CVP Generation** Average annual reduction of 5.3 percent. Average annual dry period (1929-1934) reduction of 5.3 percent. Average monthly capacity reduction of 1.3 percent. Average monthly dry period (1929-1934) capacity reduction of 4.9 percent. **CVP Project Use** Average annual reduction of 4.0 percent. Average annual dry period (1929-1934) reduction of 1.6 percent. Average monthly on-peak capacity reduction of 2.8 percent. Average monthly dry period (1929-1934) on-peak capacity increase of 0.2 percent. **Market Value of Power** Reduction in average annual energy available for sale of 5.8 percent. Increase in average monthly capacity with energy for sale of 3.2 percent, based on 90 percent exceedence synthetic dry year. Reduction in average monthly capacity without energy for sale of 13.7 percent, based on 90 percent exceedence synthetic dry year. Reduction in total average annual market value of 2.2 percent.
3a	Conditions are similar to Alternative 3, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required.
	Changes Compared to the No-Action Alternative
4	**CVP Generation** Average annual reduction of 5.1 percent. Average annual dry period (1929-1934) reduction of 4.9 percent. Average monthly capacity reduction of 1.6 percent. Average monthly dry period (1929-1934) capacity reduction of 4.8 percent. **CVP Project Use** Average annual reduction of 11.3 percent. Average annual dry period (1929-1934) reduction of 11.5 percent. Average monthly on-peak capacity reduction of 10.0 percent. Average monthly dry period (1929-1934) on-peak capacity reduction of 9.9 percent. **Market Value of Power** Reduction in average annual energy available for sale of 2.6 percent. Increase in average monthly capacity with energy for sale of 2.6 percent, based on 90 percent exceedence synthetic dry year. Reduction in average monthly capacity without energy for sale of 15.9 percent, based on 90 percent exceedence synthetic dry year. Reduction in total average annual market value of 1.4 percent.
4a	Conditions are similar to Alternative 4, except in dry years when site-specific transfers may affect power operations. Further site-specific analyses will be required.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting from implementing the Preferred Alternative.	**CVP Generation** Average annual: 5169 GWh/yr Average annual dry period (1929-1934): 2946 GWh/yr Average monthly available capacity: 1656 MW Average monthly dry period (1929-1934) available capacity: 1404 MW **CVP Project Use** Average annual: 1394 Gwh/yr Average annual dry period (1929-1934): 901 Gwh/yr Average monthly on-peak capacity: 166 MW Average monthly dry period (1929-1934) on-peak capacity: 122 MW **Energy and Capacity**

TABLE IV-29. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Average annual energy available for sale: 3779 GWh/yr Average monthly capacity with energy for sale: 747 MW, based on 90 percent exceedence synthetic dry year Average monthly capacity without energy for sale: 739 MW, based on 90 percent exceedence synthetic dry year
Preferred Alternative Changes as Compared to the Revised No-Action Alternative	**CVP Generation** Average annual reduction of 6% Average annual dry period (1929-1934) reduction of 12% Average monthly available capacity reduction of 2% Average monthly dry period (1929-1934) available capacity reduction of 8% **CVP Project Use** Average annual reduction of 11% Average annual dry period (1929-1934) reduction of 18% Average monthly on-peak capacity reduction of 8% Average monthly dry period (1929-1934) on-peak capacity reduction of 12% **Energy and Capacity** 4% reduction in average annual energy available for sale 8% reduction in average monthly capacity with energy for sale based on 90% exceedence synthetic dry year 7% reduction in average monthly capacity without energy for sale based on 90% exceedence synthetic dry year

CVP OPERATIONS

The Project Simulation Model (PROSIM) and San Joaquin Area Simulation Model (SANJASM) were used to simulate monthly CVP water facility operations. The model simulations were carried out for the period 1922 through 1990, using historical hydrology adjusted for a projected 2025 level of development. The power module of the PROSIM model was used to calculate monthly CVP generation, available capacity, and CVP Project Use energy and capacity. The simulation of CVP water facilities was conducted on a monthly time step using generalized reservoir operating rules and system criteria. The power information computed for each of the alternatives should only be interpreted in a comparative manner, and is only intended to provide an indication of the potential changes to CVP power generation, available capacity, and Project Use that would result from the implementation of the alternative considered in the PEIS.

MARKET VALUE OF POWER

The electric production cost model, PROSYM, used the output from the hydrologic model, PROSIM, and the PROSIM power module to develop an estimate of the annual change in the market value of CVP power production for each alternative, as compared to the No-Action Alternative.

Generation in an average year was based on a monthly average of the generation at each powerplant over the 69 years of simulation from the PROSIM model. The value of energy produced by the CVP was estimated based on a marginal heat rate approach. To the extent the CVP power output is increased or decreased in a particular time period, an opposite change will occur in the output of the marginal unit which is operating at the same time. The marginal heat rates for Northern California, Pacific Northwest, Southwest, and southern California from which power may be transmitted and purchased were reviewed. It was then assumed that, given industry restructuring, it would be possible to access the source of energy having the lowest delivered cost. This resulted in the alternative energy source varying monthly and by time of day (on-peak versus off-peak). The energy values used in this analysis ranged from $11.67 per megawatt-hour to $22.54 per megawatt-hour (1992 dollars).

The value of capacity available for sale was determined based on the monthly maximum level of load-carrying capability (capacity supported with energy) available under adverse hydrologic conditions. Dry year energy and capacity were chosen such that the CVP energy is available at least 90 percent of the time for any given month (barring equipment failure). Thus, a 90 percent hydrologic exceedence level was utilized (i.e., the level of energy assumed to be produced in any month will be exceeded 90 percent of the time). The resulting twelve months of energy levels developed for the PEIS alternative analysis comprise a synthetic year based on monthly data from different years that do not resemble any specific operating or chronological year within the 69-year simulation period. This synthetic year does not necessarily represent a worst case generation year or worst case of net available power for marketing, but is for use in comparison of alternatives to the No-Action Alternative. The value of capacity supported with energy was estimated to be $6.28 per kilowatt-month at 1992 dollars. In addition, capacity without energy (available capacity less capacity supported with energy) was also valued based on its ability to provide certain ancillary services (primarily spinning and installed reserves). This capacity was valued at 20 percent of the value used for capacity supported with energy.

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the CVP power generation facilities are operated in a manner similar to the operations discussed under the Affected Environment. The primary differences between operations under the No-Action Alternative and Affected Environment are primarily related to changes due to the Bay-Delta Plan Accord, revised Stanislaus River operations, and the availability of the Shasta Temperature Control Device that eliminates the need for bypass of Shasta Powerplant.

ALTERNATIVE 1

Average annual CVP power generation under this alternative is reduced at Trinity, Carr, and Spring Creek powerplants, as compared to the No-Action Alternative, due to increases in instream flows in the Trinity River and the decreased diversions from the Trinity River Basin in the spring and summer as well as increased CVP reservoir releases in the fall and spring months under (b)(2) Water Management. Power generation is also slightly reduced at other CVP powerplants due to changes in reservoir operations under (b)(2) Water Management. The simulated average annual generation for each powerplant is shown in Figure IV-46. The average annual generation and available capacity for the CVP system, based upon PROSIM output, is shown in Table IV-30. The average annual CVP generation under long term (1922-1990) and under dry hydrologic conditions (1929-1934) is reduced as compared to the No-Action

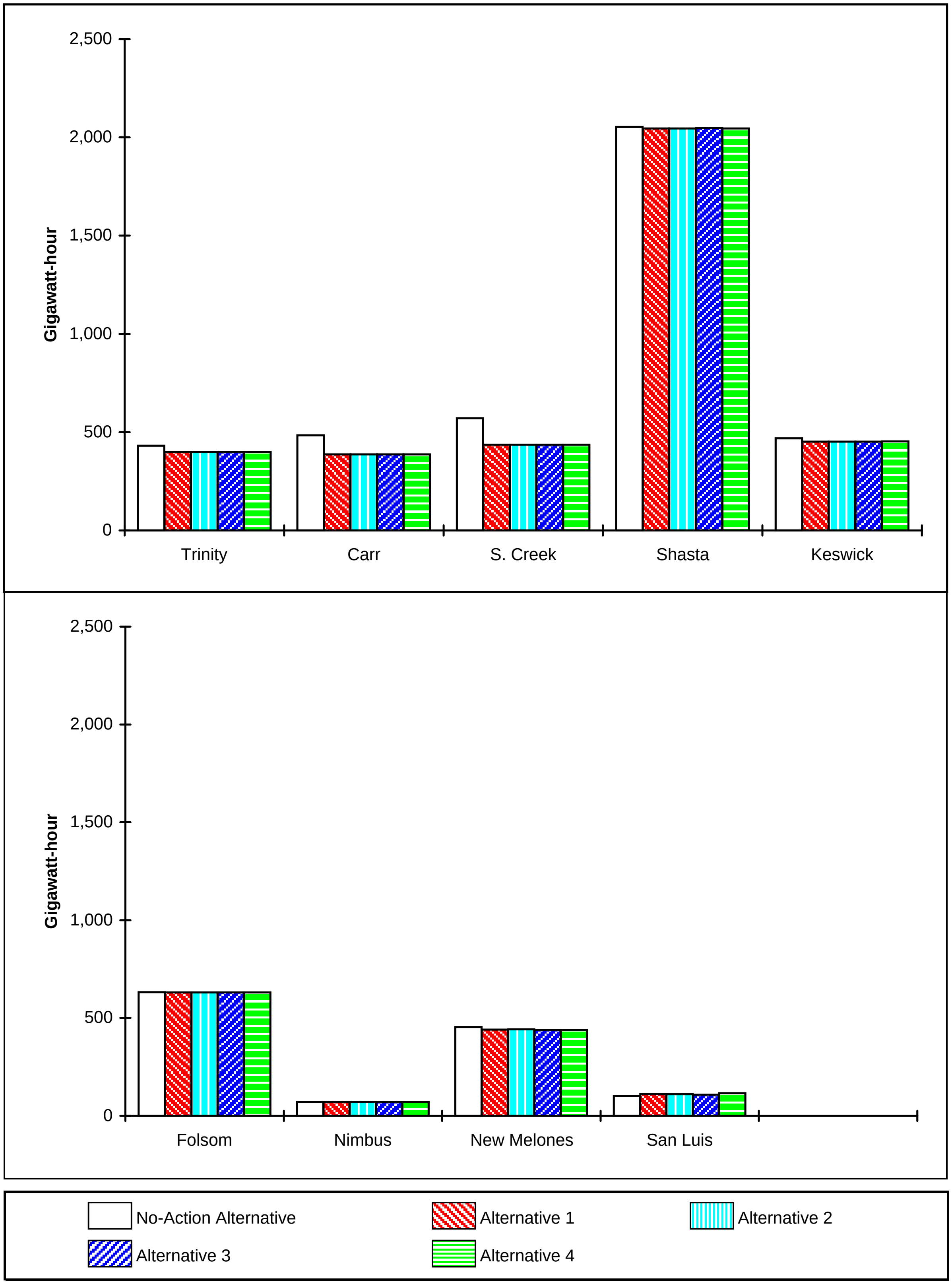


FIGURE IV-46

SIMULATED AVERAGE ANNUAL GENERATION AT CVP POWERPLANTS

TABLE IV-30

CVP GENERATION

Alternative	Average Annual Generation (GWh)		Average Monthly Available Capacity (MW)	
	Long Term (1922-1990)	Dry Period (1929-1934)	Long Term (1922-1990)	Dry Period (1929-1934)
No-Action Alternative	4,935	2,764	1,597	1,380
1	4,667	2,626	1,575	1,315
2	4,678	2,633	1,575	1,314
3	4,674	2,618	1,576	1,312
4	4,682	2,630	1,571	1,313

Alternative by 5.4 percent and 5.0 percent, respectively. The average total CVP available generating capacity for the long term and dry period is reduced 1.4 percent and 4.7 percent, respectively. Average monthly generation and available capacity are shown in Figures IV-47 and IV-48.

Changes in CVP pumping plant operations result in differences in the CVP Project Use energy and capacity in Alternative 1, as compared to the No-Action Alternative. Increased fall and reduced summer Tracy Pumping Plant exports and increased fall pumping to lift water into San Luis Reservoir shift the simulated average monthly Project Use energy and capacity. Project Use needs are reduced during the spring and summer and are increased in the fall and winter months. Average Project Use is shown in Table IV-31. The long-term average annual Project Use energy is reduced 10.3 percent compared to the No-Action Alternative. Average monthly Project Use energy and capacity are shown in Figures IV-49 and 50.

The long-term average annual energy available for sale and capacity available for sale (based on the 90 percent exceedence synthetic year) are shown in Table IV-32. This information was prepared for the PEIS by Western Area Power Administration. The energy available for sale under average conditions decreases by 3.4 percent compared to the No-Action Alternative, resulting in a reduction in energy value. However, the energy available for sale under adverse conditions is greater than in the No-Action Alternative, resulting in high firm load-carrying capability value (capacity with energy). This increase in capacity with energy for sale of 6.0 percent under adverse conditions offsets the reduction in value due to reduced average year energy. Capacity without energy for sale decreases by 12.1 percent. Based on the market value of power analysis, the net increase in the value of CVP power production under Alternative 1, as compared to the No-Action Alterative, is approximately $100,000 per year, an increase of 0.1 percent.

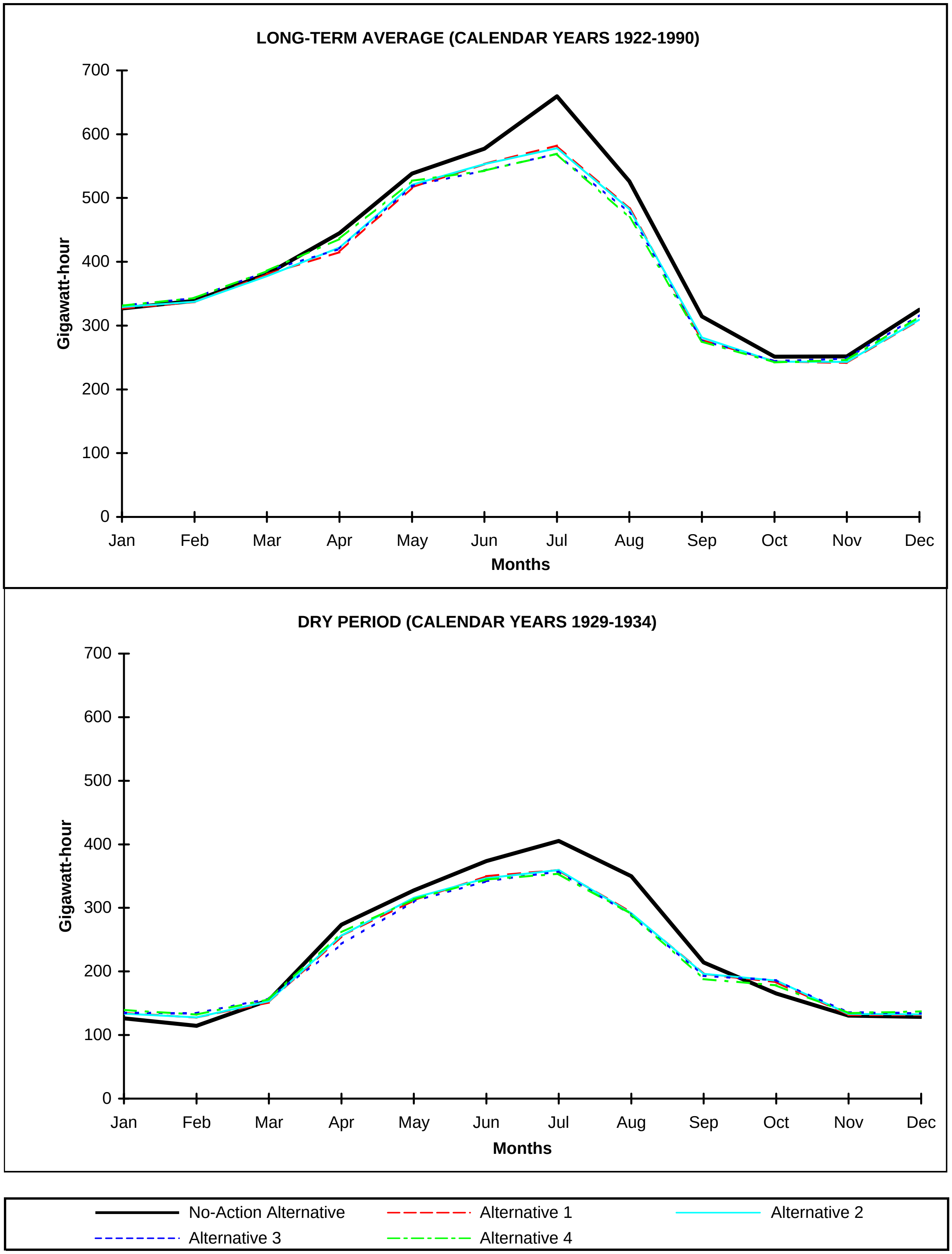


FIGURE IV-47

SIMULATED AVERAGE MONTHLY CVP GENERATION

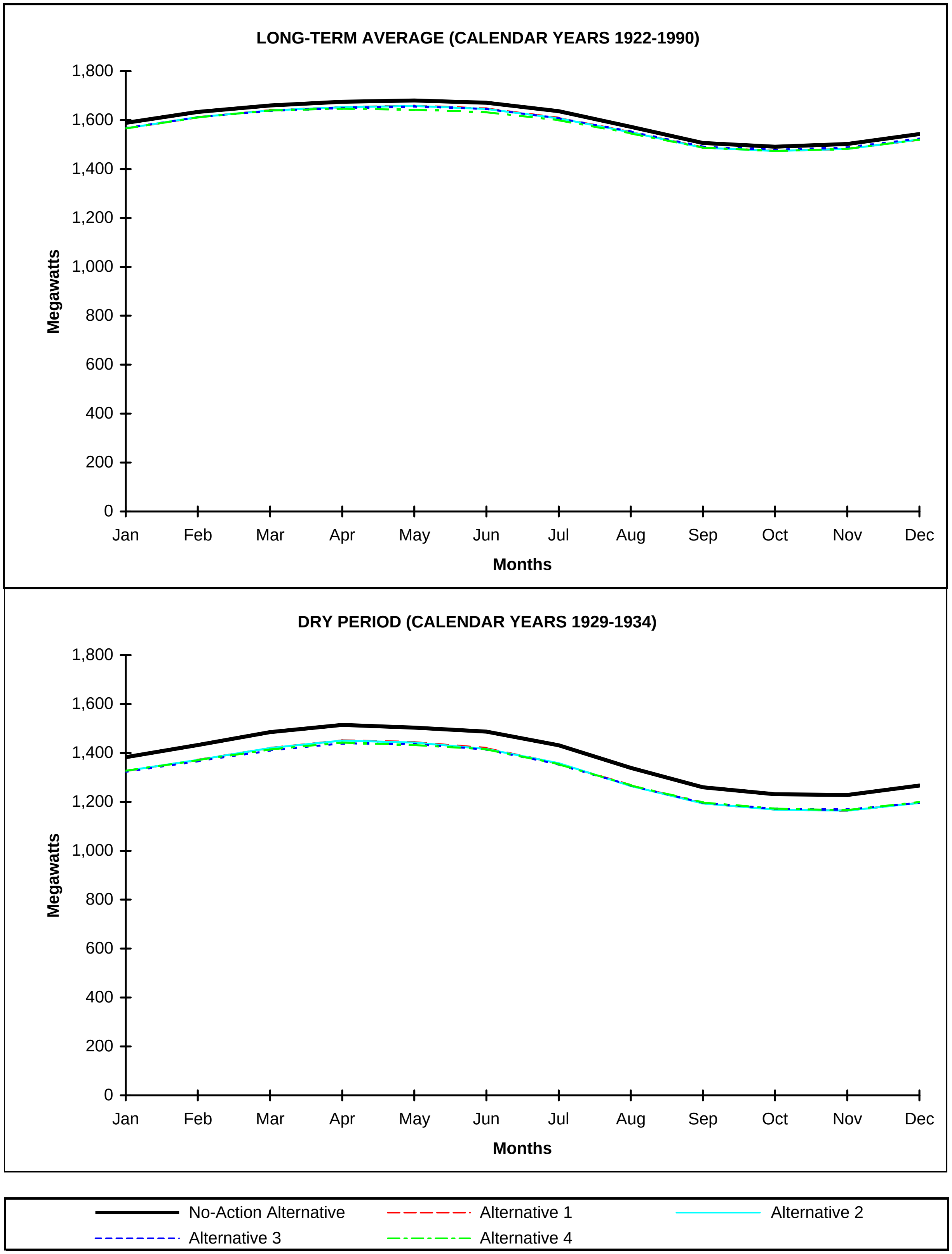


FIGURE IV-48

SIMULATED AVERAGE MONTHLY AVAILABLE CAPACITY

TABLE IV-31

AVERAGE CVP PROJECT USE

Alternative	Average Annual Project Use Energy (GWh)		Average Monthly On-Peak Project Use Capacity (MW)	
	Long Term (1922-1990)	Dry Period (1929-1934)	Long Term (1922-1990)	Dry Period (1929-1934)
No-Action Alternative	1,425	974	184	142
1	1,278	870	169	129
2	1,280	871	170	129
3	1,367	990	179	142
4	1,263	862	166	128

These changes would affect all preference power customers, including first preference power customers. The overall impacts to preference power customers are shown in Table IV-32. This analysis did not specifically evaluate the impacts on first preference power customers. However, the impacts would be relatively small as compared to the No-Action Alternative based upon changes in annual generation. In the Trinity River Division, annual generation would be reduced by 261 Gwh to 1,225 Gwh as compared to 1,486 Gwh in the No-Action Alternative (18 percent reduction). In the New Melones Project, annual generation would be reduced by 14 Gwh to 440 Gwh as compared to 454 Gwh (3 percent reduction).

However, power production at hydropower facilities on Battle Creek could be reduced under Alternative 1 as compared to the No-Action Alternative, if restoration actions for fisheries are initiated on Battle Creek.

ALTERNATIVE 2

Changes in generation for Alternative 2 are similar to Alternative 1. Generation at New Melones powerplant is slightly reduced due to water acquisition on the Stanislaus River. The simulated average annual generation for each powerplant is shown in Figure IV-46. The average annual generation and available capacity ares shown in Table IV-30. The reduction in average annual CVP generation under average and dry hydrologic conditions for Alternative 2 as compared to the No-Action Alternative is 5.2 percent and 4.7 percent, respectively. The reduction in simulated average monthly total CVP available capacity for average and dry periods is 1.4 percent and 4.8 percent, respectively. Monthly generation and available capacity are shown in Figures IV-47 and IV-48.

In Alternative 2, CVP pumping plant operations are similar to Alternative 1. Average Project Use is shown in Table IV-31. Increased fall and reduced summer Tracy Pumping Plant exports, and increased fall pumping to lift water into San Luis Reservoir shift the simulated average monthly Project Use capacity and energy. These shifts in Project Use capacity and energy requirements are shown in Figures IV-49 and IV-50. Overall, the average annual Project Use energy is reduced 10.2 percent compared to the No-Action Alternative.

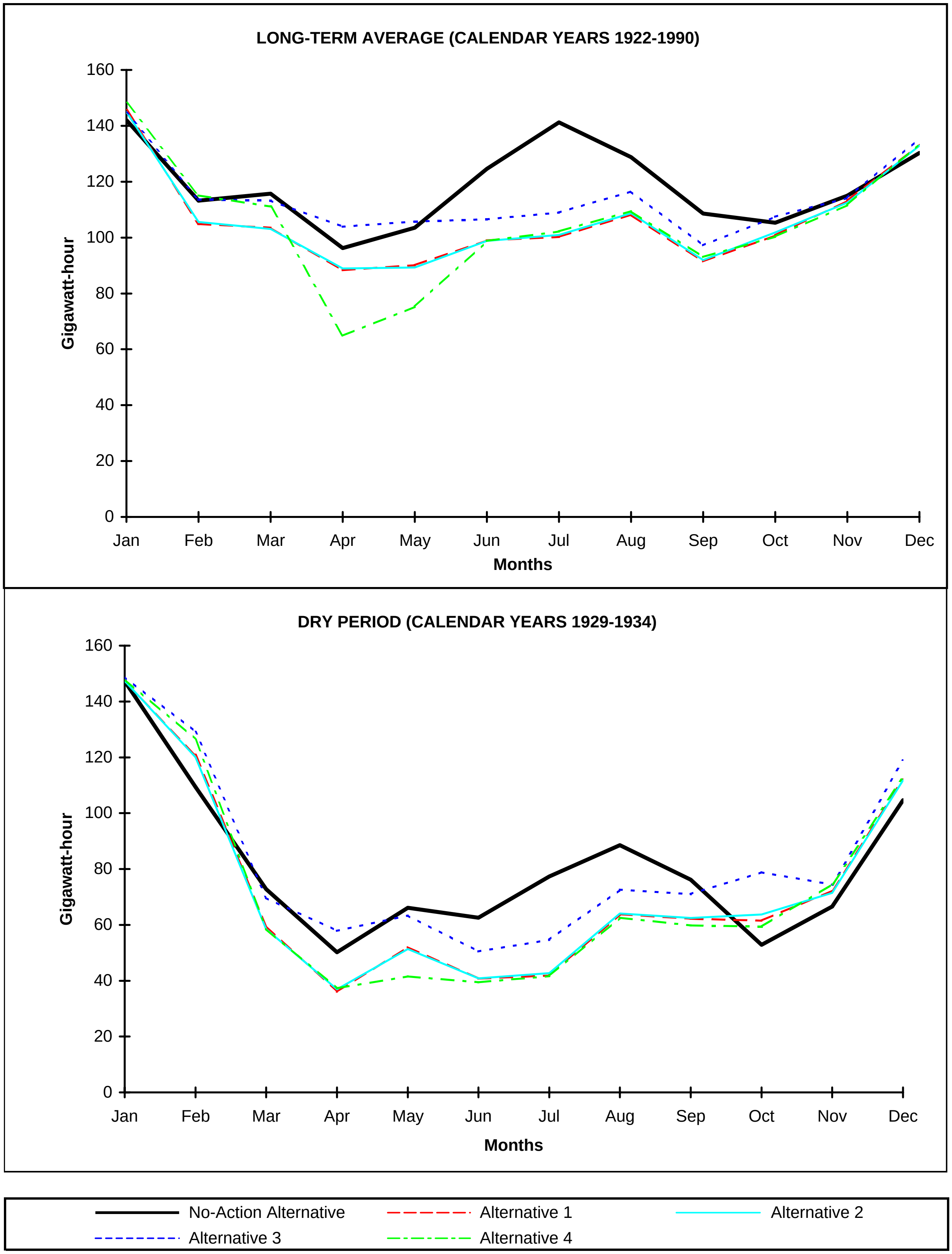


FIGURE IV-49

SIMULATED AVERAGE MONTHLY CVP PROJECT USE ENERGY

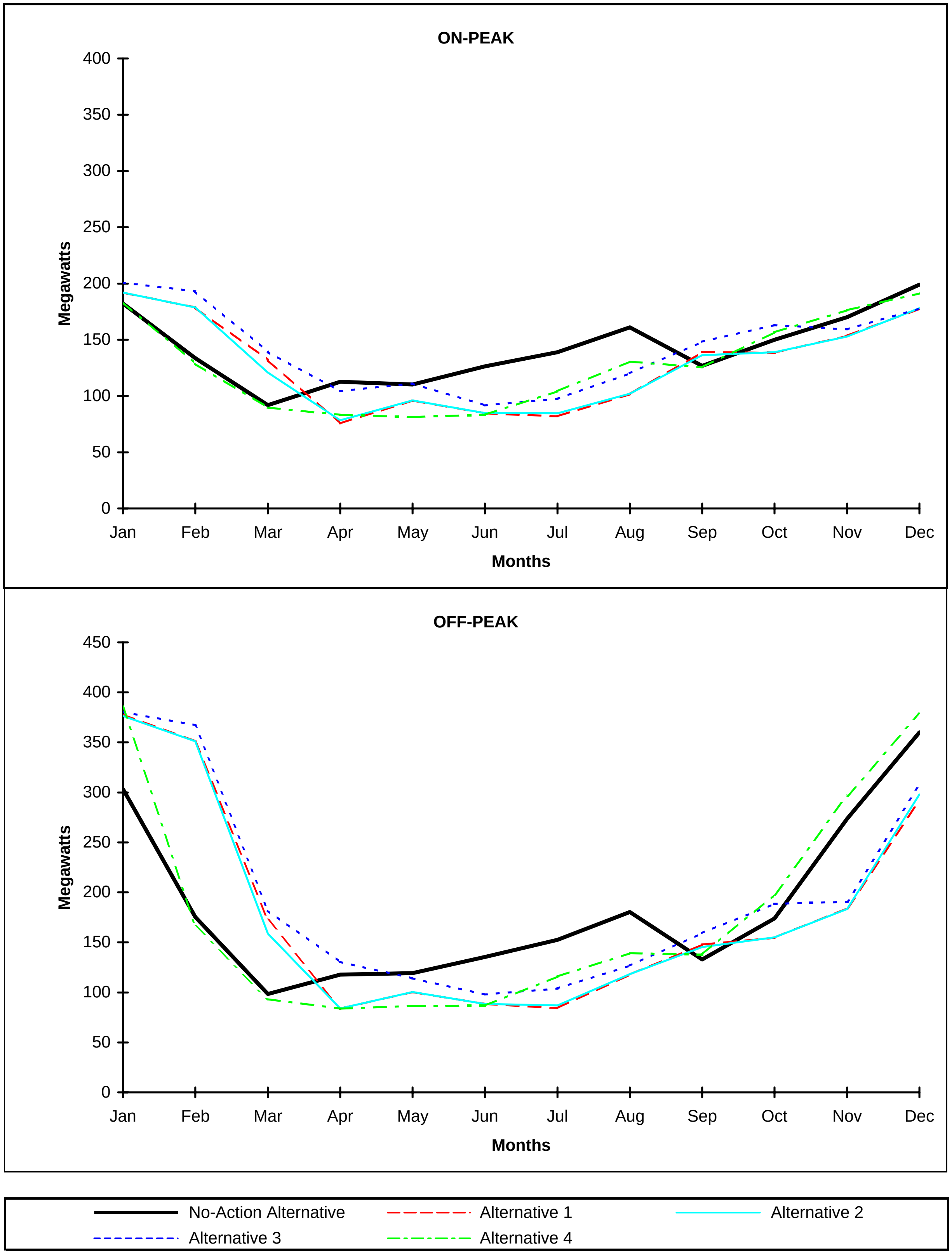


FIGURE IV-50
SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK CVP PROJECT USE CAPACITY DRY YEAR PERIOD 1929-1934

The long-term average annual energy available for sale and capacity available for sale (based on the 90 percent exceedence synthetic year) are shown in Table IV-32. The energy available for sale under average conditions decreases by 3.2 percent compared to the No-Action Alternative, resulting in a reduction in energy value. However, the energy available for sale under adverse conditions is greater than in the No-Action Alternative, resulting in higher firm load carrying capability value. This increase in capacity with energy for sale of 2.8 percent under adverse conditions partially offsets the reduction in value due to reduced average year energy. Capacity without energy for sale decreased by 8.4 percent. Based on the market value of power analysis, the net decrease in the market value of CVP power production under Alternative 2, as compared to the No-Action Alternative, is approximately $1,100,000 per year, a decrease of approximately 0.8 percent. Decreases in the energy and capacity available for sale may result in an increase in the unit cost of CVP power, which will make it more difficult to market CVP power in a competitive environment.

TABLE IV-32

CVP ENERGY AND CAPACITY AVAILABLE FOR SALE

Alternative	Average Annual Energy (GWh)	90 Percent Exceedence Synthetic Dry Year Average Monthly Capacity (MW)	
		With Energy	Without Energy
No-Action Alternative	3,511	756	708
1	3,391	801	622
2	3,401	777	649
3	3,308	780	611
4	3,420	776	595

Power production at hydropower facilities on Battle Creek and Tuolumne and Merced rivers would be reduced under Alternative 2 as compared to the No-Action Alternative due to water acquisition for the AFRP target flows.

ALTERNATIVE 3

Changes in generation for Alternative 3 are similar to Alternative 2. The simulated average annual generation for each powerplant is shown in Figure IV-46. The average annual generation and available capacity are shown in Table IV-30. The reduction in average annual CVP generation under average and dry hydrologic conditions for Alternative 3 as compared to the No-Action Alternative is 5.3 percent for both average and dry conditions. The reduction in simulated average monthly total CVP available capacity for average and dry periods is 1.3 percent and 5.0 percent, respectively. Monthly generation and available capacity are shown in Figure IV-47 and IV-48.

In Alternative 3, acquired water can be exported after it flows into the Delta as long as requirements of the Bay-Delta Accord are met. This results in increased Tracy Pumping Plant exports as compared to Alternatives 1 and 2. Average Project Use is shown in Table IV-31. The average monthly CVP Project Use energy requirements also increase in the fall and decrease in the summer in Alternative 3, as compared to the No-Action Alternative. These shifts in Project Use capacity and energy requirements are shown in Figures IV-49 and IV-50. Overall, the average annual Project Use energy is reduced 4.0 percent compared to the No-Action Alternative.

The long-term average annual energy available for sale and capacity available for sale (based on the 90 percent exceedence synthetic year) are shown in Table IV-32. The energy available for sale under average conditions decreases by 5.8 percent compared to the No-Action Alternative, resulting in a reduction in energy value. However, the energy available for sale under adverse conditions is greater than in the No-Action Alternative, resulting in higher firm load-carrying capability value. This increase in capacity with energy for sale of 3.2 percent under adverse conditions partially offsets the reduction in value due to reduced average year energy. Capacity without energy for sale decreases by 13.7 percent. Decreases in the energy and capacity available for sale may result in an increase in unit cost of CVP power, which will make it more difficult to market CVP power in a competitive environment.

Power production at hydropower facilities on Battle Creek, Tuolumne, Merced, and Yuba rivers would be reduced under Alternative 3 as compared to the No-Action Alternative, due to water acquisition for the flow targets.

ALTERNATIVE 4

Changes in generation for Alternative 4 are similar to Alternatives 2 and 3. The simulated average annual generation for each powerplant is shown in Figure IV-46. The average annual generation and available capacity are shown in Table IV-30. The reduction in average annual CVP generation under average and dry hydrologic conditions for Alternative 4 as compared to the No-Action Alternative is 5.1 percent and 4.9 percent, respectively. The reduction in simulated average monthly total CVP available capacity for average and dry periods is 1.6 percent and 4.9 percent, respectively. Monthly generation and available capacity are shown in Figures IV-47 and IV-48.

In Alternative 4 the CVP would not export acquired water after it flows into the Delta, and Tracy Pumping Plant exports would be changed due to use of (b)(2) water in the Delta above the Bay-Delta Plan Accord requirements. This results in decreased Tracy Pumping Plant energy needs as compared to the other Alternatives. Average Project Use is shown in Table IV-31. Figures IV-49 and IV-50 show the reduction in average monthly Project Use energy and capacity in April and May, for Alternative 4 as compared to the No-Action Alternative. Overall, the average annual Project Use energy is reduced 11.3 percent compared to the No-Action Alternative.

The long-term average annual energy available for sale and capacity available for sale (based on the 90 percent exceedence synthetic year) are shown in Table IV-32. The energy available for sale under average conditions decreases by 2.6 percent compared to the No-Action Alternative, resulting in a reduction in energy value. However, the energy available for sale under adverse conditions is greater than in the No-Action Alternative, resulting in higher firm load-carrying capability value. This increase in capacity with energy for sale of 2.6 percent under adverse conditions partially offsets the reduction in value due to reduced average year energy. Capacity without energy for sale decreases by 15.9 percent. Decreases in the energy and capacity available for sale may result in an increase in unit cost of CVP power, which will make it more difficult to market CVP power in a competitive environment.

Power production at hydropower facilities on Battle Creek, Tuolumne, Merced, and Yuba rivers would be reduced under Alternative 4 as compared to the No-Action Alternative, due to water acquisition for the flow targets.

RESTORATION CHARGES TO CVP POWER USERS

Section 3407 of the CVPIA established the Central Valley Project Restoration Fund. Section 3407(d)(2)(A) defined the responsibilities of CVP water and power users for payment into this fund. Although this section did not include specific annual amounts for payments to the Restoration Fund by water and power users, it did indicate that " . . . The Secretary shall require the Central Valley Project water and power contractors to make such additional annual payments as are necessary . . . " and " . . . such additional payments shall not exceed $30,000,000 (October 1992 price levels) on a three year rolling average basis . . ." and " . . . taking into account all funds collected under this title, shall, to the greatest degree practicable, be assessed in the same proportion, measured over a ten-year rolling average, as water and power users' respective allocations for repayment of the Central Valley Project."

For the purpose of the PEIS, it was assumed that payments to the Restoration Fund for CVP power users for years with average year water deliveries for Alternative 1 would be approximately $6,200,000; for Alternative 2, $6,3000,000; alternative 3, $5,300,000; and for Alternative 4, $6,500,000. This amount may be greater or lesser for any given year depending on restoration payments collected from water users for that year and the requirement to maintain the three-year average of $30,000,000.

RECREATION

Impacts on recreation are assessed for major CVP and SWP reservoirs and those operated by other agencies, rivers below these reservoirs, and Federal and State wildlife refuges receiving Federal water. Major CVP reservoirs are Shasta Lake, Whiskeytown Lake, Folsom Lake, San Luis Reservoir (joint CVP and SWP facility), Millerton Lake, and New Melones Reservoir. The major SWP reservoir is Lake Oroville. Impacts on recreation at secondary CVP and SWP reservoirs and major reservoirs operated by other agencies, including Keswick, Lake Red Bluff, Lake Natoma, Thermalito Forebay and Afterbay, O'Neill Forebay, and Bethany, are assessed at a more general level of detail.

Major rivers below CVP and SWP reservoirs are the Sacramento, Feather, American, San Joaquin, and Stanislaus. Major rivers below reservoirs operated by other agencies are the Yuba, Tuolumne, Calaveras, Merced, and Mokelumne. Federal and State wildlife refuges located in the Sacramento River, San Joaquin River, and Tulare Lake regions are also included in the impact assessment.

A summary of the assumptions associated with the alternatives for recreation is presented in Table IV-33. Table IV-34 provides a summary of the impact assessment for each of the alternatives.

TABLE IV-33

SUMMARY OF ASSUMPTIONS FOR RECREATION

Assumptions Common to All Alternatives and Supplemental Analyses
Recreational use at reservoirs will change with water levels that affect boat ramps, water skiing, and picnicking. Extremely high and extremely low water levels will have adverse impacts on quality of use. Recreational use at refuges and on rivers will change with habitat quality. Extremely high and extremely low water levels will have adverse impacts on quality of use. Reservoir operations, river flows, and refuge deliveries are estimated in the corresponding analysis for Surface Water and Facilities Operations analyses.

METHODOLOGY

Two types of changes related to recreation area are assessed in this section: changes in recreation opportunities and changes in recreation use. The assessment of recreation opportunities analyzes how changes in reservoir elevations, river flows, and water deliveries to wildlife refuges would affect the opportunities for water-related activities at these facilities. The analysis examines opportunities during on- and off-peak seasons (defined in the Recreation Technical Appendix).

The assessment of recreation use focuses on how the same changes studied in the opportunities analysis may affect annual rates of recreation use at these facilities. Because these changes in recreation use serve as the basis for estimating recreation-related economic impacts, changes in use are described but impacts are not cited.

The effects of each alternative are compared to conditions under the No-Action Alternative to determine impacts on recreation. The results of this analysis are presented below, organized by alternative.

Changes in recreational activities in the Trinity River Region would be the same for all alternatives as compared to No-Action Alternative. The impacts associated with changes in the Trinity River Region are being evaluated in a separate environmental document.

TABLE IV-34

SUMMARY OF IMPACT ASSESSMENT FOR RECREATION

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Conditions are similar to Affected Environment.
	Changes Compared to the No-Action Alternative
1	Lower surface elevations on Pitt River and Sacramento River arms of Shasta Lake constrain boating during the off season. Higher surface elevation at Lake Oroville reduces constraints on boating and shoreline activities during the peak and off-peak seasons. Higher surface elevation at Folsom Lake reduces constraints on boating and shoreline use during the peak and off-peak seasons. Flows are maintained within optimal range for boating more frequently on the upper Sacramento River during the peak season. Flows on the American River are more frequently below optimum level for swimming during the peak season. Opportunities are increased for wildlife observation, hunting, and fishing at wildlife refuges in the Sacramento River Region. Lower surface elevation at New Melones Reservoir constrains boating and increases the frequency when boat ramps are unusable. Lower surface elevation at New Melones Reservoir restricts shoreline recreation opportunities. Flows on the lower Stanislaus River are maintained above the minimum level for boating and swimming more frequently during the peak season. Opportunities are increased for wildlife observation, hunting, and fishing at wildlife refuges in the San Joaquin River Region.
	Changes Compared to Alternative 1
1a	Conditions are the same as Alternative 1.
1b	Conditions are the same as Alternative 1, except the barriers at Georgiana Slough and Old River could delay or restrict recreational boat access to portions of the Delta.
1c	Impacts could range from those similar to Alternative 1, to benefits for reservoir and/or river recreation in the Sacramento River and San Joaquin River regions.
1d	Conditions are similar to Alternative 1.
	Changes Compared to Alternative 1
1e	Conditions are similar to Alternative 1.
1f	Conditions are the same as Alternative 1.
1g	Conditions are the same as Alternative 1.
1h	Conditions are the same as Alternative 1.
1i	Conditions are the same as Alternative 1, except flatwater recreation is eliminated at Lake Red Bluff.

TABLE IV-34. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to the No-Action Alternative
2	Conditions are the same as Alternative 1, except opportunities are increased over Alternative 1 for wildlife observation, hunting, and fishing at wildlife refuges in the San Joaquin River and Tulare Lake regions.
	Changes Compared to Alternative 2
2a	Average annual conditions are the same as Alternative 2, except the barriers at Georgiana Slough and Old River could delay or restrict recreational boat access to portions of the Delta.
2b	Conditions are similar to Alternative 2.
2c	Conditions are similar to Alternative 2.
2d	Conditions are similar to Alternative 2.
	Changes Compared to the No-Action Alternative
3	Conditions are the same as Alternative 3.
3a	Conditions are similar to Alternative 3.
	Changes Compared to the No-Action Alternative
4	Conditions are the same as Alternative 3.
4a	Conditions are similar to Alternative 4.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Conditions similar to Draft PEIS No-Action Alternative except for reduced recreation potential at Shasta Lake and Folsom Lake in critical dry years.
Preferred Alternative Changes as compared to Revised No-Action Alternative	Lower surface elevations on McCloud River, Pit River, and Sacramento River arms of Shasta Lake constrain boating during the peak season. Higher surface elevation at Lake Oroville reduces constraints on boating and shoreline activities during the peak and off-peak seasons. Lower surface elevation at Folsom Lake increases constraints on boating and shoreline activities during the peak and off-peak season. Flows maintained within optimal range for boating more frequently on the upper Sacramento River during the peak season. Flows on the American River more frequently below optimum level for swimming during the peak season. Opportunities increased for wildlife observation, hunting, and fishing at refuges. Higher surface elevation at New Melones Reservoir reduces the frequency when boat ramps are unusable and reduces constraints on boating and shoreline recreation opportunities. Flows on the lower Stanisluas River are maintained above the minimum level for boating and swimming more frequently during the peak season.

NO-ACTION ALTERNATIVE

This section presents information on recreation opportunities and use at reservoirs, rivers, and wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under the No-Action Alternative. Changes in recreation opportunities and use under Alternatives 1, 2, 3, and 4 will be compared to those under the No-Action Alternative.

Reservoirs

Recreation opportunities at all major CVP and SWP reservoirs would be constrained under the No-Action Alternative due to low reservoir storage levels. As shown in Table IV-35, boating opportunities would be constrained frequently on the Pit River and McCloud River arms of Shasta Lake during the peak and off seasons. At Folsom Lake and Lake Oroville, shoreline recreation opportunities (beach use, camping, and picnicking) would be constrained frequently during the peak season, whereas boating would be constrained frequently during the off season. At San Luis Reservoir, Millerton Lake, and New Melones Reservoir, boating and shoreline recreation opportunities would be constrained only occasionally.

Recreation opportunities at secondary CVP and SWP reservoirs are expected to be the same as those under existing conditions because operation of these reservoirs is not expected to change under the No-Action Alternative.

Recreation opportunities at major reservoirs operated by other agencies are also sensitive to reservoir surface elevations. At some of the reservoirs located in the San Joaquin River Region, boating and shoreline recreation opportunities would be constrained frequently by low reservoir surface elevations during the peak season.

Annual use estimates for major CVP and SWP reservoirs are shown in Table IV-36. Under the No-Action Alternative, annual use is estimated to range from approximately 5.7 million visitors days at Shasta Lake to 184,000 visitor days at San Luis Reservoir. Combined annual recreation use at non-CVP and SWP reservoirs is estimated to total approximately 1.8 million visitor days.

Rivers

Recreation opportunities on major rivers below CVP and SWP reservoirs would be constrained under the No-Action Alternative. As shown in Table IV-37, boating opportunities on the upper Sacramento River are occasionally constrained during the peak season. On the American River, flows would frequently be above the minimum necessary to conduct boating activities, but would also frequently be outside the optimal range of flows for this activity. On the lower San Joaquin River, flows would frequently be within the optimal range for all boating activities, but would optimum flow range, for all boating activities. Flows on the lower reach of the Stanislaus River would frequently be below the minimum flows, and infrequently within the optimal range, needed for all boating activities.

TABLE IV-35

FREQUENCY WITH WHICH RECREATION THRESHOLDS ARE EXCEEDED AT MAJOR RESERVOIRS IN THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS UNDER THE NO-ACTION ALTERNATIVE

	Peak-Season Thresholds					Off-Season Thresholds	
Reservoir	**Boat-Ramp Availability**	**Limited Surface Area**	**Marinas Close**	**Beach Use Decline**	**Camping/ Picnicking Decline**	**Boat Ramp Availability**	**Limited Surface Area**
Shasta							
Main Area	0	5	0	--	--	0	6
Pit River Arm	5	24	--	--	<1	5	23
Sacramento River Arm	6	34	4	--	10	6	40
McCloud River Arm	6	10	--	--	8	6	10
Folsom	1	14	20	23	42	3	25
Oroville	7	15	--	39	6	10	23
San Luis	<1		--	--	--	0	4
Millerton	4	6	--	6	--	1	1
New Melones	>1	1	1	3	<1	1	1

NOTES:
Values are percentages of the total number of months over a 69-year hydrologic period.
Peak season is May through September (345 months) for Shasta Lake and San Luis Reservoir.
Peak season is April through September (414 months) for Folsom Lake, Lake Oroville, Millerton Lake, and New Melones Reservoir.

TABLE IV-36

ANNUAL VISITOR USE FOR RESERVOIRS IN THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Region and Reservoir	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River					
Shasta	5,740,000	5,650,000	5,670,000	5,670,000	5,650,000
Oroville	1,250,000	1,250,000	1,260,000	1,270,000	1,260,000
Folsom	910,000	930,000	930,000	930,000	930,000
San Joaquin River					
San Luis	184,000	184,000	184,000	184,000	182,000
Millerton	663,000	663,000	663,000	663,000	663,000
New Melones	800,000	788,000	788,000	785,000	785,000
Non- CVP and SWP	1,799,000	1,799,000	1,797,000	1,807,000	1,807,000

NOTES:
Use is reported in 12-hour visitor days.
Use is based on the 69-year hydrologic period.

TABLE IV-37

FREQUENCY WITH WHICH RECREATION THRESHOLDS ARE EXCEEDED DURING THE PEAK SEASON AT MAJOR RIVERS IN THE SACRAMENTO AND SAN JOAQUIN RIVER REGIONS UNDER THE NO-ACTION ALTERNATIVE

	Thresholds		
	Boating		Swimming
River	Within Optimal Flows	Below Minimum Flows	Below Minimum Flows
Sacramento	95	--	--
American	30	22	19
San Joaquin	70	--	5
Stanislaus			
Upper Reach	34	0	--
Lower Reach	7	37	--

NOTES:
Values are percentages of the total number of months over a 69-year hydrologic period.
Peak season is May through September (345 months) for all rivers.

Recreation opportunities on rivers below major reservoirs operated by other agencies are also sensitive to river flows. Flows on the Tuolumne, Mokelumne, and Merced rivers would frequently be outside the optimum range for conducting boating activities and would also frequently be below the minimum necessary for swimming activities.

Opportunities for river-related recreation on the Feather and Yuba rivers are expected to be similar to those under existing conditions.

Annual recreation use at rivers in the San Joaquin River Region is estimated to total approximately 1.2 million visitor days. Changes in recreation associated with rivers in the Sacramento River Region are not included because recreation use at these rivers would not be substantially affected by the flow changes projected for the alternatives. Information on recreation use occurring on these rivers is included in the Recreation Technical Appendix.

Wildlife Refuges

Under the No-Action Alternative, annual visitation to wildlife refuges in the Sacramento River Region is estimated to average 101,200 visitor days (Table IV-38). Nonconsumptive recreation, such as wildlife viewing and picnicking, would account for approximately 49 percent of total visitor days and consumptive recreation, such as hunting and fishing, would account for approximately 45 percent and 6 percent of total visitor days, respectively.

At wildlife refuges in the San Joaquin River Region, annual visitation is estimated to average 72,900 visitor days (Table IV-38). Nonconsumptive recreation would account for approximately 49 percent of total visitor days. Consumptive recreation, such as hunting and fishing, would account for approximately 45 percent and 6 percent of total visitor days, respectively.

In the Tulare Lake Region, annual visitation to wildlife refuges is estimated to average 4,400 visitor days (Table IV-38). Nonconsumptive recreation would account for approximately 89 percent of total visitor days.

TABLE IV-38

ANNUAL VISITOR USE AT WILDLIFE REFUGES IN THE SACRAMENTO RIVER, SAN JOAQUIN RIVER, AND TULARE LAKE REGIONS

Region and Activity	No-Action Alternative	Alternative 1	Alternatives 2 - 4
Sacramento River			
Hunting	45,000	59,400	86,100
Fishing	6,500	7,700	9,100
Nonconsumptive	49,700	58,600	69,300
Total	101,200	125,700	164,500
San Joaquin River			
Hunting	32,500	48,800	70,100
Fishing	4,600	5,100	5,900
Nonconsumptive	35,800	39,300	45,000
Total	72,900	93,200	121,000
Tulare Lake Region			
Fishing	500	500	1,300
Nonconsumptive	3,900	3,900	9,700
Total	4,400	4,400	11,000

NOTES:
Use estimates are based on Level 2 water deliveries over a 69-year hydrologic period.
Use is reported in 5-hour visitor days.

ALTERNATIVE 1

This section describes changes in recreation opportunities and use at reservoirs, rivers, and wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 1 compared to conditions under the No-Action Alternative.

At some recreation sites in the three study regions, recreation opportunities would not change or would change only slightly under some of the alternatives compared to the No-Action Alternative. Table IV-39 shows which recreation sites are discussed under each alternative. For sites where no change would occur, no impacts on recreation opportunities are expected and these sites are not discussed further in this analysis. A detailed discussion of recreation opportunities at these sites under Alternatives 1, 2, 3, and 4 is provided in the Recreation Technical Appendix.

TABLE IV-39

RECREATION AREAS INCLUDED IN THE PEIS IMPACT ANALYSIS

Recreation Sites	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Reservoirs				
Shasta Lake	X	X	X	X
Whiskeytown Lake				
Lake Oroville	X	X	X	X
Folsom Lake	X	X	X	X
San Luis Reservoir			X	
Millerton Lake				
New Melones Reservoir	X	X	X	X
Rivers				
Sacramento	X	X	X	X
Feather				
American	X	X	X	X
San Joaquin				
Stanislaus	X	X	X	X
Wildlife Refuges				
Sacramento River Region	X	X	X	X
San Joaquin River Region	X	X	X	X
Tulare Lake Region		X	X	X

Reservoirs

Recreation opportunities at Shasta Lake, Lake Oroville, Folsom Lake, New Melones Reservoir, and reservoirs operated by other agencies could be affected under Alternative 1 (Table IV-40).

At Shasta Lake during the off season, lake levels would be lower under Alternative 1 than they would be under the No-Action Alternative. These lower lake levels would constrain boating in the Pit River and Sacramento River arms more frequently under this alternative than under the No-Action Alternative. Boating and shoreline recreation opportunities during the peak season at

Shasta Lake would be nearly the same under Alternative 1 and the No-Action Alternative. The lower lake levels during the off season would result in a potential impact on off-season boating opportunities at Shasta Lake.

TABLE IV-40

CHANGES IN RECREATION OPPORTUNITIES AT IMPORTANT RECREATION SITES

	Comparison of Changes from No-Action Alternative			
Recreation Site (1)	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Major CVP/SWP Reservoirs				
Shasta Lake	Decrease boating	Decrease boating	Decrease boating	Decrease boating
Lake Oroville	Increase boating and shoreline uses	Increase boating and shoreline uses	Increase boating and shoreline uses	Increase boating and shoreline uses
Folsom Lake	Increase boating and shoreline uses	Increase boating and shoreline uses	Increase boating and shoreline uses	Increase boating and shoreline uses
New Melones Reservoir	Decrease boating and shoreline uses	Decrease boating and shoreline uses	Decrease boating and shoreline uses	Decrease boating and shoreline uses
San Luis Reservoir	No change	No change	Decrease boating and shoreline uses	No change
Non-CVP/SWP Reservoirs	No change	No change	Decrease shoreline uses	Decrease shoreline uses

At Lake Oroville during the peak season, lake levels would be higher under Alternative 1 than they would be under the No-Action Alternative. Because of these higher lake levels, usable surface area for boating would be constrained less frequently during the peak season under this alternative than under the No-Action Alternative. Shoreline recreation opportunities during the peak season and boating opportunities during the off season are expected to be similar under both alternatives. The higher lake levels during the peak season are expected to result in a potentially beneficial impact on peak-season boating opportunities.

At Folsom Lake during the peak season, lake levels would be higher under Alternative 1 than they would be under the No-Action Alternative. Because these higher levels would create more usable surface area, boating would be constrained less frequently, the lake's single marina would remain open substantially longer, and shoreline recreation opportunities would be available longer under this alternative than under the No-Action Alternative. Higher peak-season lake levels at Folsom Lake would result in a potentially beneficial impact on boating and shoreline recreation opportunities.

At New Melones Reservoir during the peak season, lake levels would be lower under Alternative 1 than they would be under the No-Action Alternative. This would result in boat ramps being unusable more frequently, boating being constrained by limited surface area more frequently, and the lakes' marinas being forced to close for longer periods under this alternative than under the No-Action Alternative. Further, the surface elevation of the reservoir would more frequently be below the level at which beach use declines. The lower lake levels at New Melones Reservoir would result in a potential impact on boating and shoreline recreation opportunities.

Recreation use estimates for reservoirs in the Sacramento River and San Joaquin River regions are shown in Table IV-36. Under Alternative 1, annual use would decrease by approximately 2 percent at Shasta Lake and by 1 percent at New Melones Reservoir. Annual use would increase by approximately 2 percent at Folsom Lake and by less than 1 percent at Lake Oroville. Annual use at San Luis Reservoir and non-CVP and SWP reservoirs in the San Joaquin Valley Region would be the same as under the No-Action Alternative.

Rivers

Recreation opportunities occurring on the Sacramento, American, and Stanislaus rivers could change under Alternative 1 (Table IV-40). No changes are expected on other study area rivers.

On the upper reach of the Sacramento River, river flows are expected to be within the optimal flow range for all boating activities more frequently under Alternative 1 than under the No-Action Alternative. On the lower reach, recreation opportunities are less sensitive to changes in river flows. Under this alternative, flows on the lower reach would be similar to those under the No-Action Alternative and recreation opportunities would not be expected to change. Frequent optimal flow ranges on the upper reach of the Sacramento River would result in a beneficial impact on boating during the peak season.

On the American River, river flows are expected to be within the optimal range for all boating activities much more frequently under Alternative 1 than under the No-Action Alternative; however, they would also be below the minimum flows frequently, offsetting the benefit. Further, river flows would be below the optimal levels for swimming much more frequently under Alternative 1 than under the No-Action Alternative. The frequency with which river flows fall below optimal levels would result in an impact on swimming opportunities.

On the upper reach of the Stanislaus River, river flows and associated recreation opportunities would be nearly the same under Alternative 1 and the No-Action Alternative. On the lower reach, river flows would be above the minimum level for all boating activities much more frequently and within the optimal range more frequently under Alternative 1 than under the No-Action Alternative. The higher flows would result in a beneficial impact on boating opportunities.

Annual use at rivers in the San Joaquin River Region is estimated to be nearly the same under Alternative 1 as under the No-Action Alternative.

Wildlife Refuges

At Sacramento River Region wildlife refuges, increased water deliveries under Alternative 1 would support an additional 3,300 acres of wetlands. The additional wetlands are expected to result in an increase in both consumptive and nonconsumptive recreation opportunities. Annual visitation under Alternative 1 is expected to be 24 percent higher than annual use estimated for the No-Action Alternative. Waterfowl hunting would increase by 32 percent; both fishing and wildlife observation would increase by 18 percent.

At San Joaquin River Region wildlife refuges, increased water deliveries under Alternative 1 would support an additional 25,700 acres of wetlands. The additional wetlands are expected to result in an increase in both consumptive and nonconsumptive recreation opportunities. Annual visitation under Alternative 1 is expected to be 28 percent higher than annual use estimated for the No-Action Alternative. Waterfowl hunting would increase by 50 percent, fishing by 11 percent, and wildlife observation by 10 percent.

Increased water deliveries to wildlife refuges in the Sacramento River and San Joaquin River regions are expected to result in a potential beneficial impact on consumptive and nonconsumptive recreation opportunities.

ALTERNATIVE 2

This section describes changes in recreation opportunities and use at reservoirs, rivers, and wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 2. At some of these sites, recreation opportunities would be the same or nearly the same under Alternative 2 and the No-Action Alternative. These sites are indicated in Table IV-39 and are not included as part of the following alternatives analysis. No impacts on recreation opportunities are expected at the indicated sites. A detailed discussion of recreation opportunities occurring at these sites under Alternative 2 is included in the Recreation Technical Appendix.

Reservoirs

Recreation opportunities at Shasta Lake, Lake Oroville, Folsom Lake, and New Melones Reservoir could be affected under Alternative 2 (Table IV-40).

At Shasta Lake, Lake Oroville, Folsom Lake, and New Melones Reservoir, changes in peak-season and off-season reservoir surface elevations under Alternative 2 would be the same as those described under Alternative 1. Changes in surface elevations are expected to result in potential:

- impacts on off-season boating opportunities at Shasta Lake,
- beneficial impacts on peak-season boating opportunities at Lake Oroville,
- beneficial impacts on boating and shoreline recreation opportunities at Folsom Lake, and
- impacts on boating and shoreline recreation opportunities at New Melones Reservoir.

Annual use under Alternative 2 would decrease by approximately 1 percent at Shasta Lake and New Melones Reservoir (Table IV-36). Annual use would increase by approximately 2 percent at Folsom Lake and by less than 1 percent at Lake Oroville, and decrease by less than 1 percent at non-CVP and SWP reservoirs in the San Joaquin River Region. Annual use at San Luis Reservoir would be the same under Alternative 2 and the No-Action Alternative.

Rivers

Recreation opportunities occurring on the Sacramento, American, Stanislaus, and other non-CVP and SWP rivers in the San Joaquin River Region could be affected under Alternative 2 (Table IV-40).

On the Sacramento and American rivers, changes in flows under Alternative 2 would be nearly the same as those described under Alternative 1. These changes in flows are expected to result in:

- potential beneficial impacts on boating opportunities occurring on the upper reach of the Sacramento River and
- potential impacts on swimming opportunities occurring on the American River.

On the upper reach of the Stanislaus River, river flows and associated recreation opportunities would be nearly the same under Alternative 2 as under the No-Action Alternative. On the lower reach, flows would be above the minimum level for all boating activities much more frequently and within the optimal range for all boating activities more frequently under this alternative than under the No-Action Alternative. The higher flows would result in a beneficial impact on boating opportunities under Alternative 2 compared to those under the No-Action Alternative.

For non-CVP and SWP rivers in the San Joaquin River Region, flows on the Tuolumne and Merced rivers would be above the flows necessary for boating activities and within the optimal range for swimming much more frequently under Alternative 2 than under the No-Action Alternative. Flows in other San Joaquin River Region rivers are expected to be the same or nearly the same under this alternative as under the No-Action Alternative. Increased flows in the Tuolumne and Merced rivers would result in a potential beneficial impact on boating and swimming opportunities.

Under Alternative 2, annual use at rivers in the San Joaquin River Region is estimated to increase by less than 1 percent.

Wildlife Refuges

At Sacramento River Region wildlife refuges, increased water deliveries under Alternative 2 would support 5,100 more acres of wetlands than under the No-Action Alternative. The additional wetlands are expected to result in an increase in consumptive and nonconsumptive recreation opportunities. Annual visitation under Alternative 2 is estimated to be 63 percent higher than annual use estimated for the No-Action Alternative. Waterfowl hunting would increase by 91 percent, fishing by 40 percent, and wildlife observation by 39 percent.

At San Joaquin River Region wildlife refuges, increased water deliveries under Alternative 2 would support an additional 25,700 acres of wetlands. The additional wetlands are expected to result in an increase in consumptive and nonconsumptive recreation opportunities. Annual visitation under Alternative 2 is estimated to be 65 percent higher than annual use estimated for the No-Action Alternative. Waterfowl hunting would increase by 116 percent, fishing by 28 percent, and wildlife observation by 26 percent.

At Tulare Lake Region wildlife refuges, increased water deliveries under Alternative 2 would support an additional 12,400 acres of wetlands. The additional wetlands are expected to result in an increase in consumptive and nonconsumptive recreation opportunities. Annual visitation under Alternative 2 is estimated to be 150 percent higher than annual use estimated for the No-Action Alternative. Wildlife observation would increase by 149 percent, and fishing would increase by 160 percent.

Increased water deliveries to wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions are expected to result in a potential beneficial impact on consumptive and nonconsumptive recreation opportunities.

ALTERNATIVE 3

This section describes changes in recreation opportunities and use at reservoirs, rivers, and wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 3. At some of these sites, recreation opportunities would be the same or nearly the same as those described under the No-Action Alternative. These sites are indicated in Table IV-39 and are not included as part of the following alternatives analysis. No impacts on recreation opportunities are expected at the indicated sites. A detailed discussion of recreation opportunities occurring at these sites under Alternatives 3 is included in the Recreation Technical Appendix.

Reservoirs

Recreation opportunities at Shasta Lake, Lake Oroville, Folsom Lake, San Luis Reservoir, New Melones Reservoir, and non-CVP and SWP reservoirs in the San Joaquin River Region could be affected under Alternative 3 (Table IV-40).

At Shasta Lake, Lake Oroville, Folsom Lake, and New Melones Reservoir, changes in peak-season and off-season reservoir surface elevations would be the same under Alternative 3 as those described under Alternative 1. Changes in surface elevations are expected to result in:

- potential impacts on off-season boating opportunities at Shasta Lake,
- potential beneficial impacts on peak-season boating opportunities at Lake Oroville,
- potential beneficial impacts on boating and shoreline recreation opportunities at Folsom Lake, and

- potential impacts on boating and shoreline recreation opportunities at New Melones Reservoir.

In addition, at San Luis Reservoir, lake levels would be lower under Alternative 3 than under the No-Action Alternative. This would limit surface area and constrain boating opportunities. Camping and picnicking activities are constrained when reservoir surface elevations fall below specific levels. The surface elevation of the reservoir would also more frequently be at or below these levels. The lower lake levels at San Luis Reservoir would result in a potential impact on boating and shoreline recreation opportunities.

Lower lake levels could result in changes in recreation opportunities at some non-CVP and SWP reservoirs in the San Joaquin River Region. Shoreline recreation activities are constrained when the surface elevation of lakes falls below specific levels. The surface elevation of New Don Pedro Reservoir and New Hogan Lake could fall below these levels more frequently under Alternative 3 than under the No-Action Alternative.

Annual use under Alternative 3 would decrease by 2 percent at New Melones Reservoir and by 1 percent at Shasta Lake (Table IV-36). Annual use would increase by approximately 2 percent at Folsom Lake and Lake Oroville, by approximately 1 percent at Shasta Lake, and by less than 1 percent at non-CVP and SWP reservoirs in the San Joaquin Valley Region. Annual use at San Luis Reservoir would be the same under both Alternative 3 and the No-Action Alternative.

Rivers

Recreation opportunities on the Sacramento, American, Stanislaus, and other non-CVP and SWP rivers in the San Joaquin River Region could be affected under Alternative 3 (Table IV-40).

On the Sacramento and American rivers and on non-CVP and SWP rivers in the San Joaquin River Region, changes in flows under Alternative 3 would be nearly the same as those described under Alternative 1. These changes in flows are expected to result in:

- potential beneficial impacts on boating opportunities on the upper reach of Sacramento River,
- potential impacts on swimming opportunities on the American River, and
- potential beneficial impacts on boating and swimming opportunities on the Tuolumne and Merced rivers.

On the lower reach of the Stanislaus River, flows under Alternative 3 would be above the minimum level for all boating activities much more frequently, but would be within the optimal range slightly less frequently than under the No-Action Alternative. On the upper reach of the Stanislaus River, flows under Alternative 3 would be within the optimal range for all boating activities much more frequently than under the No-Action Alternative. These higher flows would result in a beneficial impact on boating opportunities on the Stanislaus River under Alternative 3 compared to those under the No-Action Alternative.

Under Alternative 3, annual use at rivers in the San Joaquin River Region is estimated to increase by approximately 3 percent.

Wildlife Refuges

Changes in recreation opportunities and use of wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 3 would be same as those described under Alternative 2. Water deliveries made to these refuges under Alternative 3 would result in a potential beneficial impact on consumptive and nonconsumptive recreation opportunities.

ALTERNATIVE 4

This section describes changes in recreation opportunities and use at reservoirs, rivers, and wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 4. At some of these sites, recreation opportunities would be the same or nearly the same under this alternative as those described under the No-Action Alternative. These sites are indicated in Table IV-39 and are not included as part of the following alternatives analysis. No impacts on recreation opportunities are expected at the indicated sites. A detailed discussion of recreation opportunities occurring at these sites under Alternative 4 is included in the Recreation Technical Appendix.

Reservoirs

Recreation opportunities at Shasta Lake, Lake Oroville, Folsom Lake, New Melones Reservoir, and non-CVP and SWP reservoirs in the San Joaquin River could be affected under Alternative 4 (Table IV-40).

At Shasta Lake, Lake Oroville, and Folsom Lake, changes in peak-season and off-season reservoir surface elevations under Alternative 4 would be the same as those described under Alternative 1. Changes in surface elevations are expected to result in:

- ♦ potential impacts on off-season boating opportunities at Shasta Lake,
- ♦ potential beneficial impacts on peak-season boating opportunities at Lake Oroville, and
- ♦ potential beneficial impacts on boating and shoreline recreation opportunities at Folsom Lake.

At New Melones Reservoir and at non-CVP and SWP reservoirs in the San Joaquin River Region, changes in peak-season reservoir surface elevations under Alternative 4 would be the same as those described under Alternative 3. Changes in reservoir surface elevations are expected to result in:

- ♦ potential impacts on boating and shoreline recreation opportunities at New Melones Reservoir and
- ♦ changes in shoreline recreation opportunities at New Don Pedro Reservoir and New Hogan Lake.

Annual use under Alternative 4 would decrease by approximately 2 percent at Shasta Lake and New Melones Reservoir and by 1 percent at San Luis Reservoir (Table IV-36). Annual use would increase by approximately 2 percent at Folsom Lake and by less than 1 percent at Lake Oroville and non-CVP and SWP reservoirs in the San Joaquin Valley Region.

Rivers

Recreation opportunities occurring on the Sacramento, American, and Stanislaus rivers and at non-CVP and SWP rivers in the San Joaquin River Region could be affected under Alternative 4 (Table IV-40).

On the Sacramento and American rivers, changes in flows under Alternative 4 would be nearly the same as those described under Alternative 1. These changes in flows are expected to result in:

- potential beneficial impacts on boating opportunities occurring on the upper reach of the Sacramento River and
- potential impacts on swimming opportunities occurring on the American River.

On the Stanislaus and on non-CVP and SWP rivers in the San Joaquin River Region, changes in flows under Alternative 4 would be nearly the same as those described under Alternative 3. These changes in flows are expected to result in:

- potential beneficial impacts on boating opportunities on the Stanislaus River and
- potential beneficial changes in boating and swimming opportunities on the Tuolumne and Merced rivers.

Under Alternative 4, annual use at rivers in the San Joaquin River Region is estimated to increase by approximately 3 percent.

Wildlife Refuges

Changes in recreation opportunities and use of wildlife refuges in the Sacramento River, San Joaquin River, and Tulare Lake regions under Alternative 4 would be same as those described under Alternative 2. Water deliveries made to these refuges under Alternative 4 would result in a potential beneficial impact on consumptive and nonconsumptive recreation opportunities.

FISH, WILDLIFE, AND RECREATION ECONOMICS

The analysis of recreation economics focuses on changes in recreation-related expenditures, recreation trip-related spending, and recreation benefits. The evaluation depends on predicted changes in recreation use, which would occur at reservoirs operated by the CVP, SWP, and other water agencies; rivers and streams; Federal and State wildlife refuges; and private hunting clubs. Table IV-41 provides a summary of the assumptions used for the analysis.

TABLE IV-41

SUMMARY OF ASSUMPTIONS FOR FISH, WILDLIFE, AND RECREATION ECONOMICS

Assumptions Common to All Alternatives and Supplemental Analyses
For each Alternative or Supplemental Analysis, stream flow, reservoir levels, and refuge supplies are estimated in the corresponding analysis for Surface Water Supplies and Facilities Operations analyses. Existing relationships among recreational use, expenditure, and benefit are assumed to apply.

In this analysis, changes in recreation-related expenditures relate only to the expenditures of recreationists that are made within the region of interest. For estimating changes in recreation trip-related spending, spending profiles were developed and applied to changes in recreation use at each affected recreation area. This procedure resulted in estimates of spending by recreationists associated with predicted visitation at each site. Recreation benefits measure recreationists' additional willingness to pay for recreation. Because these benefits are not actual expenditures (and thus not tied to a geographic location), all of these benefits are reported.

Tables IV-42 and IV-43 summarize the direct economic impacts associated with changes in the fishery and recreational resources.

NO-ACTION ALTERNATIVE

Projected annual recreation trip-related spending levels at affected reservoirs and wildlife refuges in the Sacramento River Region under the No-Action Alternative are shown in Table IV-44. Projected spending includes recreation-related purchases made within the Sacramento River Region by residents of the region and by people visiting regional recreation areas who live in other regions. It excludes recreation-related purchases made outside the region by visitors in preparation for their trips or en route to regional recreation areas.

Total spending associated with use of affected reservoirs in the Sacramento River Region in 2025 under the No-Action Alternative is projected to be approximately $141 million. Shasta Lake is the predominant recreation area in the Sacramento River Region, accounting for 72 percent of the total spending associated with use of regional reservoirs. Folsom Lake and Lake Oroville are the second and third leading areas in the region, each accounting for about 14 percent of spending at affected regional reservoirs.

Recreation use of Sacramento River Region wildlife refuges would result in annual expenditures of approximately $3.4 million.

Economic activity associated with affected rivers in the Sacramento River Region is not shown because recreation uses of these rivers would not be substantially affected by the estimated flow changes in the alternatives.

TABLE IV-42

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITHOUT WATER TRANSFERS FOR FISH, WILDLIFE, AND RECREATION ECONOMICS

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	$145 million per year in recreation-related expenditure at reservoirs and refuges in the Sacramento River Region, and about $85 million per year in the San Joaquin River and Tulare Lake Region combined. Additional, unquantified expenditure and benefits to river recreation in the Sacramento River Region, and to ocean recreation related to Central Valley anadromous fisheries.
	Changes Compared to the No-Action Alternative
1	Small increase in recreation-related expenditures (less than 3%) at reservoirs and rivers. About 25% increase in expenditure at refuges resulting from greater use. Additional, unquantified expenditure and benefit to fisheries and recreational use.
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1.
1b	Conditions are similar to Alternative 1.
1c	Potential reallocation of water for other uses could change quantity and timing of releases from reservoirs and flow in streams, with potential impacts on fisheries, recreational use, and benefits.
1d	Conditions are similar to Alternative 1.
1e	See summary of impacts of Alternatives with Water Transfers.
1f	See summary of impacts of Alternatives with Water Transfers.
1g	Conditions are similar to Alternative 1.
1h	Conditions are similar to Alternative 1.
1i	Conditions are similar to Alternative 1, but recreational expenditures and benefits associated with Lake Red Bluff would be substantially reduced. Some of this expenditure could shift to other uses or sites within the region. Fisheries may benefit.
	Changes Compared to the No-Action Alternative
2	Impacts in CVP streams and reservoirs are similar to Alternative 1. Estimated increases of 70% in expenditure and benefits to refuge wildlife recreation occur due to Level 4 water deliveries. The purchase of (b)(3) water for instream flow provides potential increases in benefits related to streamflow and fisheries.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	See summary of impacts for Alternatives with Water Transfers.
2c	See summary of impacts for Alternatives with Water Transfers.
2d	Changes are similar to those described under Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Impacts are similar to those described for Alternative 2.

TABLE IV-42. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	The purchase of additional (b)(3) water for instream flow provides potential increases in benefits related to streamflow and fisheries.
	Changes Compared to Alternative 3
3a	See summary of impacts for Alternatives with Water Transfers.
	Changes Compared to the No-Action Alternative
4	Impacts are similar to those described for Alternative 3.
	Changes Compared to Alternative 4
4a	See summary of impacts for Alternatives with Water Transfers.

TABLE IV-43

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITH WATER TRANSFERS FOR FISH, WILDLIFE, AND RECREATION ECONOMICS

Alternative or Supplemental Analysis	Impact Assessment
Base Transfer Scenario	Impacts of water transfers on fish, wildlife, and recreation benefits depend on the timing and location of flows affected by water transfers. Negative impacts could occur if flow is reduced in a stream during a period of high recreational use. These would be offset to some extent by increased flows during other periods. Overall impact is uncertain.
	Changes Compared to the Base Transfer Scenario
1e	Potential impacts are similar to those described under the Base Transfer Scenario.
1f	Potential impacts are similar to those described under the Base Transfer Scenario.
2b	Potential impacts are similar to those described under the Base Transfer Scenario.
2c	Potential impacts are similar to those described under the Base Transfer Scenario.
3a	Potential impacts are similar to those described under the Base Transfer Scenario.
4a	Potential impacts are similar to those described under the Base Transfer Scenario.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	$176 million per year in recreation-related expenditure at reservoirs and refuges in the Sacramento River Region, and about $152 million per year in the San Joaquin River and Tulare Lake Region combined. Additional, unquantified expenditure and benefits to river recreation in the Sacramento River Region, and to ocean recreation related to anadromous fisheries.

TABLE IV-43. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
Preferred Alternative Changes as compared to Revised No-Action Alternative	Small increase in recreation-related expenditures (less than 3%) at reservoirs and rivers. About 70% increase in expenditure at refuges resulting from greater use.

TABLE IV-44

RECREATION TRIP-RELATED EXPENDITURES AT KEY RECREATION AREAS IN THE SACRAMENTO RIVER REGION

		Changes Compared to No-Action Alternative			
Recreation Area	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Lakes					
Shasta	101,821	0*	0*	0*	0*
Oroville	19,492	0*	0*	0*	0*
Folsom	19,727	0*	0*	0*	0*
Subtotal	141,040	0*	0*	0*	0*
Wildlife Refuges	3,434	848	2,206	2,206	2,206
Total	144,474	848	2,206	2,206	2,206

NOTES:
All values are expressed in thousands of 1992 dollars.

The term "0*" denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Table IV-45 shows levels of recreation-related spending only by visitors at affected facilities in each affected study area region. Visitors are defined as users of recreation areas who reside outside the region in which the area is located. Under the No-Action Alternative, recreation-related spending by visitors to the Sacramento River Region is estimated at approximately $54 million.

The benefits of recreation activity at affected reservoirs, lakes, and wildlife refuges in the Sacramento River Region are estimated to average approximately $211 million annually under the No-Action Alternative, as shown in Table IV-46. Seventy-three percent of this value is associated with recreation activity at Shasta Lake.

TABLE IV-45

REGIONAL RECREATION-RELATED EXPENDITURES OF VISITORS BY ALTERNATIVE

Region	No-Action Alternative	Changes Compared to No-Action Alternative			
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River	54,238	312	838	838	838
San Joaquin River	22,909	294	688	1,050	1,050
Tulare Lake	34	0	52	52	52

NOTES:
All values are expressed in thousands of 1992 dollars.
Visitors are defined as users of recreation areas who reside outside the region in which the recreation area is located.

TABLE IV-46

RECREATION BENEFITS AT KEY RECREATION AREAS IN THE SACRAMENTO RIVER REGION

Recreation Area	No-Action Alternative	Changes Compared to No-Action Alternative			
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Lakes					
Shasta	154,472	0*	0*	0*	0*
Oroville	17,981	0*	0*	0*	0*
Folsom	36,667	0*	0*	0*	0*
Subtotal	209,120	0	0	0	0
Wildlife Refuges	2,092	527	1,386	1,386	1,386
Total	211,212	527	1,386	1,386	1,386

NOTES:
All values are expressed in thousands of 1992 dollars.

The term “0*” denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Under the No-Action Alternative, total spending associated with use of recreation areas in the San Joaquin River Region is projected to be approximately $84 million, as shown in Table IV-47. Reservoir activities account for 65 percent of the total regional recreation spending. Recreation use at rivers and wildlife refuges accounts for about 35 percent of the total spending.

The benefits of recreation activity at affected reservoirs and lakes in the San Joaquin River Region are estimated to average approximately $33 million annually under the No-Action

TABLE IV-47

ANNUAL RECREATION TRIP-RELATED EXPENDITURES AT KEY RECREATION AREAS IN THE SAN JOAQUIN RIVER REGION

Recreation Area	No-Action Alternative	Changes Compared to the No-Action Alternative			
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Reservoirs and Lakes					
San Luis	4,142	0*	0*	0*	0*
Millerton	10,454	0*	0*	0*	0*
New Melones	12,306	0*	0*	0*	0*
Non-CVP reservoirs (1)	28,254	0*	0*	0*	0*
Subtotal	**55,156**	**0**	**0**	**0**	**0**
Rivers (2)					
San Joaquin	11,712	0*	0*	0*	0*
Stanislaus	6,646	0*	0*	447	447
Non-CVP rivers (3)	9,089	0*	0*	379	379
Subtotal	**27,447**	**0**	**0**	**826**	**826**
Wildlife Refuges	1,891	662	1,547	1,547	1,547
Total	**84,494**	**662**	**1,547**	**2,373**	**2,373**

NOTES:

All values are expressed in thousands of 1992 dollars.

The term “0*” denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Because of model limitations, wildlife refuge values should be interpreted as indicators of potential changes.

(1) Includes Lake McClure, New Don Pedro Reservoir, New Hogan Lake, and Camanche Reservoir.

(2) Includes fishing, boating, swimming, and wildlife viewing activities only.

(3) Includes the Merced and Tuolumne rivers.

Alternative, as shown in Table IV-48. Total recreation benefits at affected facilities in the San Joaquin River Region are estimated to average approximately $56 million annually, with affected reservoirs accounting for about 59 percent of this value.

TABLE IV-48

RECREATION BENEFITS AT KEY RECREATION AREAS IN THE SAN JOAQUIN RIVER REGION

		Changes Compared to No-Action Alternative			
Recreation Area	**No-Action Alternative**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Reservoirs and Lakes					
San Luis	1,768	0*	0*	0*	0*
Millerton	6,361	0*	0*	0*	0*
New Melones	7,676	0*	0*	0*	0*
Non-CVP reservoirs (1)	17,274	0*	0*	0*	0*
Subtotal	33,079	0	0	0	0
Rivers (2)					
San Joaquin	9,362	0*	0*	0*	0*
Stanislaus	5,100	0*	0*	337	337
Non-CVP rivers (3)	7,009	0*	0*	288	288
Subtotal	21,471	0	0	625	625
Wildlife Refuges	1,507	463	1,091	1,091	1,091
Total	56,057	463	1,091	1,716	1,716

NOTES:
All values are expressed in thousands of 1992 dollars.

The term “0*” denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

(1) Includes Lake McClure, New Don Pedro Reservoir, New Hogan Lake, and Camanche Reservoir.
(2) Includes fishing, boating, swimming, and wildlife viewing activities only.
(3) Includes the Merced and Tuolumne rivers.

Study area recreation sites in the Tulare Lake Region include Kern and Pixley National Wildlife Refuges (NWRs). Total recreation-related expenditures associated with use of these refuges are projected to be $77,000 under the No-Action Alternative. Recreation benefits associated with use of these refuges are estimated to be about $79,000.

ALTERNATIVE 1

Under Alternative 1, annual spending associated with use of Sacramento River Region reservoirs and lakes would not change relative to the No-Action Alternative. Spending associated with use of Sacramento River Region wildlife refuges would increase by $848,000. Total recreation-related spending by visitors to the region is projected to increase by $312,000 under Alternative 1.

The annual benefits of recreation activity at affected reservoirs and lakes in the Sacramento River Region are not expected to change under Alternative 1 compared to the No-Action Alternative. Spending on recreation activity at State and Federal wildlife refuges in the Sacramento River Region are estimated to increase by approximately $848,000 per year under Alternative 1, or about 25 percent compared to the No-Action Alternative. Associated benefits would increase about $527,000 per year.

Under Alternative 1, spending associated with use of reservoirs in the San Joaquin River Region would not be expected to change. Spending associated with regional wildlife refuge use would increase by $662,000. Spending associated with use at affected rivers in the San Joaquin River Region would not change appreciably relative to the No-Action Alternative. Benefits associated with use at regional wildlife refuges would increase by $463,000.

No change in spending and recreation benefits associated with use of Tulare Lake Region wildlife refuges is projected under Alternative 1.

Benefits associated with sport and commercial fishing in the San Francisco Bay and Pacific Coast Regions could increase as a result of improvements in habitat conditions. Due to uncertainties in the degree of improvement, these changes have not been quantified.

Recreation-related spending and benefits associated with waterfowl hunting on private lands, in all regions, are expected to be unchanged compared to the No-Action Alternative.

ALTERNATIVE 2

Under Alternative 2, recreation-related spending and benefits associated with use of Sacramento River Region reservoirs and lakes would not change. Spending associated with use at wildlife refuges would increase by $2.2 million. The benefits of recreation activity at State and Federal wildlife refuges in the Sacramento River Region are estimated to increase by approximately $1.4 million under Alternative 2, or about 66 percent compared to the No-Action Alternative.

Under Alternative 2, recreation-related spending and benefits associated with use at affected reservoirs and rivers in the San Joaquin River Region would not be expected to change. Recreation-related spending would increase by approximately $1.5 million for the region’s wildlife refuges. The benefits of recreation activity at State and Federal wildlife refuges in the San Joaquin River Region are estimated to increase by approximately $1.1 million under Alternative 2, or about 72 percent compared to the No-Action Alternative.

Spending associated with use of the Tulare Lake Region’s wildlife refuges would increase by $116,000 under Alternative 2. Recreation benefits are estimated to increase by $119,000. Total recreation-related spending by visitors to the region is projected to increase by $52,000 under Alternative 2.

Benefits associated with sport and commercial fishing in the San Francisco Bay and Pacific Coast regions could increase as a result of improvements in habitat conditions. Due to uncertainties in the degree of improvement, these changes have not been quantified. Some additional improvement over Alternative 1 is possible due to (b)(3) water acquired for instream flow.

Recreation-related spending and benefits associated with waterfowl hunting on private lands, in all regions, are expected to be unchanged compared to the No-Action Alternative.

ALTERNATIVE 3

Under Alternative 3, spending and benefits associated with use of Sacramento River Region reservoirs would not change. Spending and benefits associated with use of regional wildlife refuges is projected to be similar to those described under Alternative 2.

Spending at affected reservoirs in the San Joaquin Region would not change compared to the No-Action Alternative. Spending related to recreation use at the Merced, Tuolumne, and Stanislaus rivers would increase by $826,000. The largest spending impact in the San Joaquin River Region under this alternative would consist of a $1.5 million increase for the wildlife refuges.

The annual benefits of recreation activity at affected reservoirs and lakes in the San Joaquin River Region are not expected to change compared to the No-Action Alternative. The annual benefits of recreation activity at affected rivers in the San Joaquin River Region are estimated to increase by approximately $625,000 under Alternative 3. This change represents a 5 percent increase in recreation benefits compared to the No-Action Alternative. The benefits of recreation activity at State and Federal wildlife refuges in the San Joaquin River Region are estimated to increase by approximately $1.1 million under Alternative 3, or by about 72 percent compared to the No-Action Alternative. Annual recreation benefits at all affected recreation areas in the San Joaquin River Region are estimated to increase by $1.7 million.

Spending associated with use of Kern and Pixley NWRs would increase by $116,000. Recreation benefits are estimated to increase by $119,000.

Benefits associated with sport and commercial fishing in the San Francisco Bay and Pacific Coast regions could increase as a result of improvements in habitat conditions. Due to uncertainties in the degree of improvement, these changes have not been quantified. Some additional improvement over Alternative 2 is possible due to increased (b)(3) water acquired for instream flow.

Spending and recreation benefits associated with waterfowl hunting opportunities on private lands, in all regions, are expected to be unchanged compared to the No-Action Alternative.

ALTERNATIVE 4

Impacts are similar to those described under Alternative 3. Some improvements in fishery habitat conditions beyond Alternative 3 are possible, and could provide additional benefits to recreational and commercial fishing, Due to uncertainties in the degree of improvement, these additional benefits have not been quantified.

REGIONAL ECONOMICS

The direct impacts considered in the regional economic analysis were agricultural production, recreation, and municipal water costs. These direct impacts, estimated by the respective economic analysis tools, were input into the regional economics analysis as the change caused by each alternative as compared to the No-Action Alternative. Regional economic analysis was conducted for the average condition only. A summary of the assumptions associated with each of the alternatives is presented in Table IV-49.

TABLE IV-49

SUMMARY OF ASSUMPTIONS FOR REGIONAL ECONOMICS

Assumptions Common to All Alternatives and Supplemental Analyses
For purposes of impact assessment, the structure of the regional economy in the year 2025 is assumed to be similar to Recent Conditions. For each alternative or Supplemental Analysis: changes in agricultural production, costs, and revenues are derived from the Agricultural Economics and Land Use analysis; changes in recreation use and expenditures are estimated in the Fish, Wildlife, and Recreation Economics analysis; changes in water costs to retail customers of municipal water providers are estimated in the Municipal Water Cost analysis.

Direct economic impacts of the alternatives have been measured for activities occurring throughout California, but the incidence of the direct impacts depends on the location of the affected industries and economies. To better reflect these locational differences, multi-county regions were identified for which boundaries were be determined in part by the expected location of direct economic impacts. Figure IV-51 shows the regional economic impacts regions.

Direct impacts, aside from employment, were expressed in dollar terms for all impacted sectors, and used in an input-output model to estimate total (including secondary) impacts to the regional economy. Direct agricultural impacts were measured as changes in gross and net revenues. Direct recreation-related impacts of the alternatives were estimated as changes in expenditures by recreation users, based on estimated changes in visitor days. Direct impacts on the municipal and industrial users were measured as changes in the cost of water. Summaries of the impact assessments for the alternatives, with and without water transfers are presented in Tables IV-50 and 51.

FIGURE IV-51

REGIONAL ECONOMICS STUDY AREA

TABLE IV-50

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITH WATER TRANSFERS FOR REGIONAL ECONOMICS

Alternative or Supplemental Analysis	Impact Assessment
Base Transfer Scenario	Impacts on the local economy of areas selling water would be similar in direction to those resulting from (b)(3) water acquisition: land fallowed to provide water for transfer would result in losses of jobs and income, offset by a (usually) smaller increase in economic activity generated by spending revenue received for selling water. Regions buying water generally have positive impacts. Water bought can support economic activity at a lower cost than developing or using more expensive alternative supplies.
	Changes Compared to the Base Transfer Scenario
1e	Conditions are similar to those described under the Base Transfer Scenario.
1f	Conditions are similar to those described under the Base Transfer Scenario.
2b	Conditions are similar to those described under the Base Transfer Scenario.
2c	Conditions are similar to those described under the Base Transfer Scenario.
3a	Conditions are similar to those described under the Base Transfer Scenario.
4a	Conditions are similar to those described under the Base Transfer Scenario.

TABLE IV-51

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITHOUT WATER TRANSFERS FOR REGIONAL ECONOMICS

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Annual Central Valley output of $221 billion and $119 billion of personal income. 3.4 million jobs, including 1.3 million in Sacramento River Region, 0.89 million in San Joaquin River Region, and 0.47 million in Tulare Lake Region. 1991 economic data provided as basis for comparison.
	Changes Compared to the No-Action Alternative
1	Annual Central Valley loss of 0.11 percent in output, 0.09 percent in personal income, and 0.1 percent in jobs. Adverse impacts concentrated in the CVP water service areas. Adverse impacts are partially offset by additional economic activity during the period of construction of restoration actions.

TABLE IV-51. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1, with some additional negative impacts in CVP water service areas due to higher cost of pumping groundwater.
1b	Conditions are similar to Alternative 1.
1c	Large additional losses of jobs and income in the Sacramento River Region due to land out of production. Additional losses in San Joaquin River Region due to higher cost of pumping groundwater.
1d	Conditions are similar to Alternative 1, with small additional negative impacts in CVP water service areas due to higher cost of pumping groundwater.
1e	See summary of impacts of Alternatives with Water Transfers.
1f	See summary of impacts of Alternatives with Water Transfers.
1g	Conditions are similar to Alternative 1, with some additional negative impacts in Sacramento River Region CVP water service areas due to higher cost of pumping groundwater.
1h	Conditions are similar to Alternative 1.
1i	Conditions are similar to Alternative 1.
	Changes Compared to the No-Action Alternative
2	Annual Central Valley losses of 0.14 percent in output, 0.11 percent in personal income, and 0.13 percent in jobs. Adverse impacts concentrated in the CVP water service areas. Impacts from land fallowing due to (b)(3) water acquisition are somewhat offset by revenue from water sold. Adverse impacts are partially offset by additional economic activity during the period of construction of restoration actions.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	See summary of impacts for Alternatives with Water Transfers.
2c	See summary of impacts for Alternatives with Water Transfers.
2d	Changes are similar to those described under Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Annual Central Valley losses of 0.16 percent in output, 0.12 percent in personal income, and 0.15 percent in jobs. Adverse impacts in CVP water service areas. Impacts from land fallowing due to (b)(3) water acquisition are somewhat offset by revenue from water sold. Adverse impacts are partially offset by additional economic activity during the period of construction of restoration actions.
	Changes Compared to Alternative 3
3a	See summary of impacts for Alternatives with Water Transfers.
	Changes Compared to the No-Action Alternative
4	Annual Central Valley losses of 0.20 percent in output, 0.15 percent in personal income, and 0.18 percent in jobs. Adverse impacts concentrated in CVP water service areas. Impacts from land fallowing due to (b)(3) water acquisition are somewhat offset by revenue from water sold. Adverse impacts are partially offset by additional economic activity during the period of construction of restoration actions.
	Changes Compared to Alternative 4
4a	See summary of impacts for Alternatives with Water Transfers.

TABLE 51. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	1991 economic data provided as basis for comparison.
Preferred Alternative Changes as compared to Revised No-Action Alternative	Annual Central Valley losses of 0.06 percent in output, 0.05 percent in personal income, and 0.04 percent in jobs.

NO-ACTION ALTERNATIVE

For purposes of impact analysis, the structure of the regional economy in the No-Action Alternative is assumed to be similar to recent economic conditions as described in Chapter III. This assumption avoids speculation about how regional economies may change in the future, and allows an input-output model based on recent conditions to be used to assess alternatives. The PEIS regional economic analysis uses the 1991 IMPLAN database, as described in Chapter III, as a baseline condition for purposes of comparison. It is implicitly assumed that the structure of the California economy and the technical relationships and production processes incorporated into the input-output models will be valid at a 2025 level of development. Given this assumption, any overall growth (or decline) in the regional economy between now and 2025 would not affect the estimates of output, income, or employment changes.

ALTERNATIVE 1

Table IV-52 shows the overall change in employment, output, and place-of-work income for Alternative 1. Alternative 1 would result in the loss of about 2,790 jobs, $183 million in output, and $80 million in place-of-work income statewide. Most of the adverse effect occurs in the San Joaquin River Region, with some offsetting economic stimulus in the Central and South Coast. Results by economic sector are provided in the Regional Economics Technical Appendix. The largest total impacts (sum of direct, indirect, and induced) in California occur in the agricultural sector because of both land fallowing and higher water costs. The next largest impacts would be in the trade sector because of reduced spending by farmers for production inputs and for household items; and lower spending on non-water items by all households that must pay higher water costs.

TABLE IV-52

TOTAL REGIONAL ECONOMIC IMPACTS: CHANGES RELATIVE TO THE NO-ACTION ALTERNATIVE

Region	Alternatives			
	1	2	3	4
	Absolute Change Relative to No-Action			
Sacramento River				
Employment (#)	-260.0	-560.0	-1,310.0	-1,310.0
Output ($MM)	-19.6	-46.3	-111.8	-110.8
Income ($MM)	-9.8	-20.5	-46.7	-46.3
San Joaquin River				
Employment (#)	-2,450.0	-2,999.0	-2,960.0	-3,860.0
Output ($MM)	-166.3	-201.9	-197.7	-257.0
Income ($MM)	-77.5	-89.7	-79.0	-105.4
Tulare Lake				
Employment (#)	-940.0	-870.0	-800.0	-1,100.0
Output ($MM)	-59.6	-55.3	-51.1	-69.4
Income ($MM)	-27.0	-25.0	-22.7	-31.4
Bay Area				
Employment (#)	-100.0	-100.0	-90.0	-100.0
Output ($MM)	-7.4	-7.4	-7.0	-7.4
Income ($MM)	-4.2	-4.2	-4.0	-4.2
South & Central Coast				
Employment (#)	960.0	960.0	3,110.0	-180.0
Output ($MM)	69.6	69.6	225.0	-12.7
Income ($MM)	38.9	38.9	125.9	-7.1
California Total				
Employment (#)	-2,790.0	-3,550.0	-2,060.0	-6,540.0
Output ($MM)	-183.4	-241.3	-142.7	-457.2
Income ($MM)	-79.6	-100.5	-26.5	-194.5

Sacramento River Region

Total direct, indirect, and induced impacts of Alternative 1 include losses of about 260 jobs, $19.6 million in output, and $9.8 million in place-of-work income. The greatest total regional effects on employment, output, and income would be attributable to the direct impacts on agriculture. Alternative 1 results in reduced personal income because of higher water costs, due primarily to the installation of household water meters and Restoration Fund payments.

The largest employment, output, and income impacts would be in services. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Reduced recreation expenditures and higher M&I water costs affect the trade and service sectors as well.

San Joaquin River Region

Total direct, indirect, and induced impacts include losses of about 2,450 jobs, $166.3 million in output, and $77.5 million in place-of-work income compared to the No-Action Alternative. The largest employment impacts would be in agriculture, trade, and services. The largest output impacts would be in agriculture, manufacturing, and finance, insurance, and real estate (FIRE). The largest income impacts would be in FIRE, trade, and services. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the manufacturing, FIRE, and trade and services sectors. Reduced recreation expenditures and higher M&I water costs affect the trade and service sectors as well.

Tulare Lake Region

Total direct regional impacts due to Alternative 1 changes in agriculture include direct losses of about 430 jobs, $30.3 million in output, and $11.3 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 940 jobs, $59.6 million in output, and $27.0 million in place-of-work income.

The largest employment impacts would be in agriculture, trade, and services. The largest output impacts would be in agriculture, trade, and manufacturing. The largest income impacts would be in trade, agriculture, and FIRE. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Other impacts would be attributable primarily to those originating in agriculture.

San Francisco Bay Region

Alternative 1 directly results in reduced personal income of $3.8 million per year in the San Francisco Bay Region because of higher water costs, due primarily to restoration payments. The resultant declines in consumer spending cause direct losses of about 40 jobs, $3.5 million in output, and $1.9 million in place-of-work income. Total impacts include losses of about 100 jobs, $7.4 million in output, and $4.2 million in place-of-work income.

Central and South Coast Region

Alternative 1 directly results in increased direct personal income of $32.8 million per year in the Central and South Coast Region because of reduced water costs resulting from greater deliveries of SWP water for M&I purposes. The resultant increases in consumer spending cause direct gains of about 410 jobs, $30.6 million in output, and $16.3 million in place-of-work income.

Total impacts include gains of about 960 jobs, $69.6 million in output, and $38.9 million in income.

Total Impacts

Total direct impacts across all affected regions in California include losses of about 1,130 jobs, $92.9 million in output, and $31.0 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 2,790 jobs, $183.4 million in output, and $79.6 million in place-of-work income. Total regional job losses due to agricultural impacts include about 2,190 due to fallowed land and 1,280 due to reduced net income. Those losses would be offset in part by the positive effects of increased M&I water deliveries and resultant job gains in the South Coast Region.

ALTERNATIVE 2

Table IV-52 shows the overall change in employment, output, and place-of-work income for Alternative 2. Results by sector are provided in the Regional Economics Technical Appendix.

Sacramento River Region

Total direct impacts of Alternative 2 include losses of about 110 jobs, $18.9 million in output, and $5.5 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 560 jobs, $46.3 million in output, and $20.5 million in place-of-work income. The greatest total regional effects on employment, output, and income would be attributable to the direct impacts on agriculture.

The largest employment impacts would be in agriculture. The largest output impacts would be in manufacturing. The largest income impacts would be in services and FIRE. Reduced rice output and lower net farm income cause reduced output by the rice milling sector and lower demands for production inputs. Reduced recreation expenditures and higher M&I water costs also affect the trade and services sectors.

San Joaquin River Region

Total direct impacts of Alternative 2 include losses of about 1,330 jobs, $94.3 million in output, and $30.9 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 2,990 jobs, $201.9 million in output, and $89.7 million in place-of-work income. The largest employment impacts would be in agriculture, trade, and services. The largest output impacts would be in agriculture, manufacturing, and FIRE. The largest income impacts would be in FIRE, agriculture, and services.

Tulare Lake Region

Total direct impacts of Alternative 2 on the Tulare Lake Region include direct losses of about 390 jobs, $28.0 million in output, and $10.4 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 870 jobs, $55.3 million in output, and $25.0 million in place-of-work income.

The largest employment impacts would be in agriculture, trade, and services. The largest output impacts would be in agriculture, trade, and manufacturing. The largest income impacts would be in trade, agriculture, and FIRE. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Other impacts would be attributable primarily to those originating in agriculture.

San Francisco Bay Region

The impacts would be the same as those for Alternative 1.

Central And South Coast Region

The impacts would be the same as those for Alternative 1.

Total Impacts

The total direct impacts of Alternative 2 across all affected regions in California include losses of about 1,270 jobs, $114.2 million in output, and $32.4 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 3,550 jobs, $241.3 million in output, and $100.5 million in place-of-work income.

ALTERNATIVE 3

Table IV-52 shows the overall change in employment, output, and place-of-work income for Alternative 3. Results by affected economic sector are provided in the Regional Economics Technical Appendix.

Sacramento River Region

Total direct impacts of Alternative 3 include losses of about 170 jobs, $43.0 million in output, and $9.4 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 1,310 jobs, $111.8 million in output, and $46.7 million in place-of-work income.

The largest employment and output impacts would be in agriculture. The largest income impacts would be in FIRE. Reduced rice output and lower net farm income cause reduced output by the rice milling sector and lower demands for production inputs. Reduced recreation expenditures and higher M&I water costs also affect the trade and services sectors.

San Joaquin River Region

Total direct impacts of Alternative 3 include losses of about 290 jobs, $83.6 million in output, and $17.6 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 2,960 jobs, $197.7 million in output, and $79.0 million in place-of-work income.

The largest employment impacts would be in agriculture, services, and trade. The largest output impacts would be a decrease in agriculture, manufacturing, and FIRE. The largest income impacts would be in FIRE, services, and agriculture.

Tulare Lake Region

Total direct impacts of Alternative 3 on the Tulare Lake Region include direct losses of about 350 jobs, $25.6 million in output, and $9.1 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 800 jobs, $51.1 million in output, and $24.7 million in place-of-work income.

The largest employment and output impacts would be in agriculture. The largest income impacts would be in agriculture and trade. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Other impacts would be attributable primarily to those originating in agriculture.

San Francisco Bay Region

Alternative 3 results in reduced direct personal income of $3.6 million per year in the San Francisco Bay Region because of higher water costs. The resultant declines in consumer spending cause direct losses of about 40 jobs, $3.4 million in output, and $1.8 million in place-of-work income. Total impacts include losses of about 90 jobs, $7.0 million in output, and $4.0 million in place-of-work income.

Central and South Coast Region

Alternative 3 results in increased direct personal income of $105.9 million per year in the Central and South Coast Region because of reduced water costs resulting from greater deliveries of SWP water for M&I purposes. The resultant increases in consumer spending cause direct gains of about 1,330 jobs, $98.8 million in output, and $52.9 million in place-of-work income. Total impacts include gains of about 3,110 jobs, $225.0 million in output, and $125.9 million in place-of-work income.

Total Impacts

The total direct impacts of Alternative 3 across all affected regions in California include losses of about 240 jobs and $56.7 million in output, and a gain of $15.0 million in place-of-work income.

Total direct, indirect, and induced impacts include losses of about 2,060 jobs, $142.7 million in output, and $26.5 million in place-of-work income.

The direct income impacts would be positive, while the total income impacts would be negative because of the relative magnitudes of the multipliers for fallowed land, increased water sales, and lower M&I water costs. The multiplier for fallowed land (reduced output) would be 3.6 for the specific combination of crop acres idled under this Alternative. The multiplier for income from reduced M&I water costs would be 2.4, and the multiplier for income from water sales would be 1.8. Therefore, every $1.00 in reduced income from fallowed land causes a $3.60 dollar decline in total regional income across all sectors. Every $1.00 reduction in M&I water costs is assumed to represent an equivalent increase in income, and causes a $2.40 increase in total regional income across all sectors, and every $1.00 in increased income from water sales causes a $1.80 increase in total regional income. As a result, while the direct negative impacts of fallowed land do not outweigh the direct positive impacts of water sales and reduced M&I water costs, the total negative impacts on income from fallowed land more than offset the total positive impacts from water sales and reduced M&I water costs.

ALTERNATIVE 4

Table IV-52 shows the overall change in employment, output, and place-of-work income for Alternative 4. Results by economic sector are provided in the Regional Economics Technical Appendix.

Sacramento River Region

Total direct impacts of Alternative 4 include losses of about 170 jobs, $42.6 million in output, and $9.4 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 1,310 jobs, $110.8 million in output, and $46.3 million in place-of-work income. The largest employment and output impacts would be in agriculture. The largest income impacts would be in FIRE.

San Joaquin River Region

Total direct impacts of Alternative 4 include losses of about 1,340 jobs, $111.0 million in output, and $26.6 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 3,860 jobs, $257.0 million in output, and $105.4 million in place-of-work income.

Tulare Lake Region

Total direct impacts of Alternative 4 on the Tulare Lake Region include direct losses of about 490 jobs, $35.0 million in output, and $13.0 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 1,100 jobs, $69.4 million in output, and $31.4 million in place-of-work income.

The largest employment and output impacts would be in agriculture. The largest income impacts would be in trade. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Other impacts would be attributable primarily to those originating in agriculture.

San Francisco Bay Region

Alternative 4 results in reduced direct personal income of $3.8 million per year in the San Francisco Bay Region because of higher water costs. The resultant declines in consumer spending cause direct losses of about 40 jobs, $3.5 million in output, and $1.9 million in place-of-work income. Total impacts include losses of about 100 jobs, $7.4 million in output, and $4.2 million in place-of-work income.

Central and South Coast Region

Alternative 4 results in reduced direct personal income of $6.0 million per year in the Central and South Coast Region because of higher water costs resulting from reduced deliveries of SWP water for M&I purposes. The resultant declines in consumer spending cause direct losses of about 70 jobs, $5.6 million in output, and $3.0 million in place-of-work income. Total impacts include losses of about 180 jobs, $12.7 million in output, and $7.1 million in place-of-work income.

Total Impacts

The total direct impacts on Alternative 4 across all affected regions in California include losses of about 2,130 jobs, $197.7 million in output, and $53.9 million in place-of-work income. Total direct, indirect, and induced impacts include losses of about 6,540 jobs, $457.2 million in output, and $194.5 million in place-of-work income.

ADDITIONAL IMPACTS DURING THE PERIOD OF CONSTRUCTION

The 2020 analysis of alternatives included the impact of restoration fund payments as reduced agricultural net income and increased M&I water costs. However, the analysis did not include all Restoration Fund expenditures as part of the impact assessment, because much of this is spent on construction activities that will be complete by 2020. The expenditure of Restoration Funds may offset some of the adverse regional effects of restoration fund payments. Estimated capital, operating and maintenance costs of CVPIA-mandated actions were developed and used to estimate construction-related regional economic impacts.

In the Sacramento Valley, total direct and indirect increases in employment, output and income caused by Restoration Fund expenditure would be 1,530 jobs, $101 million, and $30 million, respectively. Alternatives 1 and 2 would result in a net increase in employment, output and income in the Sacramento Valley during the period of construction. In Alternatives 3 and 4, employment would increase and output and income decrease by very small amounts relative to the size of the regional economy.

In the San Joaquin Valley, Restoration Fund expenditure would result in 690 jobs, $45 million in output, and $13 million of place-of-work income. These amounts are much smaller than the negative effects, so overall effects on employment, output and income remain negative.
In California as a whole, results are adjusted for the $15.0 million state contribution included in the $67.0 million total. The $15.0 million would have no net impact on the state economy because it would induce a reduction in final demand elsewhere in the state. Therefore, the statewide gain of 1,730 jobs, $113 million in output and $33 million in income is less than the sum of these impacts for the Sacramento Valley and San Joaquin Valley. Even with the restoration fund expenditure included, overall impacts of the alternatives on the state economy remain negative.

MUNICIPAL AND INDUSTRIAL WATER USE AND COSTS

The implementation of CVPIA actions, as considered in the PEIS alternatives, could result in changes in municipal water costs due to changes in the availability of CVP and SWP water and, for CVP water service contractors, other costs induced by the CVPIA. The main alternatives considered in the PEIS do not include water transfers from or within the Central Valley as a means to obtain replacement water supplies for municipal and industrial (M&I) use. To evaluate the potential effects of water transfers on municipal water costs, supplemental analyses were conducted. Results of the supplemental analyses are expressed as the difference between the results with transfers and results without transfers. In this manner, the supplemental analysis shows the effect of water transfers on M&I water costs and use for one alternative. Assumptions associated with alternatives are summarized in Table IV-53.

The analysis includes ten groups of M&I providers aggregated into four regions: the Sacramento Valley, the San Joaquin Valley, the San Francisco Bay Area, and the Central and South Coast. The Central and South Coast region, which includes the Los Angeles and San Diego metropolitan areas, is approximately twice as large in terms of water demand as the other three regions combined. All of the regions, except the Central and South Coast, include M&I users that obtain some CVP contract supplies. All of the regions, except the Sacramento Valley, include M&I users that obtain some SWP supplies, which can also be affected by CVPIA alternatives. All regions obtain some M&I water supplies from other sources that are not expected to be affected by the implementation of CVPIA, and are therefore excluded from this analysis.

The estimated reductions or increases in M&I water costs are relatively small as compared to the entire M&I water economy of each region. However, some water providers within three of the four regions (all but the Central and South Coast) are entirely dependent on CVP contract supplies. Two relatively large CVP M&I contractors have been identified with the potential need to implement water meter retrofits under the CVPIA water measurement requirements. Customers of these water providers could experience relatively large cost increases as a result ofimplementation of CVPIA provisions. Results for alternatives with and without water transfers are summarized in Tables IV-54 and IV-55.

TABLE IV-53

SUMMARY OF ASSUMPTIONS FOR MUNICIPAL WATER COSTS

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
Assumptions Common to All Alternatives and Supplemental Analyses	
	For each alternative or analysis, CVP and SWP water deliveries are estimates from the corresponding Surface Water and Facilities Operations analysis. Urban water demand levels are similar to those presented in the California Department of Water Resources Bulletin 160-93 for year 2025 with Level 1 conservation, except that additional conservation may be induced by increased price if supplies must be developed to balance demand and supply. Mandatory conservation in dry years considers demand hardening due to Level 1 conservation, and providers develop supplies to eliminate any remaining shortage. In the long run, demand must equal supply and revenue must equal cost. In dry years, additional shortage eliminated with more conservation up to maximum, then additional supplies are developed.
No-Action Alternative	Common assumptions only.
1	Restoration payments and conservation costs resulting from CVPIA are imposed and affect retail water price and demand.
1a	Assumptions are the same as Alternative 1.
1b	Assumptions are the same as Alternative 1.
1c	Assumptions are the same as Alternative 1, except that CVP water prices begin at the full cost rates for the first 80 percent of contract total, with delivery between 80 and 90 percent priced at 110 percent of full-cost rates, and deliveries more than 90 percent priced at 120 percent of full-cost rates.
1d	Assumptions are the same as Alternative 1.
1e	Same as Alternative 1 except water transfers are allowed to replace new developed supplies. Transfers of CVP water service and exchange contract water are allowed, subject to the charges and conditions specified in CVPIA. Water transfers to South Coast are limited to 100,000 AF in average years and 400,000 AF in dry years.
1f	Same assumptions as Supplemental Analysis 1e, except an additional $50 per acre-foot fee is charged to any CVP water transferred.
1g	Assumptions are the same as Alternative 1.
1h	Assumptions are the same as Alternative 1.
1i	Assumptions are the same as Alternative 1.
2	Assumptions are the same as Alternative 1.
2a	Assumptions are the same as Alternative 1.
2b	Assumptions are the same as Supplemental Analysis 1e.
2c	Assumptions are the same as Supplemental Analysis 1f.

TABLE IV-53. CONTINUED

Alternative or Supplemental Analysis	Assumptions Specific to the Alternative or Supplemental Analysis
2d	Assumptions are the same as Supplemental Analysis 1c.
3	Assumptions are the same as Alternative 1.
3a	Assumptions are the same as Supplemental Analysis 1e.
4	Assumptions are the same as Alternative 1.
4a	Assumptions are the same as Supplemental Analysis 1e.
Revised No-Action Alternative	Assumptions are the same as No-Action Alternative.
Preferred Alternative	Assumptions are the same as Alternative 1.

TABLE IV-54

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITHOUT WATER TRANSFERS: MUNICIPAL WATER COSTS

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Similar to DWR Bulletin 160-93, plus South Coast would develop supplies and increase price to meet 2025 average demand. All municipal water use regions would impose conservation and develop supplies in dry years.
	Changes Compared to the No-Action Alternative
1	CVP M&I water supplies are reduced, and restoration payments ($6.4 million on average) and conservation costs increase price and reduce water use. Most of the impact is on CVP contractors with no other supplies. Increased SWP supplies reduce water costs and retail price. Most benefit is in the Central and South Coast Region.
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1.
1b	Conditions are similar to Alternative 1.
1c	Conditions are similar to Alternative 1, except that M&I payments into the Restoration Fund are increased to $11.5 million annually.
1d	Conditions are similar to Alternative 1.
1e	See summary of impacts of Alternatives with Water Transfers.
1f	See summary of impacts of Alternatives with Water Transfers.
1g	Conditions are similar to Alternative 1.

TABLE IV-54. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
1h	Conditions are similar to Alternative 1.
1i	Conditions are similar to Alternative 1.
	Changes Compared to the No-Action Alternative
2	Same as Alternative 1.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 1.
2b	See summary of impacts for Alternatives with Water Transfers.
2c	See summary of impacts for Alternatives with Water Transfers.
2d	Changes are similar to those described under Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Similar to Alternative 1, except SWP supplies increase.
	Changes Compared to Alternative 3
3a	See summary of impacts for Alternatives with Water Transfers.
	Changes Compared to the No-Action Alternative
4	Similar to Alternative 1, except SWP supplies are similar to No-Action Alternative. Some additional shortages are imposed on CVP municipal users.
	Changes Compared to Alternative 4
4a	See summary of impacts for Alternatives with Water Transfers.
Revised No-Action Alternative	Same as No-Action Alternative.
Preferred Alternative Changes as compared to No-Action Alternative	CVP M&I water supplies are reduced and restoration payments and conservation costs increase price and reduce water use. Most of the impact is on CVP contractors with no other supplies. Decreased SWP supplies in the average period increase water costs and retail price. Increased SWP supplies in the dry period decrease water costs and retail price. The regions affected are primarily the Central and South Coast regions.

ALTERNATIVE 1

In the Sacramento Valley, M&I water supplies would be reduced by about 3,000 acre-feet on average and 1,500 acre-feet in the dry condition, as compared to the No-Action Alternative. Annual costs of M&I water, due to the imposition of CVPIA provisions, would be $4.9 million in the average condition and $2.8 million annually in the dry condition, as shown in Table IV-56. These increase in costs would result primarily from restoration payments and implementation of metering requirements.

TABLE IV-55

SUMMARY OF IMPACT ASSESSMENT FOR ALTERNATIVES WITH WATER TRANSFERS: MUNICIPAL WATER COSTS

Alternative or Supplemental Analysis	Impact Assessment
Base Transfer Scenario	M&I users in the Sacramento Valley and San Joaquin regions do not participate in water transfer markets. The San Francisco Bay Area purchases very little water in the average condition, but about 160,000 acre-feet are purchased in a dry year at a cost of $90 million delivered to retail users. In the Central and South Coast, 105,000 acre-feet are purchased in the average condition at a cost of $39 million delivered, and 363,000 acre-feet are purchased in the dry condition at a cost of $209 million delivered.
	Changes Compared to the Base Transfer Scenario
1e	In an average year, results are similar to the Base Transfer Scenario. The Central and South Coast purchases about the same amount of water, but $1 million is saved due to lower water transfer prices. In a dry year, the San Francisco Bay Area purchases about 180,000 acre-feet transfers worth roughly $30 million annually in net cost savings as compared to the Base Transfer analysis. The Central and South Coast Region purchases about the same as in the Base Transfer Scenario, but lower transfer prices are worth $37 million in cost savings.
1f	Quantities purchased would be similar to Supplemental Analysis 1e, but almost no CVP water would be purchased and costs would be higher due to the additional fee imposed on CVP water transferred.
2b	Changes are similar to those described under Supplemental Analysis 1e, except that average condition transfers to the Central and South Coast cost about $2 million more than in the Base Transfer Scenario. The San Francisco Bay Area purchases about 180,000 acre feet in the dry condition. These transfers are worth about $30 million annually as compared to the Base Transfer Scenario. In the Central and South Coast, dry year transfers are worth $28 million in cost savings in comparison to the Base Transfer Scenario.
2c	Changes are similar to those described under Supplemental Analysis 1f.
3a	Changes are similar to those described under Supplemental Analysis 1e, except that the San Francisco Bay Area purchases about 160,000 acre feet in the dry condition. These transfers are worth about $18 million annually as compared to the Base Transfer analysis. In the Central and South Coast, dry year transfers are worth $22 million in cost savings in comparison to the Base Transfer Scenario.
4a	Changes are similar to those described under Supplemental Analysis 1e, except that average condition transfers to the Central and South Coast cost about $2 million more than in the Base Transfer Scenario. The San Francisco Bay Area purchases about 190,000 acre-feet in the dry condition. These transfers are worth about $20 million annually as compared to the Base Transfer analysis. In the Central and South Coast, dry year transfers are worth $16 million in cost savings in comparison to the Base Transfer Scenario.
Revised Base Transfer Scenario	Similar to Base Transfer Scenario.
Preferred Alternative	Similar to Supplemental Analysis 1e.

TABLE IV-56

SUMMARY OF M&I WATER USE AND ECONOMICS ANALYSIS COMPARISON OF CVPIA PEIS ALTERNATIVES

		Change from the No-Action Alternative			
Result	**No-Action Alternative**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Average Condition Supplies, 1,000 acre-feet (1)					
Sacramento Valley	933	-8	-8	-8	-8
Bay Area	1,025	-2	-2	-1	-2
San Joaquin Valley	708	-7	-7	-6	-8
Central and South Coast	5,797	20	20	64	-4
Average Condition Economic Costs, Million $ (2)					
Sacramento Valley		4.9	4.9	4.9	4.9
Bay Area		4.9	4.9	4.7	4.9
San Joaquin Valley		4.4	4.4	3.2	5.0
Central and South Coast		-32.9	-32.9	-105.6	6.1
Dry Condition Supplies, 1,000 acre-feet (3)					
Sacramento Valley	992	-1.5	-1.5	-1.5	-1.5
Bay Area	886	1.6	1.6	21.7	-7.5
San Joaquin Valley	663	3.9	3.9	12.9	-1.1
Central and South Coast	4,890	89.9	89.9	215.7	0.0
Annual Cost of Dry Condition, Million $ (4)					
Sacramento Valley	3.1	2.8	2.8	2.8	2.8
Bay Area	177.7	0.3	0.3	-19.3	9.5
San Joaquin Valley	8.8	4.9	4.9	4.5	5.1
Central and South Coast	823.1	-67.3	-67.3	-119.9	-8.0

Notes:
Water transfers not considered as replacement supplies in this comparison.
(1) After purchase or development of non-transfer replacement supplies to make supply equal demand.
(2) Total costs include replacement supplies, Restoration Fund payments, and metering. A negative cost means a net gain is estimated.
(3) Before development of any replacement supplies. A positive means the Alternative provides more water supply than the No-Action Alternative. Dry condition results do not include supply changes from the average condition.
(4) The annual cost of shortage following the average condition.

The Bay Area receives M&I water from both CVP and SWP supplies. Under Alternative 1, average CVP contract supplies would decrease and SWP supplies would increase, for a net decrease of 6,000 acre-feet. Because most water users in the region are projected to have excess supplies in average years, this relatively small change in water supplies would have little economic effect. Annual costs to the San Francisco Bay Area M&I water supplies associated with restoration payments and net supply reductions to CVP contractors would total approximately $4.9 million in average conditions. These costs would be passed on to water customers in the form of higher retail water prices. Under dry conditions, M&I supplies to the Bay Area would increase slightly (1,600 acre-feet), due to the interaction between lower CVP and higher SWP supplies, and would partially offsets costs of restoration payments. Net annual dry condition costs are estimated at $0.3 million.

San Joaquin Valley providers also obtain both CVP and SWP supplies, and results also reflect a mixture of gains and losses. The region obtains about 1,000 acre-feet more supplies, on average, in Alternative 1. The costs of these supplies are similar to the costs of make-up supplies (groundwater), but CVP contractors would pay more in the form of metering and restoration payments. CVPIA costs amount to $4.4 million annually, and costs during the dry condition amount to $4.9 million annually.

Municipal water costs in the Central and South Coast region would be affected only through changes in SWP supplies. Hydrologic analysis and operational assumptions that allow the SWP to export a share of increased Delta inflows suggest that this region gains water supply in Alternative 1. Because this region is projected to be in a substantial average condition supply deficit by the year 2020, additional SWP supplies of 51,000 acre-feet would be valuable in terms of cost avoided. The result is an average annual benefit of $32.9 million. During dry conditions, larger supply increases (89,900 acre-feet) are obtained, and annual economic benefits amount to $67.3 million.

ALTERNATIVE 2

Estimates of municipal water costs are identical to those described under Alternative 1.

ALTERNATIVE 3

Results for the Sacramento Valley are nearly identical to results for Alternatives 1 and 2, so they are not repeated here.

The San Francisco Bay Area would obtain more water supplies (10,000 acre-feet) in the average condition relative to the No-Action Alternative, but the region is already estimated to be in a supply surplus. The region would pay a cost associated with restoration payments and supply reductions to CVP contractors amounting to $4.7 million per year in the average condition. The region would obtain more water (21,700 acre-feet) in the Alternative 3 dry condition, which creates a benefit of $19.3 million annually during this dry period.

Compared to the No-Action Alternative, the San Joaquin Valley would also obtain more water supplies on average, but these supplies are worth little in comparison to the costs of other supplies. The region would pay a net cost of $3.2 million annually, which consists mostly of metering costs and restoration payments. Costs during the dry condition are estimated to be $4.5 million.

In the Central and South Coast, additional SWP supplies of 168,000 acre-feet in the average condition are quite valuable in terms of costs avoided, resulting in an annual average benefit of $106 million. The supply increase in the average condition would allow retail water price to be kept lower, causing demand to be higher going into the drought and reducing the economic value of any supply increase in the dry condition. An even larger SWP supply increase (216,000 acre-feet) would occur in the dry condition, but the effective supply increase is only 112,000 acre-feet because 104,000 acre-feet are needed to serve the increased demand from the average condition. Annual economic benefits amount to $120 million in the dry condition.

ALTERNATIVE 4

Results for the Sacramento Valley are nearly identical to results for Alternatives 1, so they are not repeated.

In the San Francisco Bay Area, 13,000 acre-feet less supply is available in an average supply condition, but the region is already estimated to be in a supply surplus. The region would pay costs associated with restoration payments and supply reductions amounting to $4.9 million per year in the average condition. The region would obtain less supply in the dry condition (7,500 acre-feet), which is associated with an annual cost of $9.5 million relative to the No-Action Alternative.

As compared to the No-Action Alternative, the San Joaquin Valley would obtain less water supplies on average, but these supplies are worth little in comparison to the costs of other supplies. The region would pay a net cost of $5.0 million annually consisting mostly of metering and restoration payments. Costs during the dry condition are estimated to be $5.1 million.

Average condition supplies for the Central and South Coast in Alternative 4 would be 9,000 acre-feet less than under the No-Action Alternative, and economic costs associated with this supply reduction are estimated to be $6.1 million. In the dry condition there would be no change in supplies, but demand reduction from the average condition would result in a dry condition benefit of $8.0 million annually.

ALTERNATIVES WITH WATER TRANSFERS

Supplemental Analysis 1e

The supplemental analysis of municipal water costs with water transfers allowed assumes that M&I providers could buy consumptive use and non-recoverable losses from willing agricultural sellers. In the Base Transfer Scenario, transfers of CVP water service contract water and San Joaquin River exchange water are not allowed. In this supplemental analysis, all Alternative 1 assumptions are in effect. In addition, M&I providers could transfer from CVP water service and exchange contractors as well as the non-CVP sellers allowed in the Base Transfer Scenario.

The analysis finds that M&I users in the Sacramento Valley and San Joaquin regions would not participate in water transfer markets because supplies available under Alternative 1 would be generally adequate to meet demands, and groundwater is less expensive than water transfers as a replacement supply.

M&I providers in the San Francisco Bay Area would purchase little water under average hydrologic conditions, but they would purchase up to 181,000 acre-feet under the dry condition. These transfers would provide a cost savings of roughly $30 million annually as compared to the cost of acquiring transfers and other replacement supplies under the Base Transfer Scenario. These cost savings would occur largely because the transferred water under this supplemental analysis would be up to $139 per acre-foot less than transferred water from non-CVP sources, and some of the costs of other, more expensive replacement supplies would be avoided.

For all water transfer analyses, it is assumed that no more than 100,000 acre-feet of Central Valley water would be transferred to the South Coast in the average condition. Much of the average condition value of transfers is obtained in the Base Transfer Scenario where water can be bought from non-CVP sellers. In the Base Transfer Scenario, cost savings of up to $55 million would be realized in comparison to the No-Action Alternative. The changes of Supplemental Analysis 1e would have little additional effect on the value of average condition transfers, resulting in only $1 million of additional cost savings annually. In this situation, CVPIA water transfer provisions have little effect on the source or price of water transfers.

Under the dry condition, only half of the average condition transfer is assumed to be available, and the Central and South Coast region would purchase about 363,100 acre-feet of additional water from Central Valley agricultural sellers. The addition of CVPIA water transfer provisions in Supplemental Analysis 1e would result in approximately $37 million of cost savings during the dry condition, in comparison to the Base Transfer Scenario.

Supplemental Analysis 2b

The assumptions for a supplemental analysis of the effects of water transfers from CVP water users to M&I water providers under Supplemental Analysis 2b are the same as those described under Supplemental Analysis 1e. The results of the transfer analysis under Supplemental Analysis 2b, however, are slightly different from those under Supplemental Analysis 1e because of the effects of the water acquisition program. Similar to conditions under Supplemental Analysis 1e, Supplemental Analysis 2b finds that M&I users in the Sacramento Valley and San Joaquin regions would not participate in water transfer markets because supplies are generally adequate to meet demands and groundwater is less expensive than water transfers as a replacement supply.

M&I providers in the San Francisco Bay Area would purchase little water under average hydrologic conditions, but up to 181,000 acre-feet would be purchased under the dry condition. These transfers would provide a cost savings of roughly $28 million annually as compared to the cost of obtaining transfers and other replacement supplies under the Base Transfer Scenario. These savings would occur largely because the transferred water under Supplemental Analysis 2b would cost up to $124 per acre-foot less than transferred water from non-CVP sources, and some of the costs of other, more expensive replacement supplies would be avoided.

Again, it is assumed that no more than 100,000 acre-feet of Central Valley water would be transferred to the South Coast in the average condition. Much of the average condition value of transfers is obtained in the Base Transfer Scenario where water can be bought from non-CVP sellers. Supplemental Analysis 2b would have little effect on the value of average condition transfers, resulting in an additional $1.8 million in annual cost savings.

Under the dry condition, only half of the average condition transfer is assumed to be available, and the Central and South Coast Regions would again purchase about 363,100 acre-feet more water from Central Valley agricultural sellers. The addition of CVPIA water transfer provisions in Supplmental Analysis 2b would result in approximately $28 million of cost savings in comparison to the Base Transfer Scenario. The difference between cost savings from water transfers under Supplemental Analyses 1e ($37 million) and 2b ($28 million) is due to water price changes induced by water acquisition for fish and wildlife in Supplemental Analysis 2b.

Supplemental Analysis 3a

Supplemental Analysis 3a finds that M&I users in the Sacramento Valley and San Joaquin regions do not participate in water transfer markets. The Bay Area purchases little water in the average hydrologic condition, but 162,000 acre-feet are purchased in the dry condition. These transfers are worth about $18 million annually as compared to the Base Transfer Scenario, largely because the region pays less for transfers ($102 per acre-foot less).

In the Central and South Coast region, 102,000 acre-feet are bought in the average condition. Supplemental Analysis 3a is worth only $0.2 million annually in cost savings, relative to the Base Transfer Analysis. In the dry condition 360,000 acre-feet of transfers are worth $22 million in cost savings in comparison to the Base Transfer Scenario.

Supplemental Analysis 4a

Again, Supplemental Analysis 4a finds that M&I users in the Sacramento Valley and San Joaquin regions do not participate in water transfer markets.

The San Francisco Bay Area purchases little water in the average hydrologic condition, but 190,000 acre-feet are purchased in the dry condition. These transfers are worth about $20 million annually as compared to the Base Transfer Scenario, largely because the region pays less for transfers ($82 per acre foot less) and $15.5 million of costs of other make-up supplies are avoided.

In the Central and South Coast region, 105,000 acre-feet are bought in the average condition. These transfers cost $2.6 million more than in the Base Transfer Analysis because the price is about $25 per acre-foot higher. In the dry condition 363,000 acre-feet of transfers are worth $16 million in cost savings in comparison to the Base Transfer Analysis.

THE DELTA AS A SOURCE OF DRINKING WATER

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, water quality conditions in the Delta would be governed by the Bay-Delta Plan Accord and D-1422. In general, salinity concentrations would be reduced in some months as compared to recent Delta conditions described in the Affected Environment, particularly during dry years. Agricultural return flow quantities would not change significantly from conditions described in the Affected Environment. However, agricultural return flow quality would improve by the year 2025, due to the recent or pending implementation of more stringent water quality requirements for point and non-point discharges. Also in the No-Action Alternative, the operations of New Melones Reservoir would attempt to meet all requirements of D-1422 provisions before releases would be made for other purposes.

ALTERNATIVE 1

Under Alternative 1, inflow to the Delta from the Sacramento River system would be slightly less than under the No-Action Alternative, primarily as a result of reduced diversions from the Trinity River Basin. Delta exports would be reduced in February through September due to reduced Trinity diversions and (b)(2) Water Management. The overall change in Delta outflow would be relatively small under Alternative 1 as compared to the No-Action Alternative. As a result of the operations under Alternative 1, salinity in the Delta at Collinsville would be similar to conditions under the No-Action Alternative, except for a slight increase in September due to reduced Sacramento River inflows.

During some dry years, salinity in the San Joaquin River at Vernalis would increase, as compared to concentrations under the No-Action Alternative. This would occur due to increased deliveries to and return flows from the San Luis Complex refuges. In addition, the management of (b)(2) water on the Stanislaus River would lower storage conditions in New Melones Reservoir, and would result in the imposition of the maximum water quality release threshold more frequently. During those years, less water would be released for water quality maintenance at Vernalis than under the No-Action Alternative, and the salinity concentration would be higher.

ALTERNATIVE 2

Under Alternative 2, inflow to the Delta from the Sacramento River system would be similar to conditions under Alternative 1, and would be slightly less than under the No-Action Alternative. Total irrigated acreage upstream of the Delta (including the San Joaquin River, Tulare Lake, and Sacramento River regions) would be reduced by less than 2 percent under this alternative as compared to the No-Action Alternative. Most of this change would be related to reductions in acreage of pasture and hay, rice, cotton, and other field crops such as sugar beets. This reduction in irrigated acreage would result in reduced return flows, which could reduce concentrations of DBP precursors.

The delivery of Level 4 water supplies to wildlife refuges would increase the return flows from the San Luis Complex refuges as compared to the No-Action Alternative and Alternative 1, particularly in the early spring. The release of up to 170,000 acre-feet of acquired water on the Merced, Tuolumne, and Stanislaus rivers (combined) for instream flows and Delta outflow, however, would increase instream flows on these rivers and on the San Joaquin River. This increased flow would result in lower salinity concentrations on the San Joaquin River at Vernalis, and a slight increase in Delta inflow.

As a result of the operations under Alternative 2, salinity in the Delta at Collinsville would be similar to conditions under the No-Action Alternative, except for a slight increase in September due to reduced Sacramento River inflows. Therefore, based upon the minor changes in Delta inflows and salinity, and minor reductions in irrigated acres and associated return flows, Delta water quality for drinking water uses would be similar or slightly improved in Alternative 2 as compared to the No-Action Alternative.

ALTERNATIVE 3

Under Alternative 3, inflow to the Delta from the Sacramento River system would be similar to conditions under Alternative 1, and would be slightly less than under the No-Action Alternative. Total irrigated acreage upstream of the Delta (including the San Joaquin River, Tulare Lake, and Sacramento River regions) would be reduced by less than 4 percent under this alternative as compared to the No-Action Alternative. Most of this change would be related to reductions in acreage of pasture and hay, rice, cotton, and other field crops such as sugar beets. This reduction in irrigated acreage would result in reduced return flows, which could reduce concentrations of DBP precursors.

The delivery of Level 4 water supplies to wildlife refuges would increase the return flows from the San Luis Complex refuges as compared to the No-Action Alternative and Alternative 1, particularly in the early spring. The release of up to nearly 800,000 acre-feet of acquired water on the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Yuba rivers (combined) for instream flows, however, would increase instream flows on these rivers and on the San Joaquin River. This increased flow would result in lower salinity concentrations on the San Joaquin River at Vernalis, and an increase in Delta inflow by about 400,000 acre-feet on an average annual basis.

Under Alternative 3, acquired water may be exported by CVP and SWP facilities during times when the Delta is in an excess condition. As a result, the net change in Delta outflow under Alternative 3, as compared to the No-Action Alternative, would be an increase of approximately 200,000 acre-feet on an average annual basis. Therefore, based upon the changes in Delta inflows and salinity, minor reductions in irrigated acres and associated return flows, and increased Delta outflow, it is anticipated that Delta water quality for drinking water uses would be similar or slightly improved in Alternative 3 as compared to the No-Action Alternative.

ALTERNATIVE 4

Alternative 4 includes the same water management and water acquisition actions as those described under Alternative 3. Therefore, Delta inflow from all sources would be similar to conditions described under Alterative 3. However, under Alternative 4, the CVP and SWP would not be allowed to export acquired water. As a result of this operation, Delta outflow under Alternative 4 would be approximately 700,000 acre-feet greater than under the No-Action Alternative, on an average annual basis.

Therefore, based upon the increase in Delta inflows, and minor reductions in irrigated acres and associated return flows, Delta water quality for drinking water uses would be similar or slightly improved under Alternative 4 as compared to the No-Action Alternative.

MOSQUITOS

As compared to the No-Action Alternative, the alternatives considered in the PEIS could result in changes in the location and area of mosquito breeding habitats. The incidence of mosquito breeding habitat is highly dependent on local conditions not considered in the programmatic nature of the PEIS analyses. Existing local vector abatement programs are authorized to adapt to changing local mosquito breeding conditions in order to protect public health. Therefore, no changes in public health risks would result from the implementation of the alternatives. However, because of the potential effect on local conditions, changes in local mosquito breeding conditions and funding sources for abatement will be evaluated as part of site-specific environmental documentation and potential mitigation measures.

SOCIAL CONDITIONS

The PEIS alternatives have the potential to affect several social groups. The social groups identified for this analysis are farmers, farm workers and agribusiness workers, commercial fishermen and fishing businesses, recreationists and recreation workers, and Native American tribes. The alternatives evaluation for the social analysis is based on the regional economics analysis and projected changes to regional employment. These findings have been applied to the analysis for the identified social groups. Assumptions associated with the alternatives are summarized in Table IV-57.

Results of the impact analyses for the alternatives are summarized in Table IV-58.

TABLE IV-57

SUMMARY OF ASSUMPTIONS FOR SOCIAL CONDITIONS

Assumptions Common to All Alternatives or Supplemental Analyses
Social analyses based on information estimated in the corresponding analyses for Agricultural Economics and Land Use, Regional Economics, and M&I Land Use and Demographics.

TABLE IV-58

SUMMARY OF IMPACT ASSESSMENT FOR SOCIAL CONDITIONS

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Population would continue to increase in most regions.
	Changes Compared to the No-Action Alternative
1	Annual Central Valley losses of 0.11 percent in output, 0.09 percent in personal income, and 0.1 percent in jobs. Primary loss in San Joaquin River Region (2,400 jobs) primarily in agriculture. May have minimal impact if uniformly distributed. May have significant impact if all near one community.
	Changes Compared to Alternative 1
1a	Conditions are similar to Alternative 1.
1b	Conditions are similar to Alternative 1.
1c	Large additional losses of jobs and income in the Sacramento River Region due to land out of production.
1d	Conditions are similar to Alternative 1.
1e	Average conditions are similar to Alternative 1.
1f	Average conditions are similar to Alternative 1.
1g	Conditions are similar to Alternative 1.
1h	Conditions are similar to Alternative 1.
1i	Conditions are similar to Alternative 1.
	Changes Compared to the No-Action Alternative
2	Annual Central Valley losses of 0.14 percent in output, 0.11 percent in personal income, and 0.13 percent in jobs, mostly in the San Joaquin River Region. Increases in recreation jobs.
	Changes Compared to Alternative 2
2a	Conditions are similar to Alternative 2.
2b	Average conditions are similar to Alternative 2.
2c	Average conditions are similar to Alternative 2.
2d	Changes are similar to those described under Supplemental Analysis 1c.
	Changes Compared to the No-Action Alternative
3	Annual Central Valley losses of 0.16 percent in output, 0.12 percent in personal income, and 0.15 percent in jobs. Job gains in municipal areas with increased water supplies. Significant job losses in the San Joaquin River Region (3,000 jobs).
	Changes Compared to Alternative 3
3a	Average conditions are similar to Alternative 3.
	Changes Compared to the No-Action Alternative
4	Annual Central Valley losses of 0.20 percent in output, 0.15 percent in personal income, and 0.18 percent in jobs. Job losses primarily in the San Joaquin River Basin (3,800 jobs) and municipal areas.

TABLE IV-58. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
	Changes Compared to Alternative 4
4a	Average conditions are similar to Alternative 4.
Revised No-Action Alternative Note: The Revised No-Action Alternative is only used to determine changes resulting in implementing the Preferred Alternative.	Jobs in municipalities would increase with population projections. Agricultural jobs would remain predominantly seasonal and may increase. Demand for social services could increase due to the reduced reliability of CVP water supplies.
Preferred Alternative Changes as compared to Revised No-Action Alternative	Annual Central Valley losses of 0.06 percent in output, 0.05 percent in personal income, and 0.04 percent in jobs. Primary loss in San Joaquin River Region (1,180 jobs) due to changes primarily in agriculture. Larger impacts will occur in the San Joaquin River Region as compared to the Sacramento River Region. May have minimal impact if uniformly distributed. May have significant impact if all near one community. These impacts may result in the need for evaluation under Environmental Justice provisions within future site-specific NEPA documentation.

NO-ACTION ALTERNATIVE

The demand for social services within each region is expected to remain constant or to increase and would depend on the characteristics of the local area affected. This assumption is based on population projections for the Central Valley and the projected changes in social make-up. The total population for the San Joaquin Valley is expected to continue to increase and a larger percentage of the population would be children. This change would be translated into an overall decrease in per capita income, because children do not earn income but are included in the total population when calculating per capita income.

The number of agricultural jobs available may increase in some areas due to projected changes in crop production to higher value and the introduction of more labor-intensive crops. However, improvements in mechanization for picking and sorting crops and other improvements could eliminate some tasks that are currently labor-intensive. Changes in irrigation technology also may occur that could change farm labor needs. Changes to the population, crop production, and technology resulting in a decrease in employment opportunities or the duration of seasonal employment may create an increased need for social services to provide food, health care, and housing for those facing economic hardship. These needs may be seasonal or could be year-around depending on the extent of the change and the education, training, and technical skills of the population in the area affected.

The demand for social services by less technically skilled workers, particularly unemployment insurance and food and welfare programs, may increase as the demand for such workers diminishes. Less technically skilled workers and those lacking basic education levels and English language skills may find employment more difficult. While seasonal employment may be available, the opportunity to receive income from year-around employment may become more difficult.

ALTERNATIVE 1

Implementation of the actions proposed for each alternative, as compared to No-Action Alternative, with regard to employment is shown on Table IV-59. In the Sacramento River Region the total number of jobs lost includes approximately 160 jobs due to changes in the agricultural sector and 20 jobs gained due to increases in the recreation sector. In the San Joaquin River Region, approximately 2,400 jobs would be lost from the agricultural sector and 10 would be gained from changes in the recreation sector. The Tulare Lake Region would experience losses approaching 940 jobs, of which all would be within the agricultural sector. These losses represent less than one percent reduction in agricultural jobs for each region. The projected reduction in agricultural jobs includes not only direct farm labor inputs but also related and secondary declines in manufacturing, service, construction, and retail employment opportunities throughout the region.

TABLE IV-59

CHANGES IN REGIONAL EMPLOYMENT

Region	No-Action Alternative (1)	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River	1,297,260	-260	-560	-1,310	-1,310
San Joaquin River	890,220	-2,450	-2,990	-2,960	-3,860
Tulare Lake	468,700	-940	-870	-800	1,100
San Francisco Bay	3,129,540	-100	-100	-90	-100
South and Central Coast	9,603,010	960	960	3,110	-180
Total	15,388,730	-2,790	-3,550	-2,060	-6,540

SOURCE:
(1) Regional Economic Analysis Baseline Data, 1991.

In the Sacramento Valley job losses in the agricultural sector would be limited to the west side. Recreation employment losses would occur at CVP reservoir facilities and could affect sport fishing and river recreation activities.

In the San Joaquin River and Tulare Lake regions agriculture job losses would occur mainly on the west side due to reductions in irrigated agricultural acreage. This would affect the areas near the communities of Mendota, Firebaugh, Huron, and Coalinga the greatest. Because these areas already are experiencing high levels of unemployment and the labor force is primarily farm workers, the social and economic structure of these communities could be affected further when compared to No-Action Alternative. Examples may include higher demand for social services, loss of community-specific fire and police protection services in favor of less expensive area-wide services merged with one or more other communities, increased crime such as shoplifting, and loss of local small businesses such that customers may have to travel further to purchase supplies.

There would be no other adverse impacts resulting from job losses in other regions, except the San Francisco Bay Region, where a loss of less than 100 jobs could occur due to increased water costs. Given the size of the employment base for the region, employment losses would not increase the need for social services.

In the South Coast and Central Coast regions, jobs would increase due to increased water availability. While this would be a benefit to the regions, the changes would be very small, given the size and large population of the affected areas.

In discussions with the staff of agencies providing social services in all regions, the primary concern was the need for increased social services to accommodate the loss of jobs in the agricultural sector. The Sacramento River Region also is affected by the timber industry and any losses that may occur in this industry, although unaffected by the CVPIA, would stretch the need for social services. For example, when labor reductions in the timber industry occurred following listing of the spotted owl, there were significant increases in the demand for social services—primarily unemployment assistance, medical assistance, and food stamps.

In the San Joaquin River and Tulare Lake Regions the principal concern of social service agencies was the potential for job losses to those with limited skills, such as field laborers. However, because no changes are anticipated to labor-intensive farm production under this alternative, the need to provide additional services for these persons is not expected to occur. Rather job losses would most likely be for farm managers and skilled irrigation technicians or machine operators. According to those interviewed involved in farming operations there is a demand for persons with these higher skill levels. It is anticipated that displaced farm managers and technicians could find work in other regions or other jobs related to agriculture. While there may be a temporary increase in the need for social services to provide training or economic assistance for a portion of these displaced workers, this need is not expected to be large. The need to relocate families or for family members to spend more time apart could create additional social burdens on the family and the individual members as new friendships and family structure within a new community may need to be built.

If all projected job losses were to occur near one community, the total effect to the area could be devastating. For example, the communities of Huron, Kerman, Mendota, and Coalinga have existing (1990) populations ranging from approximately 4,600 to 8,000 respectively. If all jobs lost for the San Joaquin River Region were to affect Huron, Kerman, or Mendota, over half the total population and more than half of the working population of these communities could be affected. It is impossible to determine the exact percentage of these changes in irrigated acres and associated impacts at this time.

Displaced recreation workers would likely need to receive social service benefits. Interviews with recreation service employers indicate that many recreation workers are seasonal and part-time employees. Many are students who look for seasonal employment. Loss of recreation jobs for these individuals would likely cause them to seek temporary employment elsewhere. However, in towns located adjacent to CVP recreational facilities, where employees are local townspeople, job losses could cause some displaced workers to apply for social assistance. Displaced workers who hold permanent seasonal jobs have indicated a need to utilize social service programs during the off-season months. Therefore it is anticipated that, if these workers are displaced, they may require year-round assistance until other employment can be found.

A benefit of the reallocation of water supplies from agricultural uses to fish and wildlife habitat uses may result in improved recreation opportunities and the income generated from hunters, birders, and sport fishermen visiting the wildlife refuges and streams. In addition there could be improvements to aesthetic values in rivers and refuge lands and environmental benefits that are difficult to quantify.

The lack of data for the north coastal area makes projections of potential impacts to fishermen difficult. However a decrease in water deliveries and subsequent increases in water held in reservoirs, rivers, and streams could benefit fisheries. The benefits to fishermen would not be as great because it cannot be assumed that the catch of fish would be equal to increases in fish numbers. Fishing regulations govern catch limits and may remain in place. Therefore, the true potential benefits to fishermen and fishing businesses cannot be quantified.

The Hoopa Valley and Yurok tribes would benefit from the provision of increased flows in the Trinity River. These benefits are currently being evaluated in a separate EIS for the Trinity River operations. Increased flows may improve the fishery of the river and its tributaries. Because the culture of these tribes is dependent on the fishery for subsistence and ceremonial uses, the social value of the increased flow is important. Tribal members believe that increased flows would lead to less unemployment and aid in a return to traditional lifestyles. There would be no change to housing costs or per capita income for tribal members. However, there could be intangible social benefits from the ability to lead a subsistence lifestyle.

ALTERNATIVE 2

Approximately 490 jobs would be lost from changes in the agricultural sector. There would be an increase of approximately 40 jobs due to recreation. In the San Joaquin River Region nearly all job losses would result from changes in the agricultural sector. There would be an increase of approximately 30 jobs due to recreation. The Tulare Lake Region would experience losses approaching 900 jobs, of which all would result from changes within the agricultural sector. The need for the level of social services to assist agricultural workers displaced due to implementation of Alternative 2 could increase over the level projected for the No-Action Alternative.

Job losses in the San Francisco Bay Region would be identical to the losses projected to occur under Alternative 1. In the South Coast and Central Coast regions, jobs would increase more than in Alternative 1 due to increased water availability. While this would be a benefit to the regions, the change would be very small, given the size and large population of the affected areas.

In the Sacramento River Region job losses would occur along the west side. Land owners and farm managers may seek other employment opportunities locally or may elect to relocate to other areas for employment. The losses would be spread throughout the west side and would not affect one community more than another.

In the San Joaquin River and Tulare Lake regions agriculture job losses would occur mainly on the west side of the region and could affect the areas near the communities of Mendota, Firebaugh, Huron, and Coalinga the greatest. Because these areas already are experiencing high levels of unemployment and the labor force is primarily farm workers, socio-economic impacts to this area are of concern. The social impacts to these communities would be greater under Alternative 2 than under Alternative 1. Other job losses could occur on the east side of the region near Oakdale, Modesto, and Turlock. These job losses would not be due to CVP water supply reductions, but due to a reduction in irrigated acreage resulting from the sale of water rights on the Stanislaus, Tuolumne, and Merced rivers by persons with water rights that are willing to sell those rights for other beneficial uses. Per capita income for farmers on the east side of the San Joaquin Valley that could sell water supplies could increase.

There could be a secondary impact to persons employed by businesses, such as seed, fertilizer, pesticide, equipment, and labor inputs, that support agriculture production activities on the west side of the Sacramento Valley and the west and east sides of the San Joaquin Valley. The need for social service programs to support these individuals would increase unless these workers can find other employment. Support businesses and local retail businesses could be affected by the loss of income generated from farm production. However, on the east side of the San Joaquin River Region these losses could be offset by new economic opportunities generated by the purchasing power of growers receiving income from the sale of water.

As discussed for Alternative 1, if all employment loss impacts were to occur within one community, the total effect to that community could be devastating. The projected changes to agricultural employment for this alternative are greater, but would affect the east and west sides of the San Joaquin River Region and therefore could be dispersed over several communities.

A benefit of the reallocation of water supplies from agricultural uses to fish and wildlife habitat uses could be an increase in recreation opportunities and the income generated from hunters, birders, and sport fishermen visiting the wildlife refuges and streams. In addition there may be aesthetic values and environmental benefits that are difficult to quantify for social value. Restoration activities to improve habitat also could provide limited employment opportunity. Impacts for recreation communities near reservoirs would be similar to those anticipated for Alternative 1.

Improved habitat in streams could benefit fisheries in those streams and the Delta when compared to No-Action Alternative. There also may be secondary benefits to commercial fishermen who rely on salmon harvest for their living. The benefits to commercial fishermen could be greater than under Alternative 1 because of increased flows in the tributaries of the San Joaquin Valley. This may result in improved fishing conditions leading to increased income and less demand for social services in fishing communities as fishermen and fishing businesses are better able to provide for their families.

The Hoopa Valley and Yurok tribes would benefit from the provision of increased flows in the Trinity River similar to the effects experienced under Alternative 1.

ALTERNATIVE 3

In the Sacramento River Region approximately 1,240 jobs would be lost due to changes in the agricultural sector. There would be an increase of 40 recreation-related jobs, equivalent to the employment gains under Alternative 2. In the San Joaquin River Region, approximately 3,000 jobs would be lost due to changes in agriculture. There would be a gain of approximately 50 jobs caused by increases in the recreation sector. The Tulare Lake Region would experience losses approaching 800 jobs, of which all would be due to changes in the agricultural sector. The loss of jobs for the Tulare Lake Region under Alternative 3, when compared to that anticipated under Alternatives 1 and 2, would be less. There would be an increase in more labor-intensive crop production in the Tulare Lake Region for areas receiving water from the SWP, and therefore a corresponding increase in farm employment opportunities. This increase offsets labor losses for other areas of the Tulare Lake Region that receive CVP supplies and in the San Joaquin River Region anticipated under this Alternative 3.

Job losses occurring in the San Francisco Bay Region would be identical to the losses projected to occur under Alternative 1. In the South Coast and Central Coast regions jobs would increase more than in Alternative 1 due to increased water availability. While this would be a benefit to the regions, the changes would be very small, given the size and large population of the affected areas.

Communities that lie within the areas that could be affected by the loss of agricultural employment in the Sacramento Valley are Willows, Orland, Colusa, and Chico. Land owners who are willing to sell their water supplies and remove their lands from irrigated production would be compensated and may not require other employment. Per capita income could improve for those farmers able to sell water rights. However displaced farm managers and workers would likely seek other jobs within the area or relocate to other areas. Families could be affected if they are required to move and leave behind established community connections to schools, family, church, and friends.

In the San Joaquin River and Tulare Lake regions agriculture job losses would occur on the west side of the region and would affect areas near the communities of Mendota, Firebaugh, Huron, and Coalinga the greatest. Changes to farm labor needs would be similar to those experienced under Alternative 2 when compared to the No-Action Alternative. Other job losses would occur on the east side of the region near Oakdale, Modesto, and Turlock. These job losses would not be due to CVP water supply reductions, but due to the sale of water rights on the Stanislaus, Tuolumne, and Merced Rivers. Farm managers and workers displaced from the removal of irrigation on some lands may be required to relocate or accept jobs that require less skill and training leading to underemployment of these individuals. Farmers and water rights holders able to sell water rights could receive higher per capita incomes and may generate new sources of income for other non-agriculture related business, or could use the available income from water sales to make improvements to other agricultural lands not affected by the water sales.

Skilled farm workers and machinery operators would lose employment, but may find other employment because of their skill levels. However, unlike under Alternative 2, these workers may be required to find work at a less pay and a lesser skill level or to travel further or relocate for employment opportunities. This is because more skilled workers would be displaced under Alternative 3 and therefore the potential to find similar employment opportunities could be limited and more difficult. Some skilled workers and farmworkers displaced by the reduction in irrigated acreage may choose to relocate to the Tulare Lake Region where employment opportunities may be better. Employment opportunities in the Tulare Lake Region would be seasonal, and therefore workers may require social services when seasonal employment is not available. This could stretch the availability of social services to existing residents of the region. If workers from the San Joaquin River Region choose to relocate, additional social burdens could be placed on these workers and their families as the existing social structure and support groups are left behind and new friendships and social support groups are formed in another area.

The need for social services to support displaced farm laborers with limited skills would likely increase under Alternative 3, when compared to the No-Action Alternative. The need for training programs and language programs could increase if laborers are unable to find agricultural work elsewhere in the state, such as the Tulare Lake Region or if they are unable to relocate.

The per capita and family income of the displaced workers would decrease and could affect the ability of these persons to maintain their current standard of living. If these displaced workers cannot find other employment or are unable or unwilling to relocate to other potential labor markets, the families of displaced workers and potentially their communities could be adversely affected. Examples include the possible inability of displaced workers to meet mortgage payments for homes; less opportunity for the workers or their families to obtain higher education because of lack of income to support the cost of going to school; and less income for purchases of supplies, clothing, and larger items such as cars and appliances. The lack of income and purchasing power could indirectly affect local businesses that rely on the purchases of persons within the community. If local businesses are lost, then all members of a community would need to travel further to obtain supplies. Similar changes could occur to fire and police protection services, churches, schools, and other social institutions if local communities cannot support community specific institutions; mergers may be required to maintain basic social support and protection services. If all employment losses were to affect one or several communities the effects could be devastating to the area. For example, the communities of Mendota and Firebaugh have a combined population of approximately 11,000. The loss of nearly 3,000 jobs within the area would likely affect every family and local business.

More water would be allocated to in stream fishery uses under Alternative 3 when compared to the No-Action Alternative and, therefore, it is anticipated that recreationists and recreation workers would benefit from implementation of this alternative to a greater extent. Employment projections for recreation also include indirect benefits to local businesses that support the recreation industry such as food stores, gas stations, and other businesses within a recreation community. Changes to per capita income would be negligible.

Restoration of watershed and improved habitat in streams may create secondary benefits to commercial fishermen who rely on salmon harvest for their living. Instream flows under Alternative 3 would be greater than under the No-Action Alternative and Alternatives 1 and 2. Therefore fishery numbers could improve as habitat improves.

The Hoopa Valley and Yurok tribes would benefit from the provision of increased flows in the Trinity River similar to the effects experienced under Alternative 1.

ALTERNATIVE 4

In the Sacramento River Region job losses would be nearly identical to those projected under Alternative 3. Of these, nearly all are due to changes in the agricultural sector. There would be an increase of approximately 40 recreation-related jobs, identical to those projected for Alternatives 2 and 3.

In the San Joaquin River Region, approximately 3,800 jobs would be lost. Nearly all of these would result from changes within the agricultural sector. More land would be removed from production on the west side in the CVP Delta Mendota Canal service area. Water supply reductions to these areas would affect less labor-intensive production as anticipated for each of the other alternatives. Cotton, irrigated pasture, and grains would be removed from production with CVP supplies, and land would be fallowed. Because these crops are not labor-intensive, adverse impacts are limited to farmers, farm managers, and technically skilled farm workers such as machinery operators and irrigation technicians. Workers with farm management skills are needed throughout the Central Valley. However, given the large number of farm managers displaced under this alternative, it is not likely that each would find similar employment within the affected area. Displaced farm managers may have to relocate to other areas, accept underemployment, or displace other managers who are less skilled. Employment losses on the west side could be greater than the total job losses (3,800 jobs). This is because income from east side water sales is anticipated to generate approximately 1,500 jobs and offsets most losses experienced on the west side of the region.

Farmers and agricultural workers in this area and the communities of Mendota, Firebaugh, Huron, and Coalinga would be adversely affected by the reduction in irrigated lands. As discussed under Alternative 3, these communities may not be able to support local businesses, fire and police protection services, schools, and churches because of the employment and income losses. Therefore, the small communities may be required to merge social and institutional services to provide for local residents. This could lead to a declining social support structure as people have to drive further to participate in social events, church, and schools. Family income would decline for displaced workers and additional burdens could be placed on family members if additional members are required to work to support the family, or relocation is necessary to find other employment. If workers are unable to find other employment or are unwilling or unable to relocate to other jobs, the demand for social services such as welfare, food, and health programs would be expected to increase.

In the Tulare Lake Region, approximately 200 more workers would be displaced than under the Alternatives 1, 2, and 3 as compared to the No-Action Alternative. These would include farm managers who may be able to find other jobs; but as with the San Joaquin River Region, employment opportunities may be limited. Displaced farm managers may require additional job training or education to be able to enter other employment fields and may have to relocate within the region to major economic centers or to other regions to find employment opportunities. Displaced workers within the Tulare Lake Region represent employment losses withing the Kern County State Water Project service area and the Cross Valley Canal service area. These regions also would experience losses under each alternative, with the Cross Valley service area experiencing identical losses, and the Kern County State Water Project service area experiencing acreage losses of a much higher magnitude, nearly double those anticipated under the other alternatives when compared to the No-Action Alternative. The need for social assistance for farmers, agricultural workers, and workers in supporting businesses displaced due to implementation of Alternative 4 would be more extensive than those projected for Alternatives 2 and 3.

The San Francisco Bay Region would experience a loss identical to those anticipated for Alternatives 1, 2, and 3. Unlike under Alternatives 1, 2, and 3, the South Coast and Central Coast regions would experience job losses under Alternative 4 due to reduction in water availability. These losses would be due to increases in urban water costs that could adversely affect businesses. However, the loss of jobs is small and negligible when compared to the total employment base for the regions.

There would be no change in recreation or commercial fishing employment or the projected need for social services from those anticipated under Alternative 3 when compared to the No-Action Alternative.

The Hoopa Valley and Yurok tribes would benefit from the provision of increased flows in the Trinity River similar to the effects experienced under Alternative 1.

ENVIRONMENTAL JUSTICE

Executive Order 12898 requires that Federal agencies analyze the impacts of proposed alternative actions to evaluate disproportionate impacts to minorities or low-income populations.

Table IV-60 shows the ethnic structure of the Sacramento, San Joaquin, and Tulare Lake regions. These areas would be affected the greatest by implementation of the alternatives. As discussed in Chapter III, the population of the Sacramento River region is primarily white. The population of the San Joaquin River and Tulare Lake Regions is also primarily white, but there are also communities of largely Hispanic farm laborers in the San Joaquin River and Tulare Lake regions that support truck and fruit, nut, and vine production. This results in a higher potential for effects upon this ethnic group, as shown in Table IV-61.

TABLE IV-60

ETHNICITY BY REGION

Region	Ethnicity			
	White (percent)	Black (percent)	Asian (percent)	Hispanic (percent)
Sacramento River	73	7	7	13
San Joaquin River	58	4	8	29
Tulare Lake	60	4	3	33
San Francisco Bay	59	9	16	16

SOURCE:
California Department of Finance, 1990.

TABLE IV-61

ETHNICITY OF POTENTIALLY AFFECTED COMMUNITIES IN THE SAN JOAQUIN RIVER REGION

San Joaquin River Region	Ethnicity			
	White (percent)	Black (percent)	Asian (percent)	Hispanic (percent)
Coalinga	66	1	1	33
Firebaugh	31	23	1	67
Huron	13	>1	1	86
Kerman	52	1	4	43
Mendota	15	1	1	83

SOURCE:
New United Way, Vision 20/20, May 1994.

Areas where water purchases are proposed have populations that are primarily white, except in Merced County where Hispanics and Asians make up a large portion of the population. In the Tulare Lake Region, acreage reductions would occur in areas within Kern County served by the State Water Project and areas served by the Cross Valley Canal. The Tulare Lake Region, like the San Joaquin River Region, is primarily white, but also has a large Hispanic population.

It is difficult to conclude that one social group would be adversely affected to a greater extent by implementation of any of the alternatives. In addition, because the impacts of the alternatives occur throughout the Central Valley area of California, no one ethnic group is affected more than another. Moreover, the impacts are more reflective of the type of labor requirements required for agricultural production and the skill and education level of those employees that determines the total impact to any social group. Scoping meetings were held in Mendota to specifically obtain input about these concerns.

There could be indirect adverse impacts to farm laborers, who are generally economically disadvantaged, may lack English language skills and education or training to obtain other employment, and are from minority groups; however it is not the intent of the CVPIA to affect these groups. Potential impacts to these groups are a result of direct and adverse impacts to land owners and farmers that receive CVP supplies. These persons are generally not economically disadvantaged and do not represent minority groups. However, as lands are removed from production either by reductions in CVP deliveries, land retirement programs implemented as part of the SJVDP, or through purchase of water rights from willing sellers, some labor-intensive crops would be removed from production. Indirect and adverse effects to farm laborers would occur as a result of this action.

There could be direct benefits from implementation of the CVPIA to the Native American tribes from increased flows in the Trinity River under all alternatives. These benefits are being evaluated in separate environmental documentation.

Adverse impacts to the social groups would occur throughout the Sacramento River, San Joaquin River, and Tulare Lake regions and specific areas have not been targeted for implementation of the alternatives. The west side of the San Joaquin River Region is affected particularly because of reductions in agricultural acreage that would occur under the No-Action Alternative. Implementation of the alternatives would add to the adverse impacts that would be experienced by land owners and communities resulting from implementation of the No-Action Alternative.

CULTURAL RESOURCES

Cultural resources in the study area could be affected by implementation of the CVPIA in many ways. Changes in reservoir and river operations could affect cultural resources at reservoir margins by changing historical patterns of reservoir filling and emptying. Cultural resources located in the drawdown zone of reservoirs are prone to damage from exposure caused by hydrologic changes. The most damaging impacts would probably be caused by erosion. Less obvious, but also potentially destructive, is wet/dry cycling, which is caused by repeated inundation and exposure of resources. This causes perishable items (e.g., bone, wood, shell, ceramics, pollen, and leather) to disintegrate rapidly. Other impacts tied to the exposure of resources during drawdown are potential damage caused by animals.

Vandalism, whether caused by organized artifact collectors or by inadvertent disturbance, is a constant threat to the public's cultural resources. As the number of recreationists at facilities increases (because of better boating, swimming, or fishing opportunities), cultural resources are at greater risk. These risks occur not only at sites that are exposed at water margins, but also in the zone above inundation. Increased numbers of recreationists at CVP facilities (expected when water levels are higher) may require construction of new recreational facilities that, in turn, could affect cultural resources. Impacts could occur from construction of new roads, restrooms, parking lots, marinas, and boat ramps. Lowering water levels could also require new construction to extend boat ramps, create new beaches, or relocate marinas.

Changes in river-flow patterns that result in improved fishing would attract more anglers who may walk through sensitive areas to reach the river. Increased visits to recreation areas could lead to the discovery and possible looting of cultural resources.

Agricultural practices can lead to lesser or greater impacts on cultural resources depending on the type of crop. For example, planting rice (where it is necessary to recontour the landscape) or planting orchards (where it is necessary to plow the land to a depth of approximately 2 meters) can be very destructive to cultural resources. Changes in agricultural patterns from crops that require substantial ground disturbance to pasture or grains, which involve minimal ground disturbance, would be beneficial to the preservation of cultural resources. In some cases, prehistoric sites located on agricultural land have already been disturbed (through leveling, plowing, or disking); therefore, the cessation of agricultural practices on this land would not provide a benefit to cultural resources. However, because other sites on agricultural land may not have been disturbed, this analysis assumes that the fallowing or retirement of agricultural lands provides a benefit by reducing the likelihood that cultural resources would be disturbed.

Some of the land that would be fallowed or retired under the action alternatives would be restored for terrestrial habitat. During restoration, if extensive recontouring of land takes place, an increased potential to cause disturbance to cultural resources could occur.

Cultural resources could be damaged by fish habitat restoration activities through ground-disturbing activities where cultural resources are located and through increased recreation. Installing fish screens, relocating diversions, creating escape channels, replenishing gravelbeds to restore spawning grounds, constructing pumping plants, revegetation of watercourse banks, and dredging are fish restoration actions that could affect cultural resources through ground disturbance. Dredging activities that would disturb shipwrecks are of special concern.

The delivery of water above historical levels to wildlife refuges could affect cultural resources by flooding previously dry land, applying water to existing flooded areas for longer periods of time, or through increased risk to vandalism caused by increased recreational visitation. It is assumed that, prior to any CVPIA undertaking, the lead Federal agency will comply with Section 106 of the National Historic Preservation Act (NHPA). Section 106 requires Federal agencies to take into account the effect of an undertaking on historic properties prior to implementation.

A summary of assumptions for the cultural analysis is presented in Table IV-62. The results of the impact assessment are summarized in Table IV-63.

TABLE IV-62

SUMMARY OF ASSUMPTIONS FOR CULTURAL RESOURCES

Assumptions Common to All Alternatives and Supplemental Analyses
Municipal and recreational land uses as described in DWR Bulletin 160-93.
Changes in cultivated acreage, visitor use of recreational areas, and river and reservoir water elevations based on Agricultural Economics and Land Use, and Surface Water Supplies and Facilities Operations analyses.

TABLE IV-63

SUMMARY OF IMPACT ASSESSMENT FOR CULTURAL RESOURCES

Alternative or Supplemental Analysis	Impact Assessment
No-Action Alternative	Conditions are similar to Affected Environment.
	Changes Compared to the No-Action Alternative
1	Cultural resources at New Melones Reservoir are potentially exposed to vandalism during periods of reservoir drawdown. There is the potential for flooding or increased erosion of cultural resources at wildlife refuges in the Sacramento River and San Joaquin River regions. Cultural resources in the Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta regions are potentially affected by the construction and operation of new facilities and the modification of existing facilities for anadromous fisheries habitat restoration.
	Changes Compared to Alternative 1
1a	Conditions are the same as Alternative 1.
1b	Conditions are the same as Alternative 1.
1c	Impacts could range from those similar to Alternative 1, to the potential increased risk of exposure of cultural resources near reservoirs and/or rivers in the Sacramento River and San Joaquin River regions.
1d	Conditions are the same as Alternative 1.
1e	Conditions are similar to Alternative 1, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
1f	Conditions are similar to Alternative 1.
1g	Conditions are the same as Alternative 1.
1h	Conditions are similar to Alternative 1.
1i	Conditions are the same as Alternative 1.
	Changes Compared to the No-Action Alternative
2	Conditions are the same as Alternative 1, except for the potential reduced risk of exposure of cultural resources in the San Joaquin River and Tulare Lake regions due to impacts from cultivation.
	Changes Compared to Alternative 2
2a	Conditions are the same as Alternative 2.
2b	Conditions are similar to Alternative 2, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
2c	Conditions are similar to Supplemental Analysis 2b.
2d	Conditions are similar to Supplemental Analysis 2c.
	Changes Compared to the No-Action Alternative
3	Conditions are the same as Alternative 2, except: Vandalism on cultural resources on the Stanislaus River is potentially increased due to an increase in the number of recreational visitors. The risk of exposure of cultural resources in the San Joaquin River Region is potentially reduced due to impacts from cultivation.
3a	Conditions are similar to Alternative 3, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
	Changes Compared to the No-Action Alternative

TABLE IV-63. CONTINUED

Alternative or Supplemental Analysis	Impact Assessment
4	Conditions are the same as Alternative 3, except for the potential reduced risk of exposure of cultural resources in the Sacramento River due to impacts from cultivation.
4a	Conditions are similar to Alternative 4, except the fallowing of agricultural land could reduce risk of exposure of cultural resources due to cultivation.
Revised No-Action Alternative	Same as No-Action Alternative.
Preferred Alternative	Conditions similar to Alternative 2 with more potential impacts at Shasta and Folsom Lakes.

Changes in impacts to cultural resources in the Trinity River Basin would be the same between all alternatives and the No-Action Alternative. The specific impacts are being evaluated under separate environmental documentation.

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, it is anticipated that growth would continue during the period of analysis, resulting in changes to agricultural practices and land use in general. These changes could cause additional impacts to cultural resources. The nature, location, and extent of these changes cannot be known at this time and, therefore, are not identified in this programmatic document.

ALTERNATIVE 1

Under Alternative 1, the high water levels at Sacramento River Region reservoirs would be the same as those under the No-Action Alternative and the low water level would vary slightly from the low water level under the No-Action Alternative. The drawdown levels would be much lower for New Melones Reservoir, resulting in potential impacts. Resources could be exposed more frequently than under the No-Action Alternative, therefore subject to greater risk through vandalism and more frequent wet-dry cycling. Under Alternative 1, small increases in annual recreation use at reservoirs would not have an impact on cultural resources.

Potential impacts may occur along Clear Creek and the Sacramento and American rivers. Changes in flow patterns to meet Service flow targets would increase recreation visitation, although this increase in recreational use would probably be too small to have an impact on cultural resources.

The minimal amount of change in agricultural land use under Alternative 1 would not have an impact on cultural resources. Similarly, the amount of restored terrestrial habitat that would take place under Alternative 1 would be small and would not have impacts on cultural resources.

Under Alternative 1, refuges in this region would receive Level 2 water, resulting in the delivery of more water to some refuges under this alternative than under the No-Action Alternative. Cultural resources in the areas receiving additional water could be affected by flooding or increased erosion. An increase in the number of visitors at the refuges, compared to the number under the No-Action Alternative, could lead to increased risk to vandalism.

The proposed actions to improve anadromous fisheries habitat under Alternative 1 would include some ground disturbance. Because many of these actions would occur in areas that have a high probability of containing cultural resources, it is likely that these resources would be affected. Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities.

ALTERNATIVE 2

Under Alternative 2, the impacts to reservoirs and rivers would be similar to those discussed under Alternative 1.

Under Alternative 2, less than 2 percent of the irrigated lands in the Central Valley would be fallowed. This amount of change could result in a minimal benefit to cultural resources resulting from the reduced potential for disturbance and exposure of resources.

Under Alternative 2, refuges in the study area would receive Level 4 water supplies, resulting in delivery of more water than under the No-Action Alternative. Resources in the areas receiving additional water could be flooded or subjected to increased erosion. Increased visitation at these sites could also lead to increased risk to vandalism.

Under Alternative 2, changes resulting from implementation of terrestrial and anadromous fisheries restoration actions would be similar to those actions discussed under Alternative 1.

ALTERNATIVE 3

Under Alternative 3, the potential impacts to cultural resources at reservoirs and rivers in the Sacramento River Region would be similar to those discussed under Alternative 1. Because of higher river-flows under Alternative 3, the potential for increased risk to vandalism and more frequent wet-dry cycling would occur along the Stanislaus River.

Under Alternative 3, less than 3 percent of the irrigated lands in the Central Valley would be fallowed. A potential beneficial impact on cultural resources could result from this fallowing and from the changes in crop mix that would occur in the San Joaquin River and Tulare Lake regions.

Under Alternative 3, the potential impacts on cultural resources at study area refuges would be the same as those discussed under Alternative 2. Potential impacts resulting from implementation of terrestrial and anadromous fisheries restoration actions would be the same as those discussed under Alternative 1.

ALTERNATIVE 4

Under Alternative 4, the potential impacts on cultural resources at reservoirs and rivers in the study area would be similar to those discussed under Alternative 3. Similarly, the beneficial impacts resulting from changes in agricultural land uses from fallowing and changes in crop mix would be similar to those discussed under Alternative 3.

Under Alternative 4, potential impacts on cultural resources at refuges in the study area would be the same as those discussed under Alternative 2. Potential impacts resulting from implementation of terrestrial and anadromous fisheries restoration activities would be the same as those discussed under Alternative 1.

INDIAN TRUST ASSETS

Reclamation policy is to protect American Indian Trust Assets (ITAs) from adverse impacts of its programs and activities whenever possible. Although there is no concise legal definition of Indian Trust Assets, courts have traditionally interpreted them as being tied to real property. ITAs are property interests held in trust by the United States for benefit of Indian tribes or individuals. Indian reservations, rancherias, and allotments are common ITAs. Other ITAs included traditional-use areas, and, of particular relevance to the actions considered in the Draft PEIS, the fishery resource.

The assessment of potential impacts to ITAs is based on a review of proposed actions that could affect the use and enjoyment of the trust assets. Types of actions that could affect trust assets include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts on fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely impacts uses of reserved land. Actions evaluated in the Draft PEIS include the management of water resources and the implemetation of physical actions to provide restoration and enhancement of fishery and wildlife resources in the Central Valley and Trinity River Basin.

The implementation of Alternatives 1, 2, 3, or 4, or the associated supplemental analyses evaluated in the Draft PEIS would not result in adverse impacts to Indian Trust Assets. Increased flows associated with any of the alternatives would be within the normal floodplain of affected rivers, and would not negatively affect Indian Trust Assets located adjacent to rivers. Increases in fishery resources in Central Valley rivers and in the Trinity River would be beneficial to ITAs associated with fishing rights.

AIR QUALITY

As compared to the No-Action Alternative, agricultural land use conditions would change in Alternatives 1, 2, 3, 4, and all associated supplemental analyses. As presented in the description of impacts associated with Agricultural Economics and Land Use, the total changes in land use under these alternatives would be small (less than 6 percent) in each region in the Central Valley as compared to the No-Action Alternative.

Changes to agricultural land uses resulting from the reduction of water supplies due to changes in CVP operations would be made consistent with existing land management practices. Lands fallowed due to the acquisition of water would be planted with a cover crop and irrigated during the first year of fallowed conditions to establish wind erosion controls, and would not result in increased potential for elevated PM_{10} concentrations. Specific actions to reduce air quality impacts due to land fallowing associated with the acquisition of water from willing sellers will be addressed in site-specific environmental documentation.

SOILS

Potential changes to soils resources due to implementation of PEIS alternatives are associated with changes in drainage, instream gravel mining, and stream erosion. A description of potential impacts related to drainage is provided in the discussion of groundwater.

As compared to the No-Action Alternative, aggregate removal would be reduced or eliminated in many Central Valley streams under Alternatives 1, 2, 3, 4, and all associated supplemental analyses. The reduction of aggregate gravel mining would reduce sediment loadings in rivers and streams, and would reduce the rate of removal of soils with nutrients and vegetation. The implementation of instream habitat restoration actions, including gravel replenishment, bank stabilization and vegetation, and the use of pulse flows to reduce scouring would reduce the potential for erosion in rivers.

VISUAL RESOURCES

Changes in visual resources can occur both regionally and locally. Due to the programmatic nature of the analysis in the PEIS, changes in local conditions are not evaluated in detail. Under all alternatives considered in the PEIS, it is anticipated that changes to agricultural land uses would be regionally distributed, and would occur within the existing distribution of agricultural land character types. As compared to the No-Action Alternative, changes in stream flow conditions would generally result in increased stream flow levels, which is considered a beneficial visual impact. These responses would be further enhanced with the implementation of stream habitat restoration actions. As compared to the No-Action Alternative, the continued operation of water supply facilities would occur within the same range operating conditions, and would, therefore, not affect the visual character of these facilities.

PREFERRED ALTERNATIVE

Implementation of the Preferred Alternative will protect, restore, and enhance fish, wildlife and associated habitats in the Central Valley of California. Implementation will also address impacts of the CVP on fish, wildlife, and associated habitats as well as improve operational flexibility of the system. Finally, implementation will contribute to interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Achieving a reasonable balance among competing demands for use of CVP water, including the requirements of fish and wildlife, agriculture, municipal and industrial and power contractors as directed by Congress in the CVPIA yields a variety of impacts in areas such as recreation, agriculture and the general quality of life.

The remaining part of this chapter describes the impacts from implementing the Preferred Alternative as compared to the Revised No-Action Alternative. To reflect the impact of (b)(2) most usefully in a manner that is not misleading, the PEIS displays the impact of using 800,000 acre-feet in a combination of quantitative and qualitative analyses. As described in Chapter 2, the quantitative analysis for the Preferred Alternative is based on the actions for (b)(1)B and (b)(2) water as described in the November 20, 1997 Administrative Paper. A new accounting method for (b)(2) water was finalized by Reclamation and the Service in a decision on implementation of (b)(2), dated October 5, 1999 (Attachment G-8). Implementation of the October 1999 decision would have additional effects from those described in the remaining parts of this chapter and are qualitatively discussed below. There are incremental changes in the level of impact which may vary considerably from year to year, but no new kinds of impacts or new cumulative impacts result from the October 1999 decision.

Project operations under the October decision would result in changes in CVP deliveries under the Preferred Alternative in some years with an overall increased reduction in the frequency of full contract deliveries. At no time would the (b)(2) water usage exceed 800,000 acre-feet of yield. The exact reduction in CVP deliveries resulting from these additional fish actions cannot be determined at this programmatic level due to the specific nature of those actions. Preliminary estimated annual impacts range from less than those identified in the quantitative analysis of the Preferred Alternative, to at least several hundred thousand acre-feet of additional impacts, depending on hydrology, and assumptions about SWP operations. Any increase in impacts would be concentrated in the above normal and wetter years because management of (b)(2) as modeled pursuant to the November 1997 decision already provided full or nearly full (b)(2) supplies in nearly all dry and critical years (limited to 600,000 acre-feet under extreme hydrologic conditions).

The October 1999 method would result in higher reservoir elevations in the summer to retain storage to meet fall fish flows. This would provide additional benefits to recreation than with the November 1997 criteria. The change in reservoir elevations may impact CVP power generation in two ways. First, the higher reservoir levels will increase the energy production when the water is released. However, the value of the energy could be low if the releases occur in spring or fall months when peak energy demands are low.

Reductions in exports would result in poorer drinking water quality at Contra Costa, Tracy, and Banks Pumping Plants in the South Delta, creating potential impacts on municipal and industrial water quality for CVP and SWP exports. However, reductions in exports would result in better water quality downstream of the confluence of the Sacramento and San Joaquin rivers in the Central Delta to improve fishery resources.

Application of (b)(2) water in the Preferred Alternative would provide benefits for all representative fish species by further improving environmental conditions and increasing habitat availability. These benefits would include reduced water temperature and surface level fluctuation, and improved conditions affecting movement, quantity and quality of habitat, and food web support. These actions could be implemented in Clear Creek and the Sacramento, American, and Stanislaus rivers and the Delta, and would increase benefits provided by other CVPIA actions, such as structural and habitat restoration measures. Additionally, increased flows of these management scenarios should lessen the CVP need to increase flows to meet post CVPIA requirements for listed and proposed fish species including winter and spring-run chinook salmon, steelhead, and Delta smelt.

Any additional reduction in average annual deliveries would probably have the greatest impact in in the San Joaquin Valley on export contractors, through export reductions. The additional reductions in deliveries could result in: an increase in lands going out of production, greater average fallowed acreage, or greater drafting of groundwater. Additional groundwater pumping and reduced groundwater recharge could result in additional subsidence. This additional reduction in average annual deliveries would probably have the greatest impact on export contractors, through export reductions. The additional reductions in deliveries would result in additional fallowed acreage of up to 70,000 acres.

The reduction in agricultural acreage would also result in an additional loss in agricultural productivity and job losses.

Any reduction in agricultural habitat in the Preferred Alternative would potentially improve the distribution and number of plants and animals of common and special-status species in that region. For example, if fallowed land increases in the San Joaquin Valley, native habitat acreage in that region will increase, with a greater potential to provide more sustainable habitat for associated terrestrial common and special-status species.

The changes in implementing b(2) in accordance with the October 1999 method versus the November 1997 should have no effect upon Noise, Air Quality, or Visual or Cultural Resources.

SURFACE WATER SUPPLIES AND FACILITIES OPERATION

This section summarizes potential changes to the operation of CVP and SWP facilities, river flow regimes, and CVP and SWP water supply deliveries that would result from the implementation of the PEIS Preferred Alternative analysis as compared to the Revised No-Action Alternative. Implementation of CVPIA in the Preferred Alternative includes the following specific measures and programs that directly effect CVP and SWP operations.

- Implementation of CVP reoperation and 3406(b)(2) Water Management for upstream and Delta actions similar to those defined in the November 20, 1997, Administrative Paper released by Reclamation and the Service.

- Acquisition of up to 140,000 acre-feet per year from willing sellers on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba rivers to meet instream and Delta fisheries needs. Acquired water may be exported from the Delta if other conditions allow.

- Provide firm Level 2 refuge water supplies, including a 25 percent shortage based on the 40-30-30 Index (as described in the SWRCB 1995 Water Quality Control Plan). Firm Level 2 refuge water supplies provide an additional 240,000 acre-feet per year above the Level 2 refuge water supplies delivered in the Revised No-Action Alternative. The firm Level 2 refuge water supply amounts are presented in Table IV-64.

- Acquisition of Level 4 refuge water supplies from willing sellers, including shortage criteria based on the reliability of the source from which the acquisition is made. Level 4 refuge water supplies provide an additional 150,000 acre-feet per year above firm Level 2 refuge water supplies. The Level 4 refuge water supply amounts are presented in Table IV-64.

- Preliminary Trinity River instream fishery flow pattern developed by the Service for the PEIS. The annual instream fishery flow releases range from 390,000 acre-feet in critical dry years to 750,000 acre-feet in wet years. The water year type index for these flow requirements is based on the annual inflow to Clair Engle Lake.

TABLE IV-64

FIRM LEVEL 2 AND LEVEL 4 REFUGE WATER SUPPLIES

	Firm Level 2 Water Supplies (1,000 acre-feet)			Level 4 Water Supplies (1,000 acre-feet)		
Refuge	**At Boundary**	**Conveyance Loss**	**To Be Diverted**	**At Boundary**	**Conveyance Loss**	**To Be Diverted**
SACRAMENTO VALLEY REFUGES						
Sacramento NWR	46.4	15.5	61.9	50.0	16.7	66.7
Delvan NWR	20.9	7.0	27.9	30.0	10.0	40.0
Colusa NWR	25.0	8.3	33.3	25.0	8.3	33.3
Sutter NWR	23.5	2.6	26.1	30.0	3.3	33.3
Grey Lodge NWR	35.4	5.2	40.6	44.0	7.0	51.0
TOTAL FOR SACRAMENTO VALLEY REFUGES	**151.2**	**38.6**	**189.8**	**179.0**	**45.3**	**224.3**
San Luis NWR	19.0	6.3	25.3	19.0	6.3	25.3
Kesterson NWR	10.0	1.1	11.1	10.0	1.1	11.1
Volta WMA	13.0	0.0	13.0	16.0	0.0	16.0
Los Banos WMA	16.6	2.8	19.4	25.5	5.1	30.6
San Joaquin Basin Action Lands						
Freitas	5.3	1.8	7.1	5.3	1.8	7.1

TABLE IV-64. CONTINUED

Refuge	Firm Level 2 Water Supplies (1,000 acre-feet)			Level 4 Water Supplies (1,000 acre-feet)		
	At Boundary	Conveyance Loss	To Be Diverted	At Boundary	Conveyance Loss	To Be Diverted
East Gallo	8.9	2.9	11.8	13.3	4.4	17.7
West Gallo	10.8	3.6	14.4	10.8	3.6	14.4
Salt Slough	6.7	1.2	7.9	10.0	1.8	11.8
China Island	7.0	1.2	8.2	10.5	1.8	12.3
Grasslands Resource Conservation District	125.0	22.1	147.1	180.0	31.8	211.8
Mendota WMA	27.6	0.0	27.6	29.6	0.0	29.6
Merced NWR	15.0	5.0	20.0	16.0	5.3	21.3
Kern NWR	9.9	1.5	11.4	25.0	3.7	28.7
Pixley NWR	1.3	0.0	1.3	6.0	0.8	6.8
TOTAL FOR SAN JOAQUIN VALLEY REFUGES	**276.1**	**49.5**	**325.6**	**377.0**	**67.5**	**444.5**
TOTAL FOR ALL REFUGES	**427.3**	**88.1**	**515.4**	**556.0**	**112.8**	**668.8**

Impact Assessment Methodology

The impact assessment methodology used to support the analysis presented in this section is based on the use of computer model analyses. Model simulations were conducted at a planning level, in accordance with the programmatic nature of the overall PEIS analysis. Model results are only valid on a comparative basis. The Project Simulation Model (PROSIM) and San Joaquin Area Simulation Model (SANJASM) were used to evaluate the potential to reoperate system reservoirs toward meeting CVPIA objectives, and assess the resulting impacts to CVP water supply deliveries. The model simulations were conducted utilizing the most recent version of PROSIM, referred to as PROSIM 99.0, released by Reclamation at a PROSIM Workshop on November 20, 1998.

The model simulations for these analyses were conducted using historical hydrology for the period 1922 through 1990, adjusted to be representative of a projected 2020 level of development. The projected land-use conditions were based on information developed for DWR Bulletin 160-93 (DWR, 1993) and are assumed to be constant over the simulation period. The historical hydrology for the 1922 through 1990 period is considered to be representative of the range of hydrologic conditions that may be expected under future CVP operations.

The models use a monthly time step and general operations criteria representative of CVP operations. The simulations do not take into account daily or weekly changes in operations, river travel time, or fluctuations in natural hydrology. A discussion of the specific approach, model modifications, and data development required to apply these analytical tools to the analysis of the alternatives in the PEIS is provided in the PROSIM and SANJASM Methodology/Modeling Technical Appendices.

Impacts on CVP Operations and Deliveries

This section describes potential changes to the operation of CVP facilities, river flow regimes, and water deliveries resulting from implementation of the measures and programs included in the Preferred Alternative. In general, the Preferred Alternative results in greater CVP reservoir releases and lower reservoir storages, Delta exports, and water service contractor deliveries than in the Revised No-Action Alternative. The greatest impacts of the Preferred Alternative are in the dry years when there is reduced water supply available for water service contractor deliveries after meeting water rights demands, CVP operations criteria, and CVPIA implementation actions. A discussion of the differences in SWP operations and SWP deliveries south of the Delta is provided in a later section.

CVP Operations. The integrated operation of CVP facilities was based on existing CVP obligations and operational criteria as defined under the Revised No-Action Alternative, plus the following CVPIA actions defined in the Preferred Alternative:

- Upstream and Delta actions for (b)(2) Water Management;
- Acquisition of water for instream and Delta fisheries needs;
- Provision of firm Level 2 refuge water supplies;
- Acquisition of Level 4 refuge water supplies from willing sellers; and
- Increase in Trinity River instream fishery flows.

For the discussion of CVP operations, model simulation results are presented for three separate periods to characterize the potential range of impacts under dry, wet, and long-term average hydrologic conditions. The three periods are defined as follows:

- The dry period is the critical drought period from 1929 through 1934;
- The wet period is the consecutive wet years from 1967 through 1971; and
- The long-term average period is the model simulation period from 1922 through 1990.

A summary comparison of CVP reservoir storage, Delta inflow, Delta outflow, and CVP export pumping for these three periods is provided in Table IV-65 for the Revised No-Action Alternative and the Preferred Alternative.

Trinity River Division. For the purpose of the PEIS programmatic analysis, the Revised No-Action Alternative assumes the minimum annual instream fishery flow volume is 340,000 acre-feet. The Preferred Alternative assumes minimum annual instream fishery flow volumes range from 390,000 acre-feet in critical dry years to 750,000 acre-feet in wet years. A monthly comparison of the Revised No-Action Alternative and Preferred Alternative flow requirements for wet and critical dry year types is presented in Figure IV-52. As compared to the Revised No-Action Alternative, average annual flows down the Trinity River in the Preferred Alternative increase by about 190,000 acre-feet or 50 percent during the long-term average period and by about 60,000 acre-feet or 18 percent during the dry period. Average annual

TABLE IV-65

COMPARISON OF END-OF-WATER YEAR CVP RESERVOIR STORAGE, DELTA INFLOW, DELTA OUTFLOW, AND CVP EXPORT PUMPING IN THE PREFERRED ALTERNATIVE TO THE REVISED NO-ACTION ALTERNATIVE

Item	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Change from Revised No-Action Alternative	
			1,000 acre-feet	Percent Change
Average End-of-Water Year Storage				
Clair Engle Lake				
Simulation Period	1,390	1,260	-130	-9%
Dry Period	610	520	-90	-15%
Wet Period	1,720	1,690	-30	-2%
Shasta Lake				
Simulation Period	2,770	2,640	-130	-5%
Dry Period	1,510	1,170	-340	-23%
Wet Period	3,290	3,180	-110	-3%
Folsom Lake				
Simulation Period	470	470	0	0%
Dry Period	400	310	-90	-23%
Wet Period	550	570	20	4%
Average Annual Flows and Exports				
Delta Inflow				
Simulation Period	22,620	22,410	-210	-1%
Dry Period	10,470	10,470	0	0%
Wet Period	29,730	29,340	-390	-1%
Delta Outflow				
Simulation Period	14,740	14,840	100	1%
Dry Period	5,410	5,560	150	3%
Wet Period	20,890	20,650	-240	-1%
Exports through Tracy Pumping Plant				
Simulation Period	2,650	2,420	-230	-9%
Dry Period	1,610	1,390	-220	-14%
Wet Period	2,850	2,790	-60	-2%

Notes:
Simulation Period = 1922 through 1990;
Dry Period = 1929 through 1934;
Wet Period = 1967 through 1971.

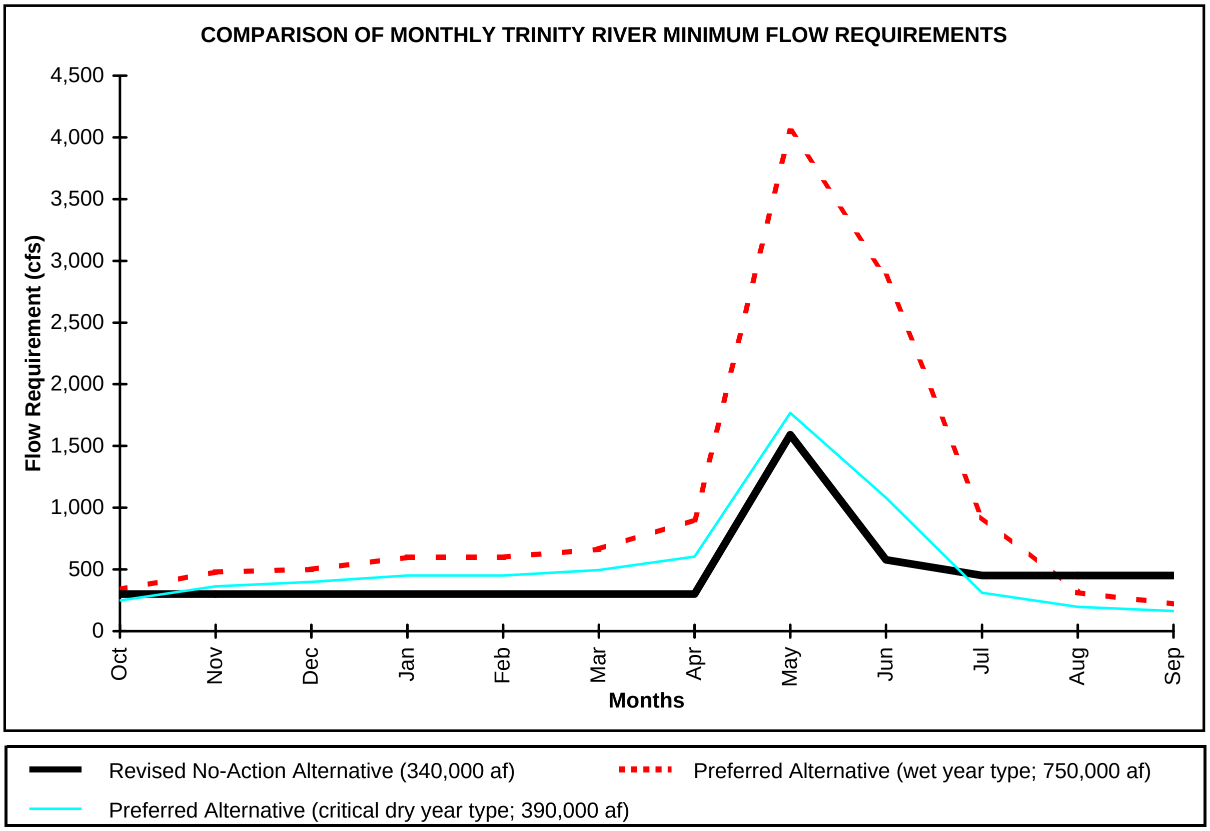
diversions from the Trinity River Basin to Whiskeytown Lake are reduced by about 180,000 acre-feet or 21 percent during the long-term average period and 80,000 acre-feet or 19 percent during the dry period to help balance the net demands on Clair Engle Lake. Frequency distributions of the simulated annual diversions from the Trinity River Basin in the Preferred Alternative and the Revised No-Action Alternative are presented in Figure IV-52. The reductions in seasonal diversions in the Preferred Alternative are also evident in Figure IV-53 which presents the average monthly diversions during the dry, wet, and long-term average periods.

As compared to the Revised No-Action Alternative, the increase in Trinity River flow releases in the Preferred Alternative reduces Clair Engle Lake average end-of-water year storage by about 130,000 acre-feet or 9 percent during the long-term average period and 90,000 acre-feet or 15 percent during the dry period. The reduction in Clair Engle Lake storage results from the increase in fishery flow releases in wet and dry years, and the low refill potential of the lake. A comparison of the frequency distributions of simulated end-of-water year storage in Clair Engle Lake for the Preferred Alternative and the Revised No-Action Alternative is shown in Figure IV-54. Simulated average end-of-month storage during the dry, wet, and long-term average periods are presented in Figure IV-55.

The Preferred Alternative includes use of (b)(2) water on Clear Creek to meet target flows. Figure IV-56 shows the increase in simulated average monthly Clear Creek flows during the dry, wet, and long-term average periods in the Preferred Alternative as compared to the Revised No-Action Alternative. Figure IV-57 shows the increase in simulated monthly Clear Creek flows for the dry and wet periods. These flow comparisons show the range of Clear Creek flow variation. The increase in flow would result in generally lower water temperatures in Clear Creek as compared to the Revised No-Action Alternative. However, the increase in Clear Creek flows combined with the decrease in diversions from the Trinity River Basin results in reduced diversions from Whiskeytown Lake to Spring Creek. As compared to the Revised No-Action Alternative, the smaller diversions may experience a greater increase in temperature as the water is conveyed during the summer months, resulting in warmer water entering the Sacramento River at Keswick.

Shasta and Sacramento River Divisions. As described in Chapter II, the Preferred Alternative includes several actions that affect operations of the Shasta and Sacramento River Divisions. These actions include changes to CVP operations associated with (b)(2) Water Management, the acquisition of water for instream and Delta fisheries needs, the provision of firm Level 2 refuge water supplies, the acquisition of Level 4 refuge water supplies from willing sellers, and the increase in Trinity River instream fishery flows. The difference in operations due to a possible shift in reservoir releases for Level 4 refuge water supplies is small in proportion to other operational changes.

The reduction in average annual diversions from the Trinity River Basin and the increase in Clear Creek flows often necessitate increased releases from Shasta Lake to meet 1995 Winter-Run Biological Opinion temperature requirements, downstream water rights and water service contracts, minimum navigational flow requirements, Delta water quality requirements, and implementation of CVPIA. The additional releases from Shasta Reservoir will often reduce



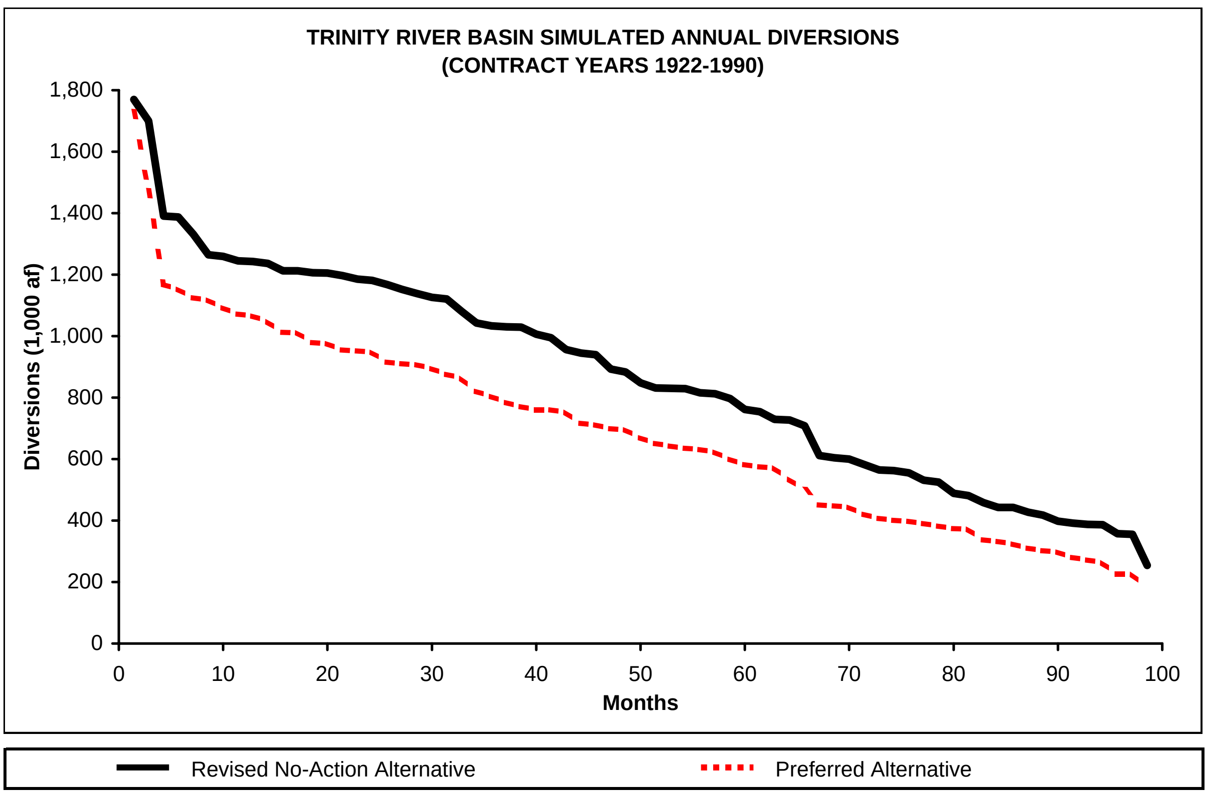


FIGURE IV-52
TRINITY RIVER MINIMUM FLOW REQUIREMENTS
AND SIMULATED ANNUAL EXPORTS

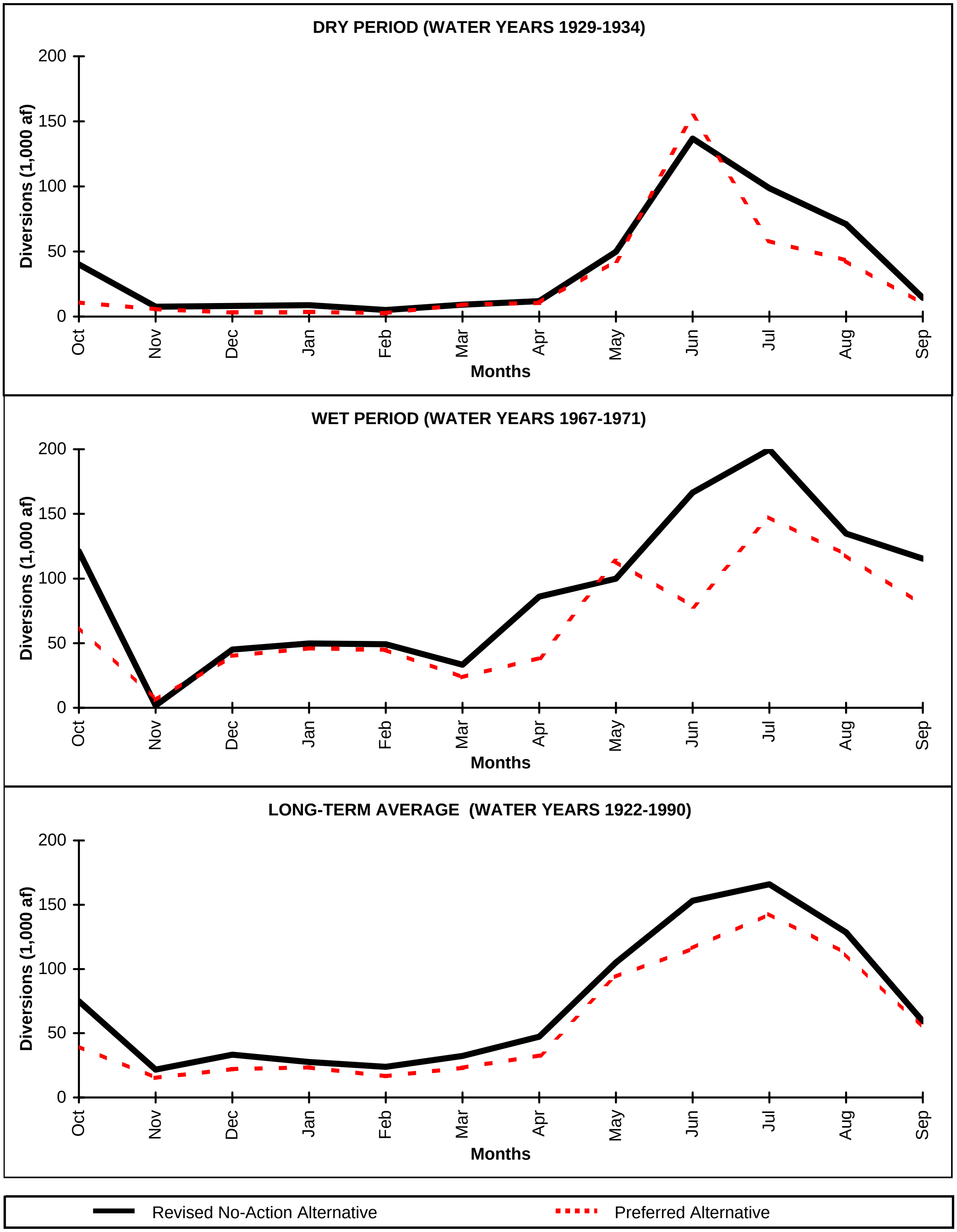


FIGURE IV-53
TRINITY RIVER BASIN
SIMULATED MONTHLY DIVERSIONS

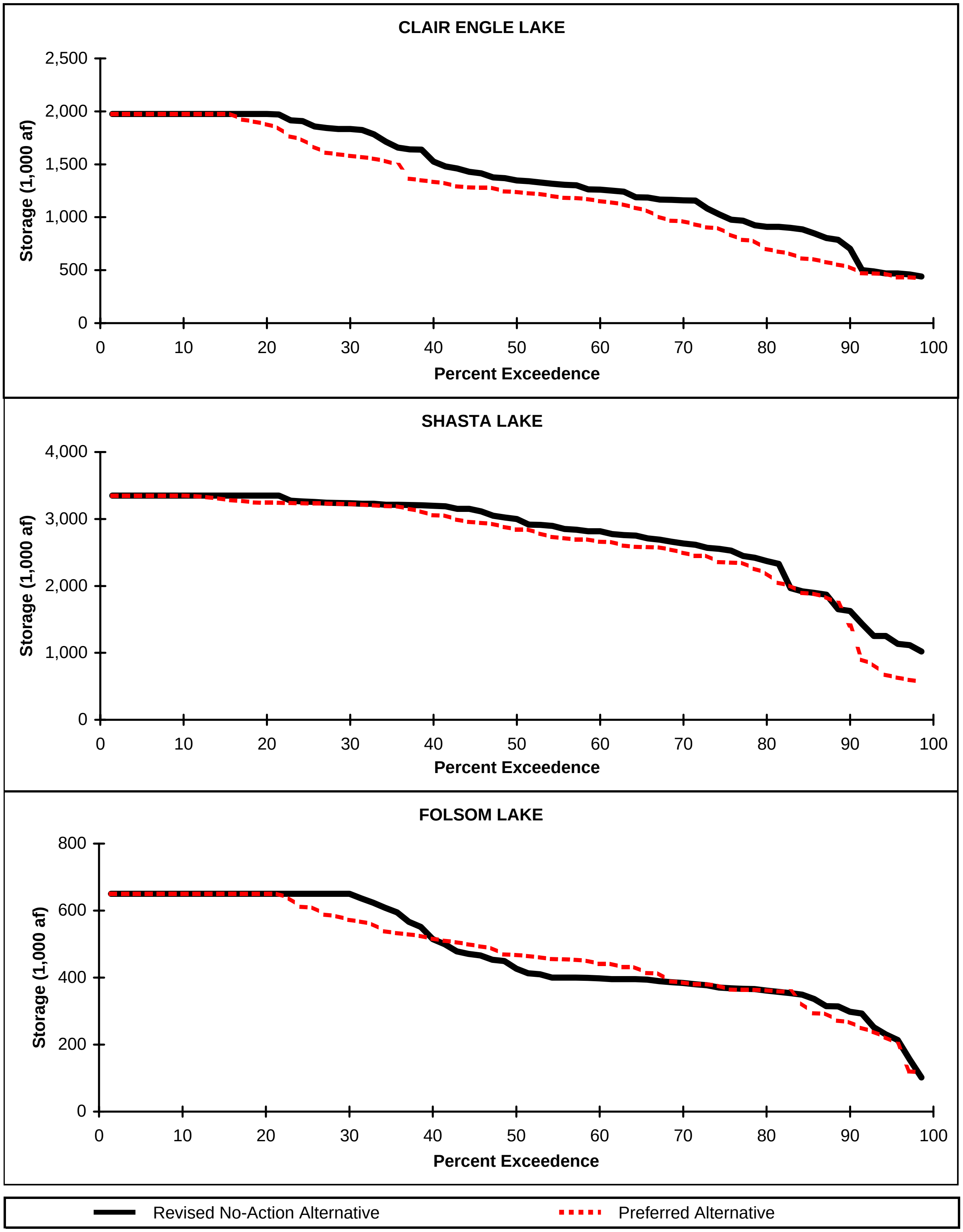


FIGURE IV-54
TRINITY, SHASTA, AND AMERICAN RIVER DIVISIONS
SIMULATED FREQUENCY OF END-OF-WATER YEAR STORAGE
WATER YEARS 1922-1990

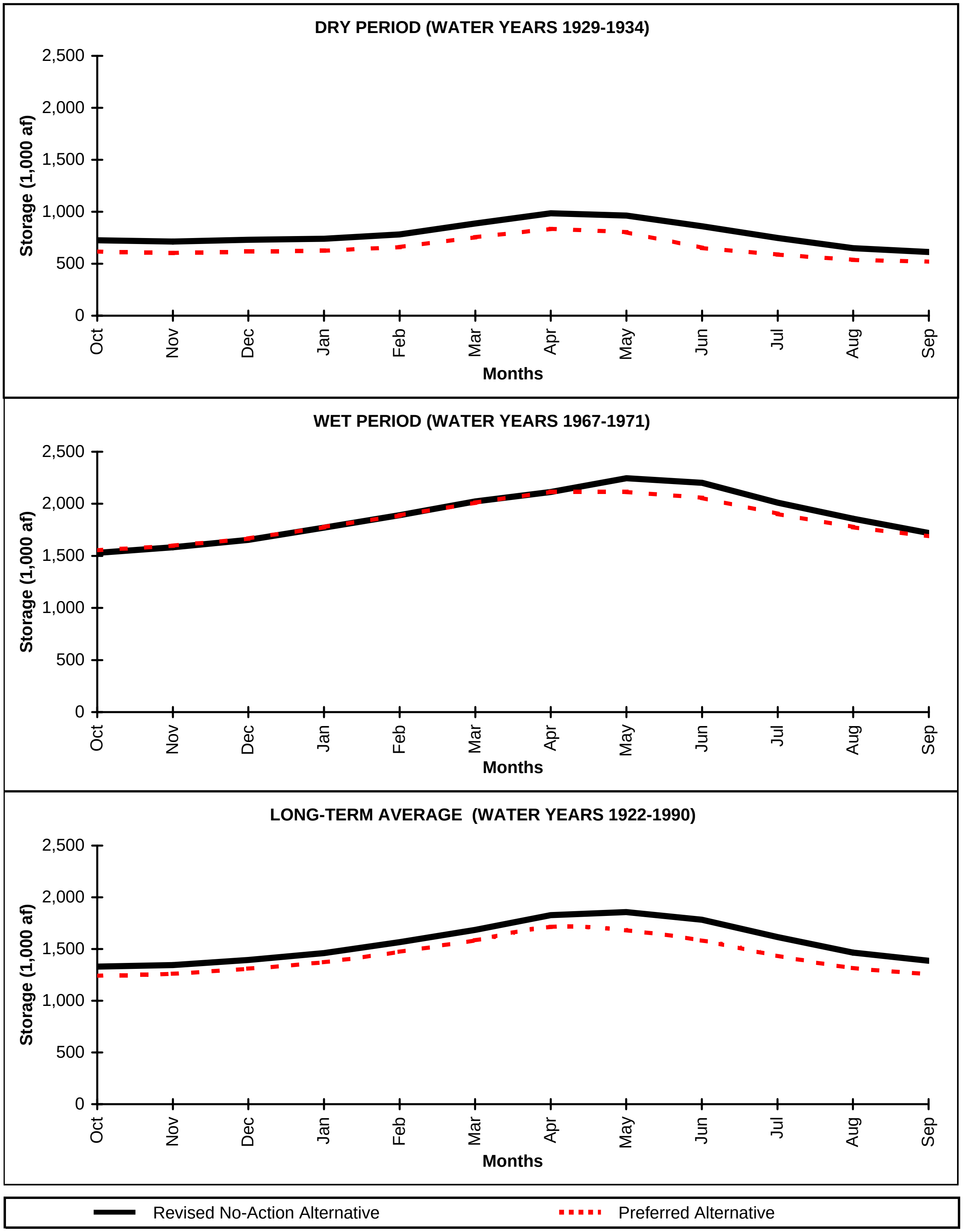


FIGURE IV-55
CLAIR ENGLE LAKE
SIMULATED AVERAGE END-OF-MONTH STORAGE

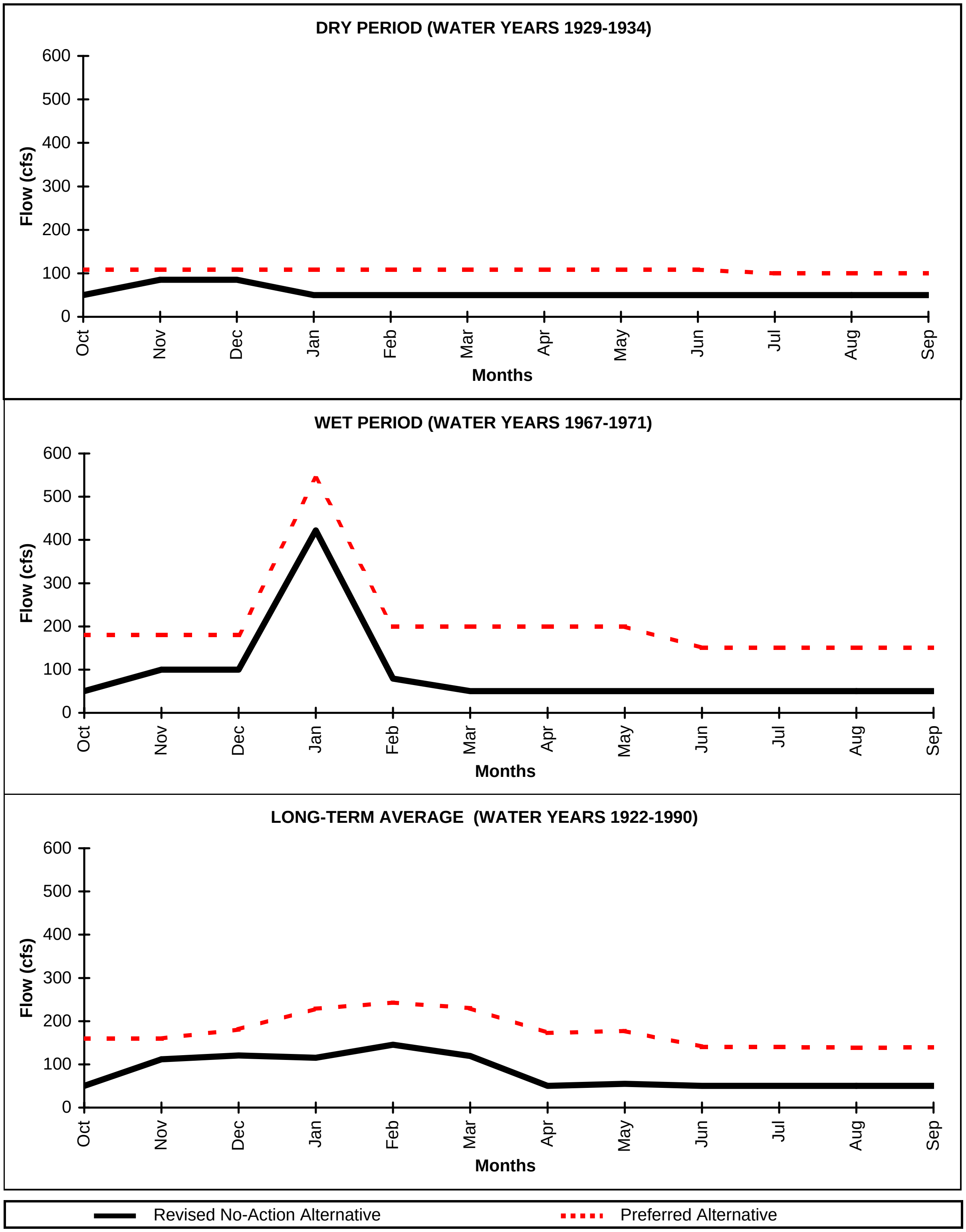


FIGURE IV-56
CLEAR CREEK BELOW WHISKEYTOWN LAKE
SIMULATED AVERAGE MONTHLY FLOWS

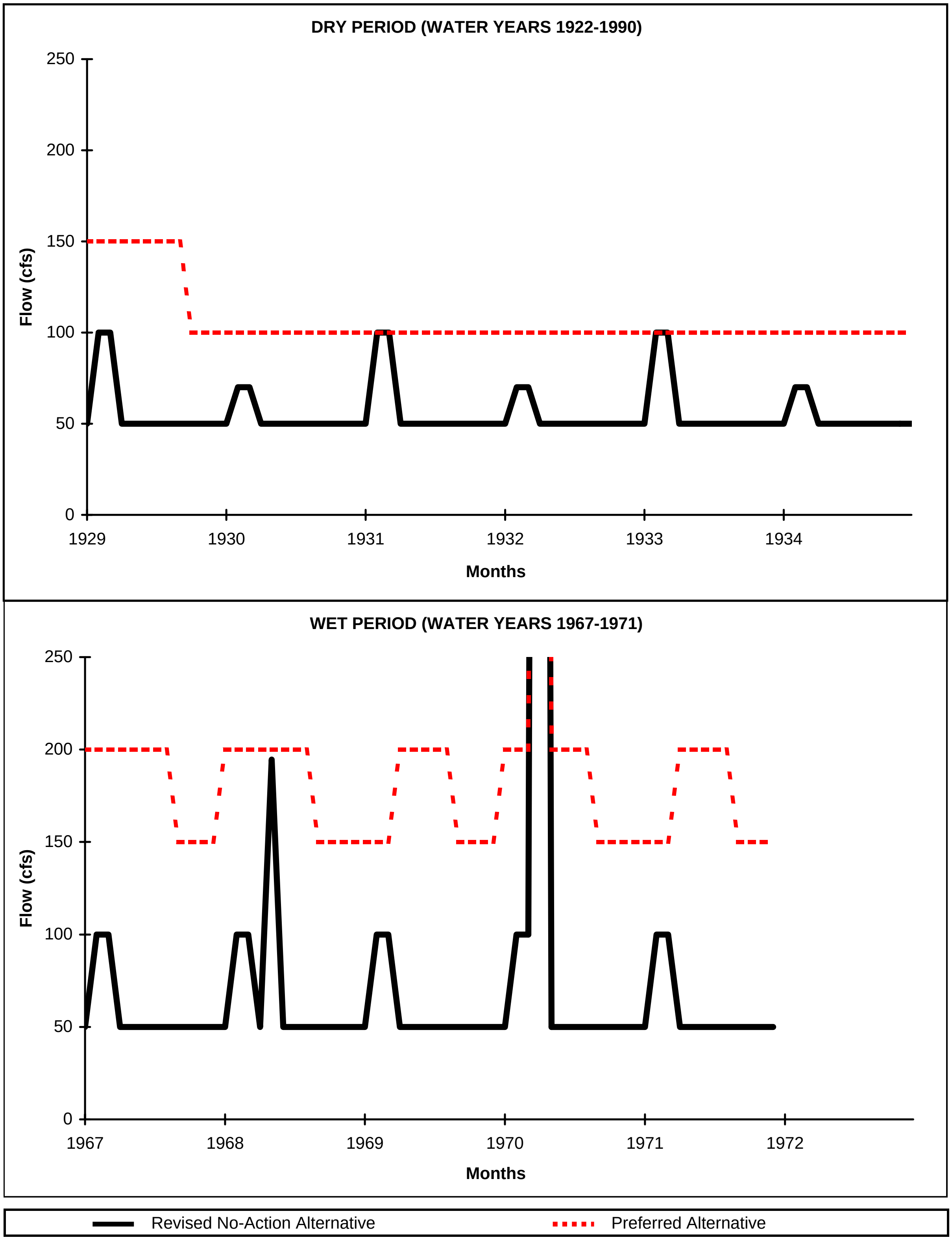


FIGURE IV-57
CLEAR CREEK BELOW WHISKEYTOWN LAKE
SIMULATED MONTHLY FLOWS

storage in following years as compared to the Revised No-Action Alternative, unless Shasta Lake refills or subsequent releases are reduced. Comparisons of average monthly flows in the Sacramento River below Keswick Dam for the dry, wet, and long-term average periods are presented in Figure IV-58. Simulated monthly flows in the Sacramento River below Keswick Dam are shown in Figure IV-59. As compared to the Revised No-Action Alternative, long-term average annual flows are 250,000 acre-feet or 4 percent lower and average annual flows during the dry period are 90,000 acre-feet or 2 percent lower.

With the implementation of Preferred Alternative, it is not possible to maintain the same minimum storage levels in Shasta Lake as in the Revised No-Action Alternative. The long-term average reduction in Shasta Lake end-of-water year storage is about 130,000 acre-feet or 5 percent. During the dry period, the minimum storage in the Preferred Alternative is reduced to approximately 540,000 acre-feet, which is 460,000 acre-feet less than the minimum storage of 1,000,000 acre-feet maintained in the Revised No-Action Alternative. This minimum storage is also lower than the historical minimum of about 560,000 acre-feet, which occurred in 1977. A comparison of Shasta Lake end-of-water year storage is shown in the frequency distributions for the Preferred Alternative and the Revised No-Action Alternative in Figure IV-54. Average end-of-month storage comparisons for the dry, wet, and long-term average periods are shown in Figure IV-60.

These storage reductions in Shasta Lake reduce the ability of the CVP to maintain the cold water pool for releases to comply with 1995 Winter-Run Biological Opinion temperature requirements and will require re-consultation with NMFS. The biological opinion requires a minimum end-of-water year storage of 1.9 million acre-feet in Shasta Lake to maintain the cold water pool for Sacramento River temperature control, except in the 10 percent driest years. In these extremely dry years, Reclamation would reconsult with NMFS to determine appropriate operations under the biological opinion. In the Revised No-Action Alternative, end-of-water year storage in Shasta Lake is below 1.9 million acre-feet in 8 years or 12 percent of the years in the 69-year simulation period. In the Preferred Alternative, end-of-water year storage in Shasta Lake is below 1.9 million acre-feet in 9 years or 13 percent. Storage in these extremely dry years is also considerably lower than in the Revised No-Action Alternative, which further reduces the ability of the CVP to meet the temperature requirements in the Preferred Alternative.

The results of Reclamation's temperature model simulations indicate a decrease in the frequency of temperature compliance during summer months in the Preferred Alternative as compared to the Revised No-Action Alternative. The percentage of months that are in compliance with the 1995 Winter-Run Biological Opinion temperature requirements in the Preferred Alternative and the Revised No-Action Alternative are presented in Table IV-66 and Figure IV-61. Table IV-67 and Figure IV-61 show the percentage of months that are predicted to be in compliance with the biological opinion temperature requirements with the critical dry years, where reconsultation would occur, removed. It must be recognized, that due to the limitations of the monthly models used to simulate temperature operations, the models are not able to account for all of the operational variables that affect river temperatures and therefore may underrepresent temperature impacts.

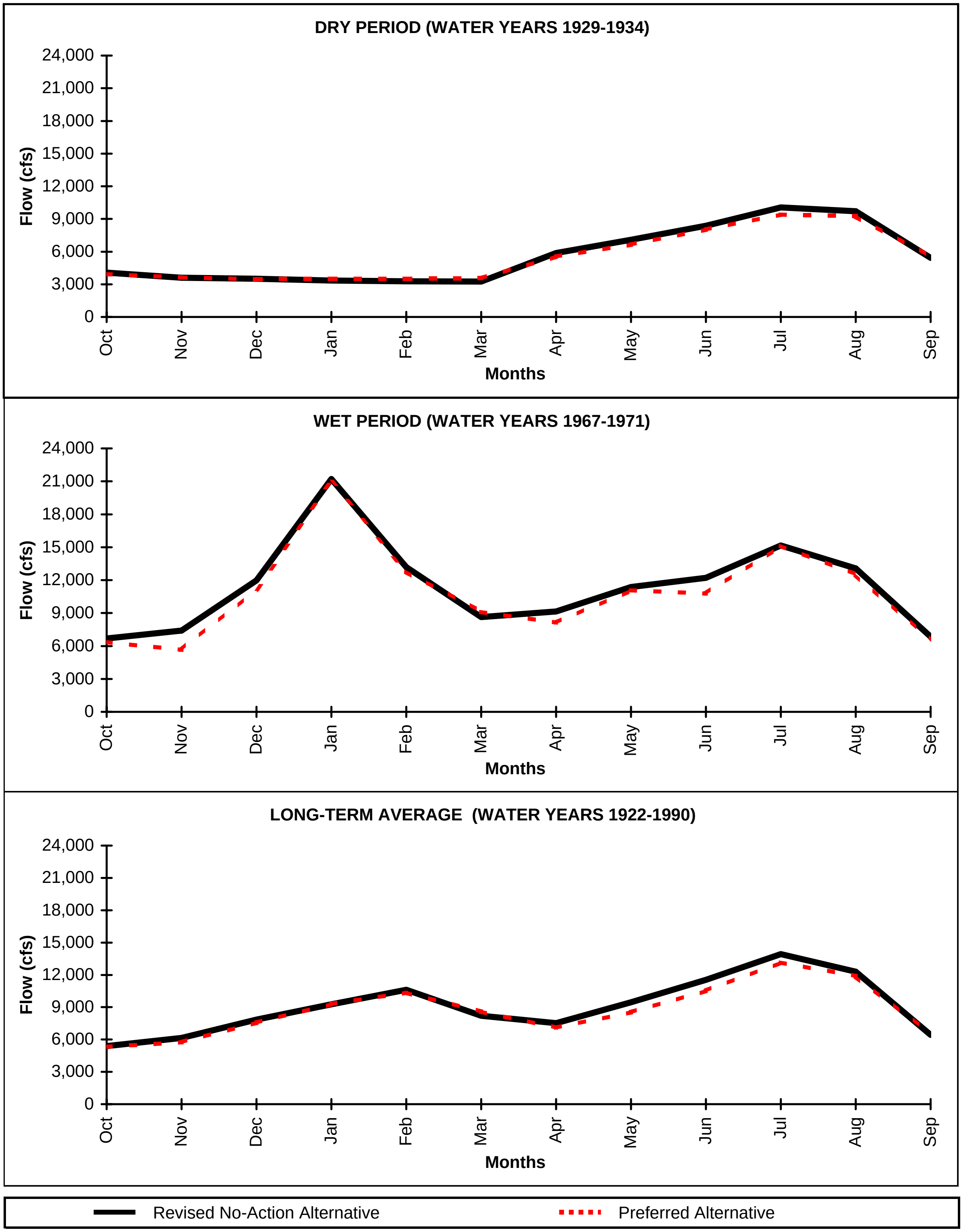


FIGURE IV-58
SACRAMENTO RIVER BELOW KESWICK
SIMULATED AVERAGE MONTHLY FLOWS

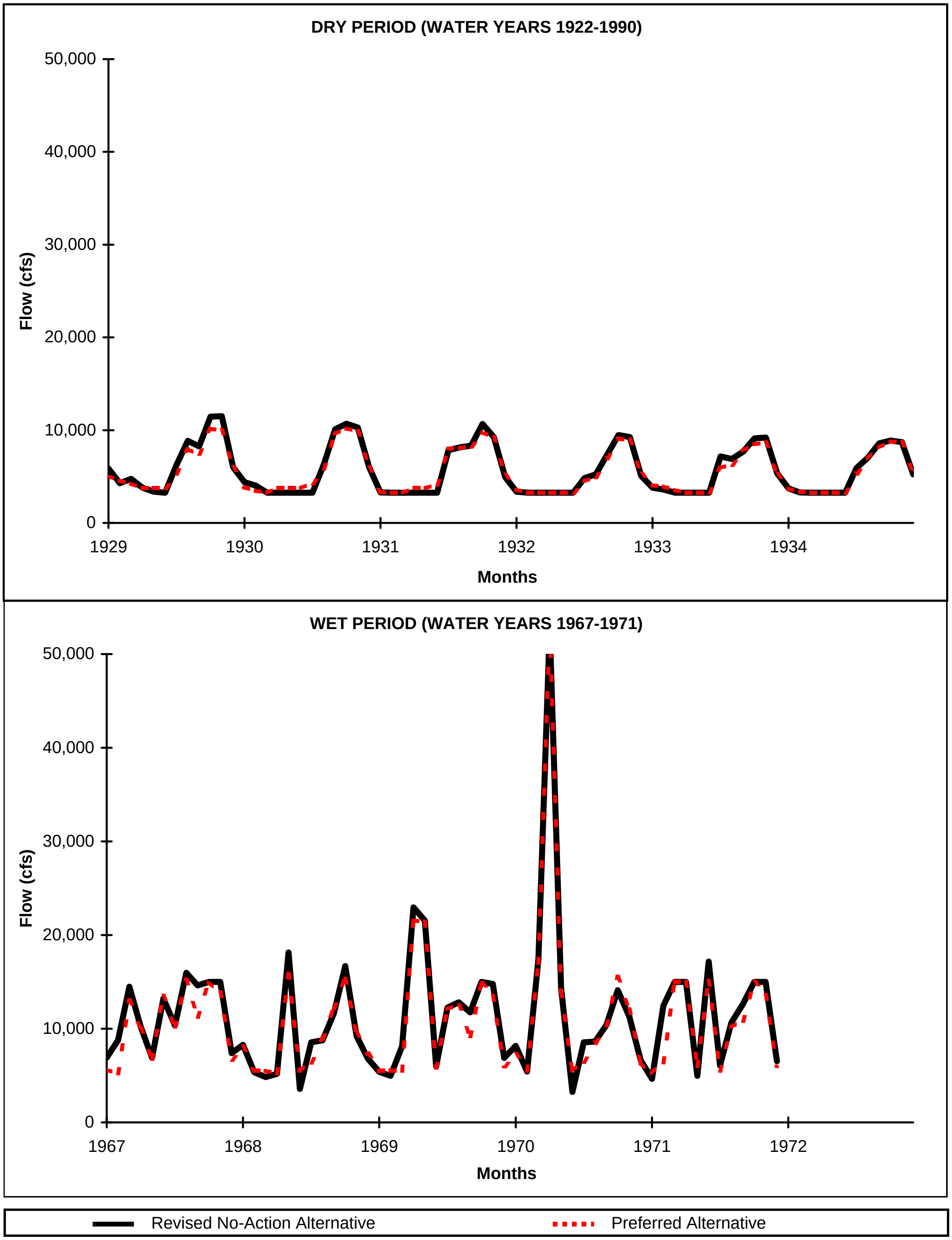


FIGURE IV-59
SACRAMENTO RIVER BELOW KESWICK
SIMULATED MONTHLY FLOWS

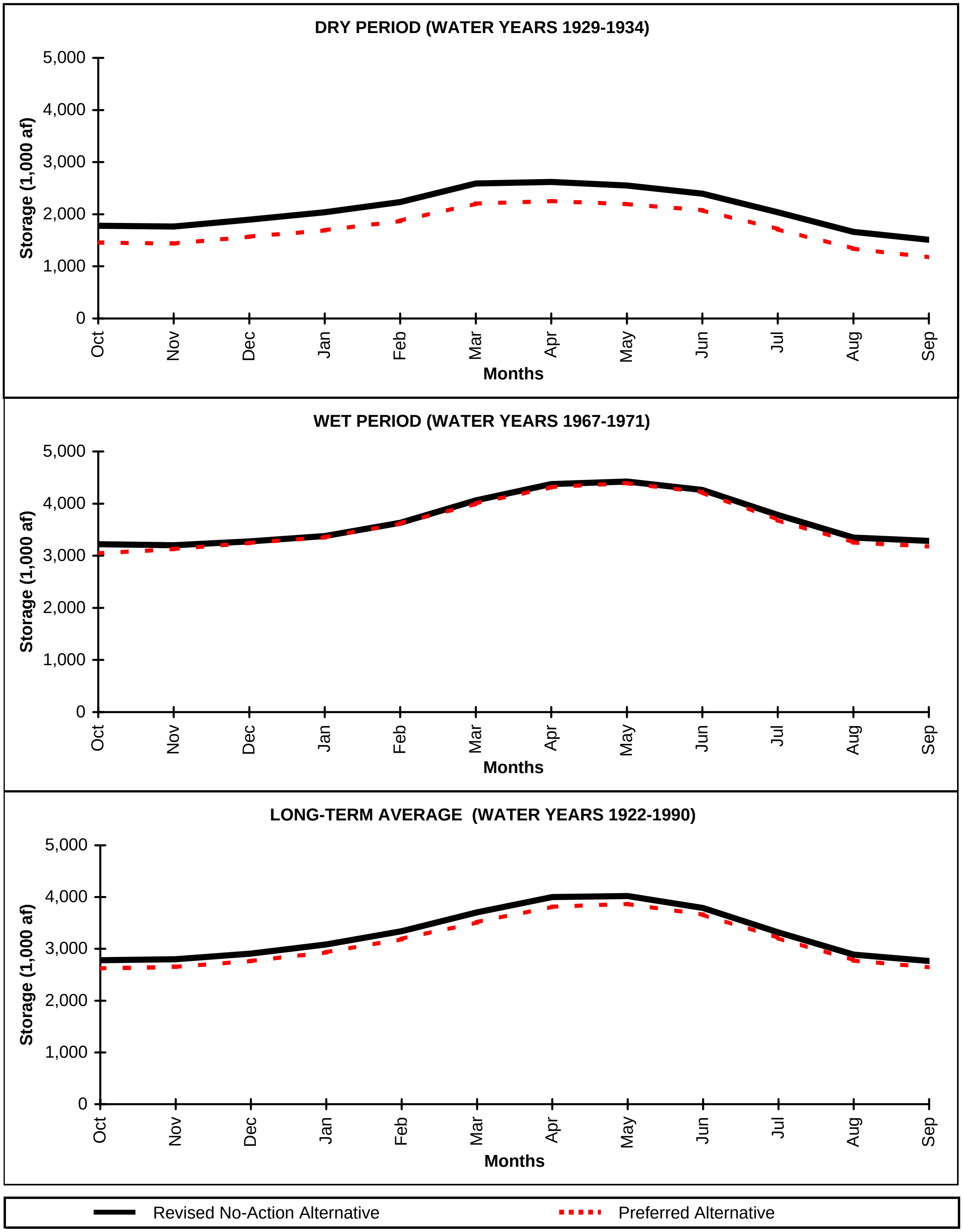


FIGURE IV-60
SHASTA LAKE
SIMULATED AVERAGE END-OF-MONTH STORAGE

TABLE IV-66

COMPARISON OF SIMULATED MONTHS MEETING THE 1995 WINTER-RUN BIOLOGICAL OPINION IN THE PREFERRED ALTERNATIVE SIMULATION TO THE REVISED NO-ACTION ALTERNATIVE SIMULATION, 1922 - 1990

Simulation	Percent of Months Meeting Temperature Requirements						
	Apr	May	Jun	Jul	Aug	Sep	Oct
Revised No-Action Alternative	93	87	87	78	81	71	91
Preferred Alternative	99	78	81	68	75	71	94

NOTE:
1995 Winter-Run Biological Opinion temperature requirements in effect April through October. Target locations between Bend Bridge and Jelly's Ferry based on Sacramento River Index.

Comparisons of average monthly flows in the Sacramento River below Grimes for the dry, wet, and long-term average periods are presented in Figure IV-62. These flows reflect operational changes upstream of Grimes including releases from Shasta and Whiskeytown lakes and from reductions in diversions from the Trinity River Basin. However, these operational changes are small in proportion to the total flows below Grimes. Simulated monthly flows in the Sacramento River below Grimes during the dry and wet periods are presented in Figure IV-63.

Changes in Folsom Lake operations for implementation of CVPIA also affect the need for releases from Shasta Lake and the resulting Sacramento River flows below Keswick. In the Preferred Alternative, releases from Folsom Lake are increased in the fall, winter, and spring months to meet (b)(2) flows on the American River. These increased flows meet a greater portion of the Delta water quality and outflow requirements, potentially reducing the need for releases from Shasta Lake which may be in excess of (b)(2) flows below Keswick. Conversely, lower Folsom Lake releases in the summer months of some years may require higher Shasta Lake releases for Delta requirements.

As system demands increase and operational criteria become more complex, the ability of the CVP to respond to short-term increases in the need for water is reduced. In most dry and critical dry years, Shasta Lake releases are governed by water rights and fisheries objectives including the (b)(2) flows, the 1995 Winter-Run Biological Opinion, and Delta water quality requirements. CVP Delta exports are generally limited to incidental Delta inflows resulting from upstream releases for fisheries purposes and return flows from water rights diversions.

American River Division. In the Preferred Alternative, Folsom Lake and American River operations are directly affected by changes in operations to meet (b)(2) flows on the American River; Delta actions specified in (b)(2) Water Management, and the changes to Trinity, Shasta, and Sacramento River division operations described above. The primary fishery goal on the American River is to provide higher, more stable fall and winter flows. The CVP's operational ability to meet the (b)(2) flows is limited by the highly variable American River flows, relatively small Folsom Lake storage capacity, and the high M&I and water rights demands.

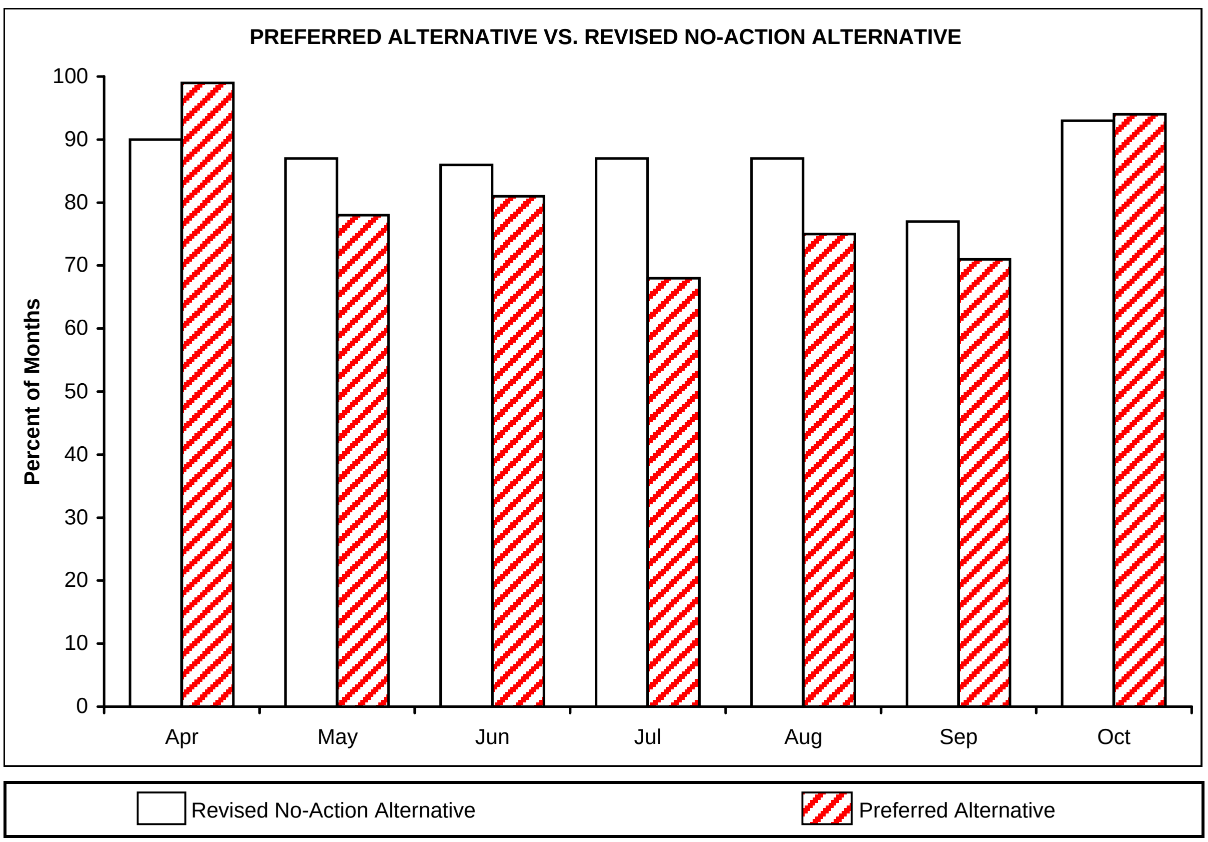


FIGURE IV-61
SIMULATED PERCENT OF MONTHS MEETING 1995 WINTER RUN B.O.
SACRAMENTO RIVER BELOW KESWICK 1922-1990

TABLE IV-67

COMPARISON OF SIMULATED MONTHS MEETING THE 1995 WINTER-RUN BIOLOGICAL OPINION IN THE PREFERRED ALTERNATIVE SIMULATION TO THE REVISED NO-ACTION ALTERNATIVE SIMULATION, NON-CRITICAL YEARS

Simulation	Percent of Months Meeting Temperature Requirements						
	Apr	May	Jun	Jul	Aug	Sep	Oct
Revised No-Action Alternative	93	88	90	88	90	80	99
Preferred Alternative	99	80	86	80	86	80	99

NOTES:

1995 Winter-Run Biological Opinion temperature requirements in effect April through October. Target locations between Bend Bridge and Jelly's Ferry based on Sacramento River Index.

Results for the critical years 1924, 1929, 1931, 1932, 1933, 1934, and 1977 are not included. Per the 1995 Winter-Run Biological Opinion, reconsultation would be expected to occur in these years because simulated end-of-water year storage in Shasta Lake is less than 1.9 million acre-feet.

Folsom Lake releases are reduced during the summer months and increased in the fall, winter, and spring months in an attempt to meet the (b)(2) flows on the American River below Nimbus. This shift in the timing of releases is shown in the comparison of average monthly flows in the American River below Nimbus during the dry, wet, and long-term average periods in Figure IV-64. Simulated monthly flows in the American River below Nimbus during the dry and wet periods are shown in Figure IV-65.

Over the long-term average, Folsom Lake end-of-water year storage is similar to the Revised No-Action Alternative. In some wet years, increased releases to meet the (b)(2) spring pulse flows result in lower storages than in the Revised No-Action Alternative, as shown in the frequency distribution in Figure IV-54. During the dry period, increased releases in the fall and winter months for target flows and Delta actions reduce average end-of-water year storage by 90,000 acre-feet or 23 percent as compared to the Revised No-Action Alternative. Average end-of-month storage comparisons for the dry, wet, and long-term average periods are shown in Figure IV-66.

Eastside Division. Frequency distributions of simulated end-of-water year storages in New Melones Reservoir are presented in Figure IV-67. As shown on this figure, end-of-year reservoir storage levels in the Preferred Alternative are lower than levels in the Revised No-Action Alternative in almost all years. The most notable difference is a reduction of frequency in years when end-of-year storage is the maximum allowable under flood control requirements. In the Revised No-Action Alternative, maximum end-of-year storage would occur in approximately 20 percent of the years. In the Preferred Alternative, this frequency is reduced to about 10 percent. The decrease in storage results primarily from changes in New Melones Reservoir operations to make additional releases to meet the target flows of the SJRA.

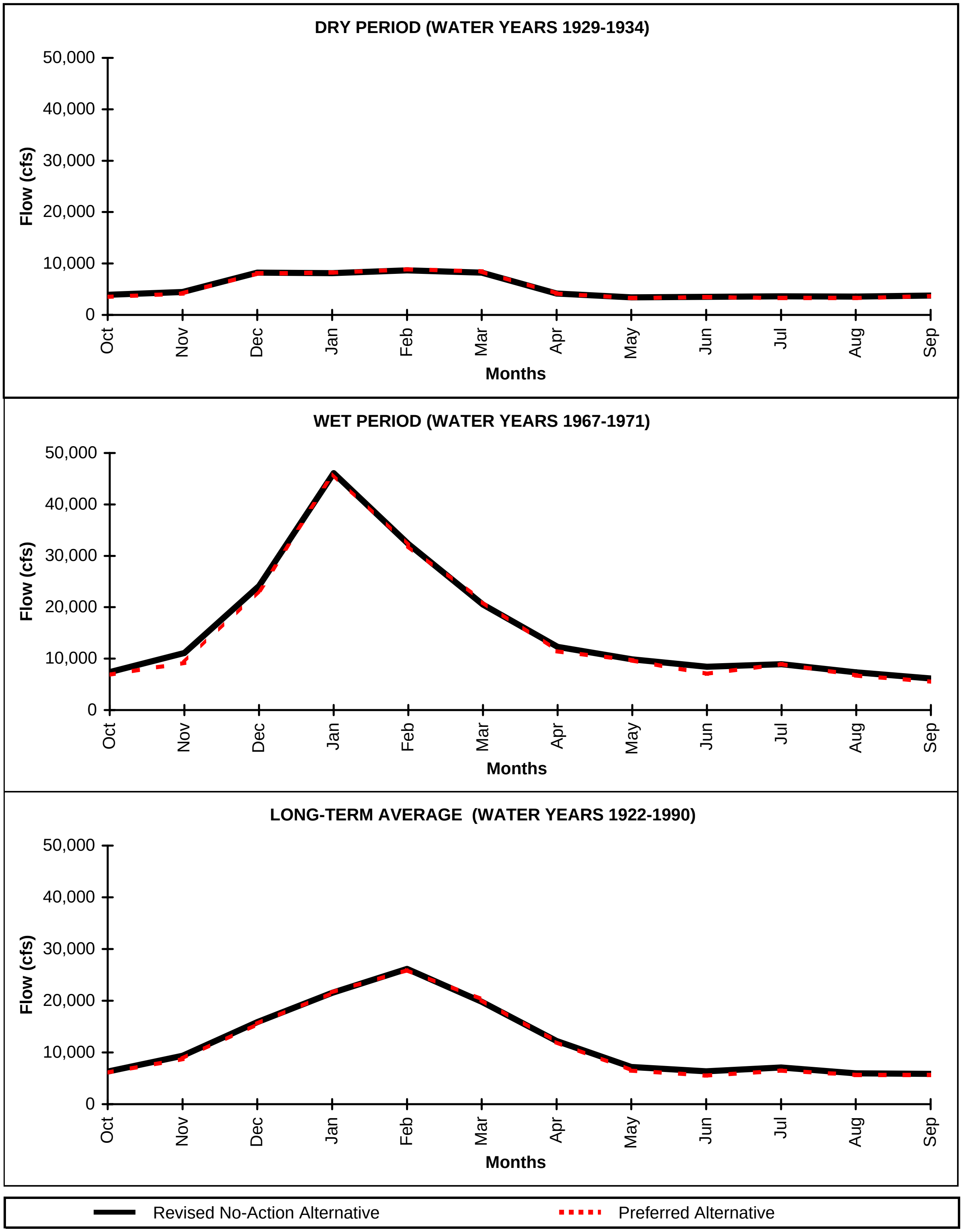


FIGURE IV-62
SACRAMENTO RIVER BELOW GRIMES
SIMULATED AVERAGE MONTHLY FLOWS

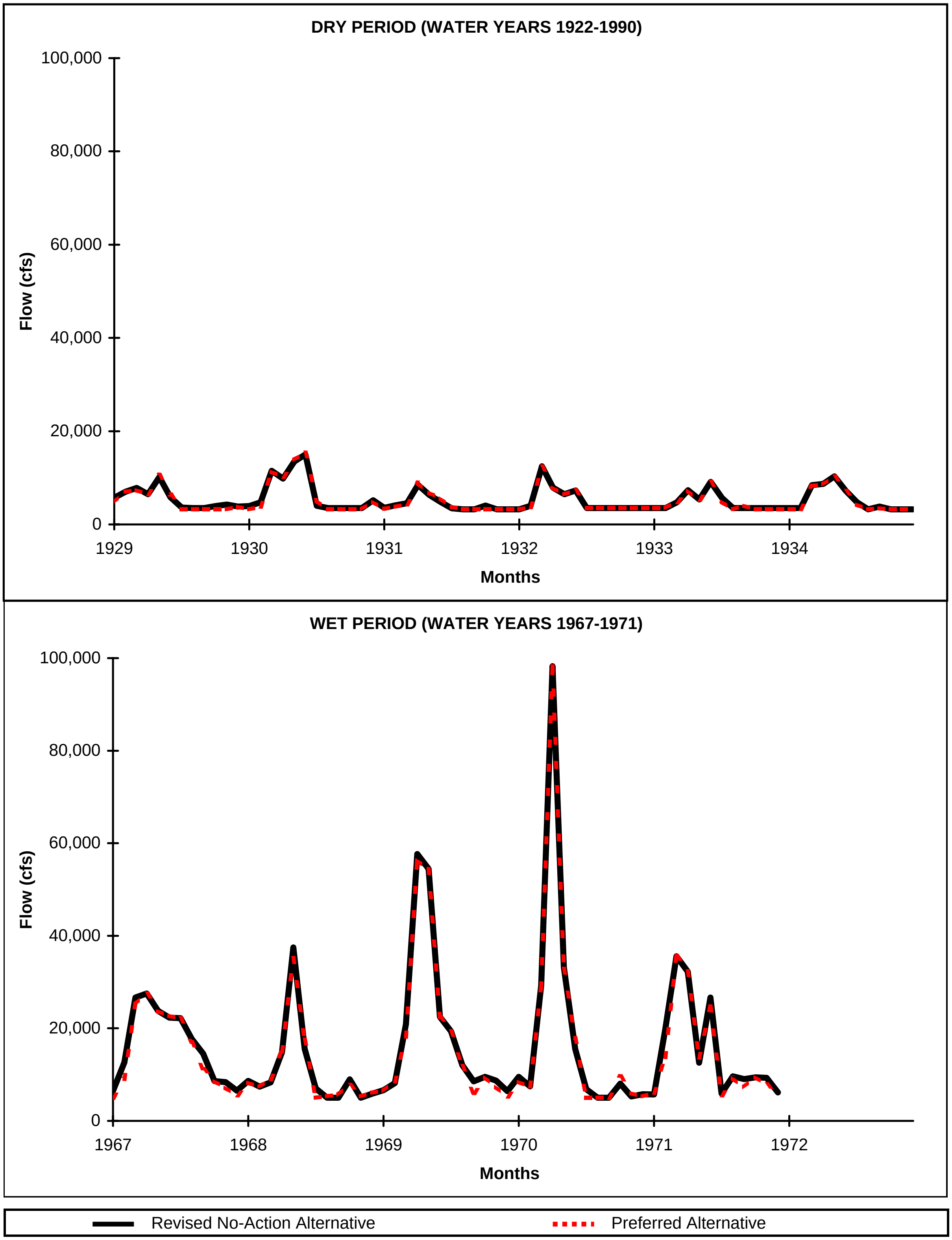


FIGURE IV-63
SACRAMENTO RIVER BELOW GRIMES
SIMULATED MONTHLY FLOWS

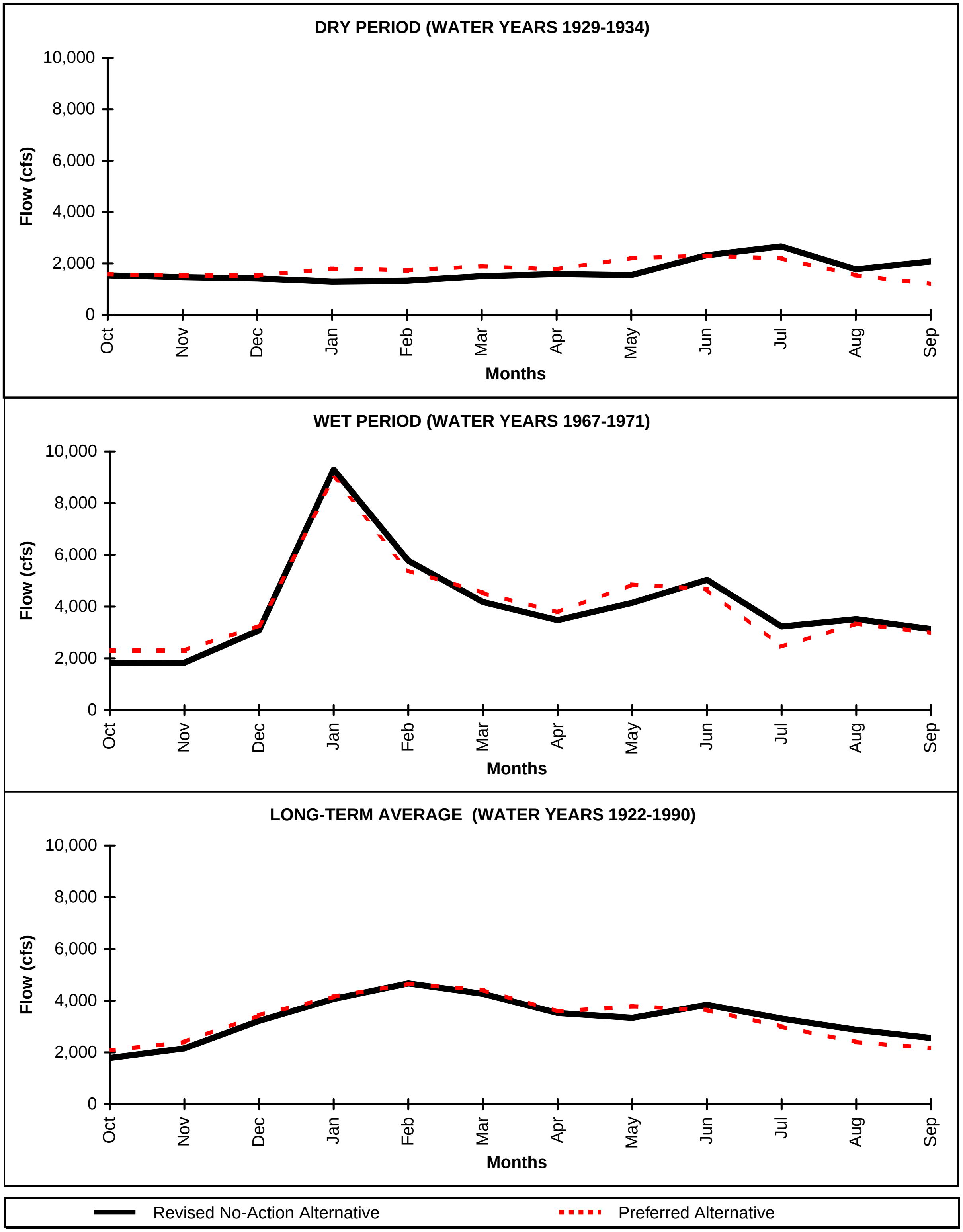


FIGURE IV-64
AMERICAN RIVER BELOW NIMBUS
SIMULATED AVERAGE MONTHLY FLOWS

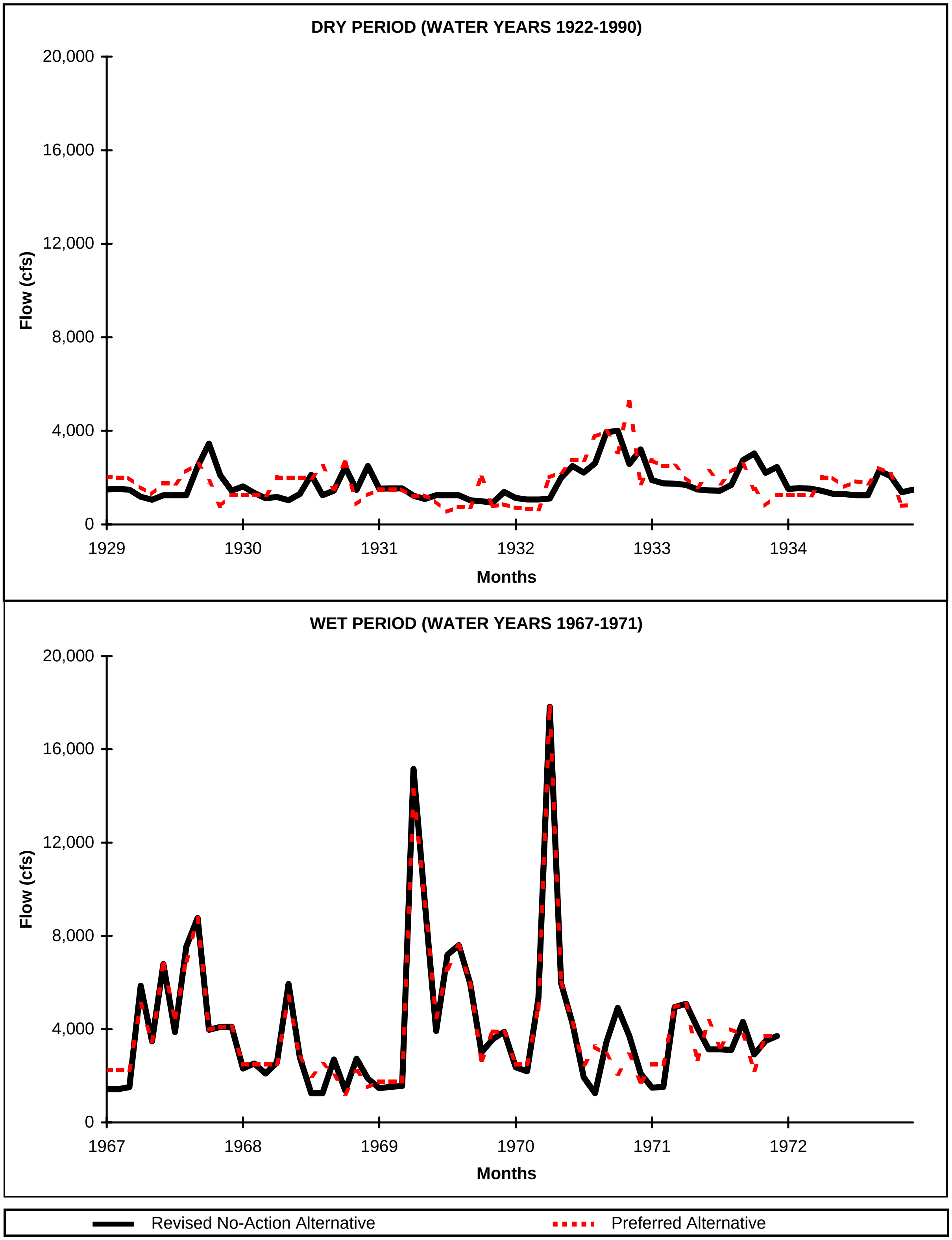


FIGURE IV-65
AMERICAN RIVER BELOW NIMBUS
SIMULATED MONTHLY FLOWS

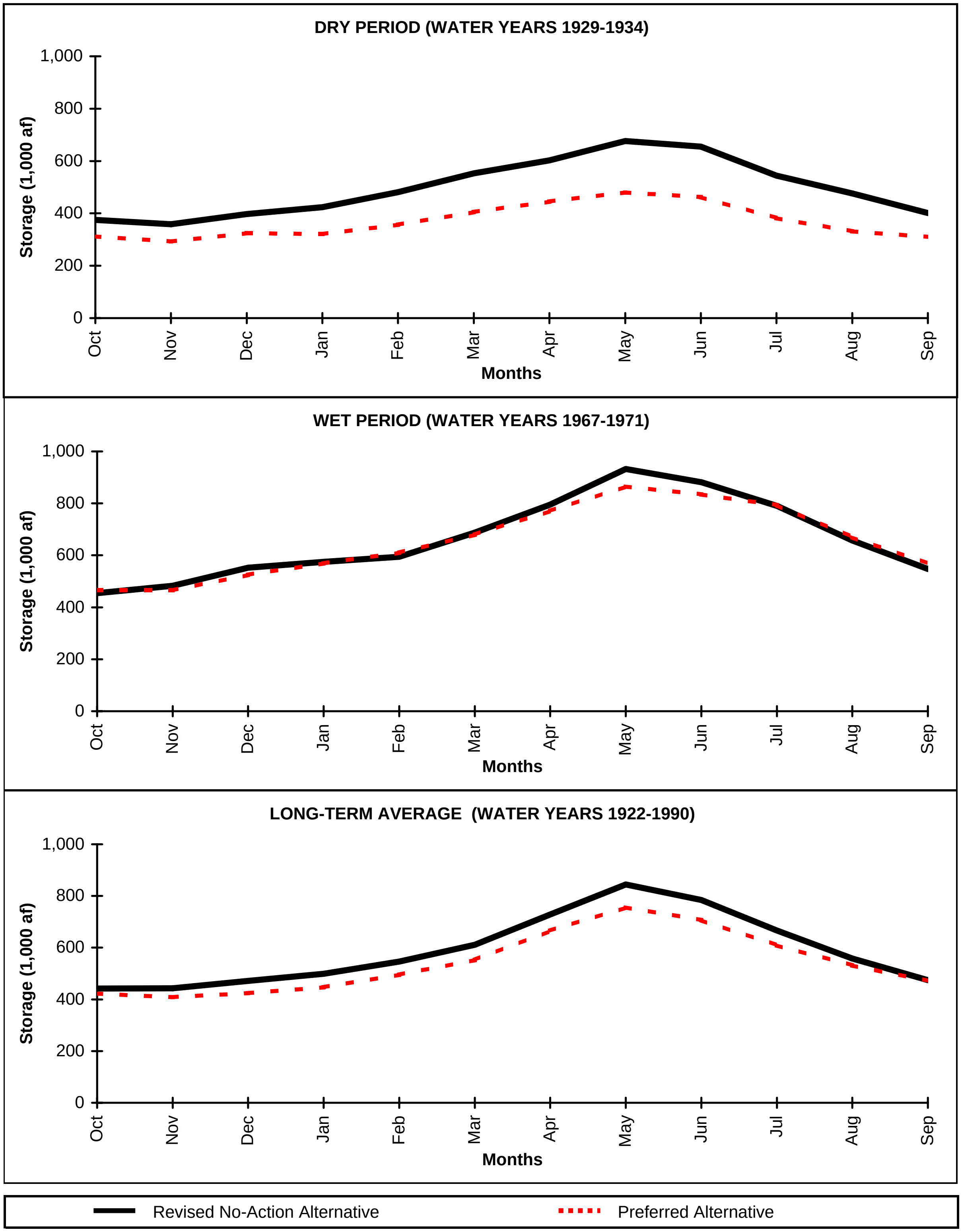
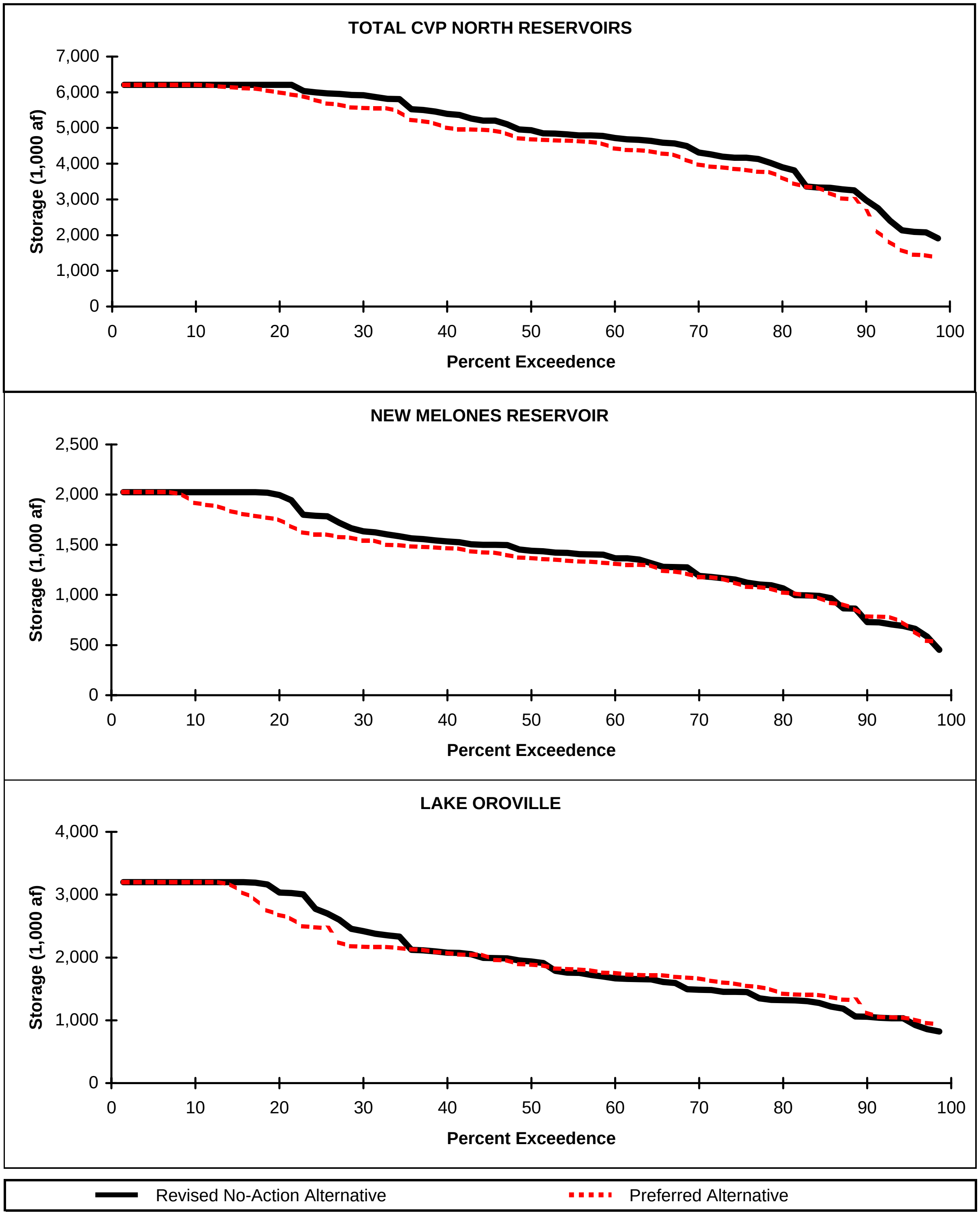


FIGURE IV-66
FOLSOM LAKE
SIMULATED AVERAGE END-OF-MONTH STORAGE



NOTE: Total CVP North Reservoirs include Clair Engle Lake, Whiskeytown Reservoir, Shatsa Lake, and Folsom Lake.

FIGURE IV-67
TOTAL CVP NORTH, EASTSIDE DIVISION, AND STATE SIMULATED FREQUENCY OF END-OF-WATER YEAR STORAGE WATER YEARS 1922-1990

As shown in Figure IV-68, simulated long-term average monthly flows in the Stanislaus River below Goodwin Dam under the Preferred Alternative would increase in the April through June pulse flow period, with offsetting reductions in flow during the summer and fall months, as compared to the Revised No-Action Alternative. Long-term average annual flow in the Stanislaus River below Goodwin Dam would remain approximately the same in both alternatives.

As shown in Figure IV-69, simulated average monthly flows in the Tuolumne River below Lagrange under the Preferred Alternative would primarily increase in the April through May pulse flow period. In wetter years, flows would also increase during the winter months. These increased flows result from implementation of the SJRA.

As shown in Figure IV-70, simulated long-term average monthly flows in the Merced River below Crocker Huffman under the Preferred Alternative would increase in the April through May pulse flow period as compared to the Revised No-Action Alternative. During wetter years, flows would decrease in the fall and winter months, as compared to the Revised No-Action Alternative. The long-term average annual flow in the Merced River below Crocker Huffman would remain approximately the same in both alternatives.

The combined contribution of acquired water released on the Merced, Tuolumne, and Stanislaus rivers would result in increased flow in the San Joaquin River at Vernalis during April and May, and decreased flow in summer and fall months, as shown in Figure IV-71. The long-term average annual flow in the San Joaquin River at Vernalis would remain approximately the same in both alternatives. Although increased flow in the April and May period would result in improved water quality conditions in these months, the frequency of months meeting Vernalis water quality standards would decrease, as shown in Figure IV-72. This results because the long-term average monthly flow during summer months (irrigation season) and late fall and winter months (non-irrigation season) is often less in the Preferred Alternative than in the Revised No-Action Alternative. Therefore, water quality is less in these months. During the irrigation season, the water quality standard is exceeded in approximately 15 percent of the years under the Preferred Alternative as compared to 10 percent of the years under the Revised No-Action Alternative. During the non-irrigation season, the water quality standard is exceeded in approximately 5 percent of the years under the Preferred Alternative as compared to 2 percent of the years under the Revised No-Action Alternative.

Delta Division. Impacts to the operations of the Delta Division in the Preferred Alternative are a result of reductions in diversions from the Trinity River Basin and of the combined changes to CVP upstream operations in Whiskeytown, Shasta, Folsom, and New Melones lakes for implementation of CVPIA. In comparison to the Revised No-Action Alternative, average annual Delta inflow decreases by approximately 220,000 acre-feet or 1 percent during the long-term average period and is similar during the dry period.

Figure IV-73 shows the change in simulated average monthly exports through Tracy Pumping Plant for the dry, wet, and long-term average periods. The figure shows an increase in average monthly exports during the winter months because of the increased upstream CVP releases to meet (b)(2) target flows. In many years, these combined upstream reservoir releases exceed the

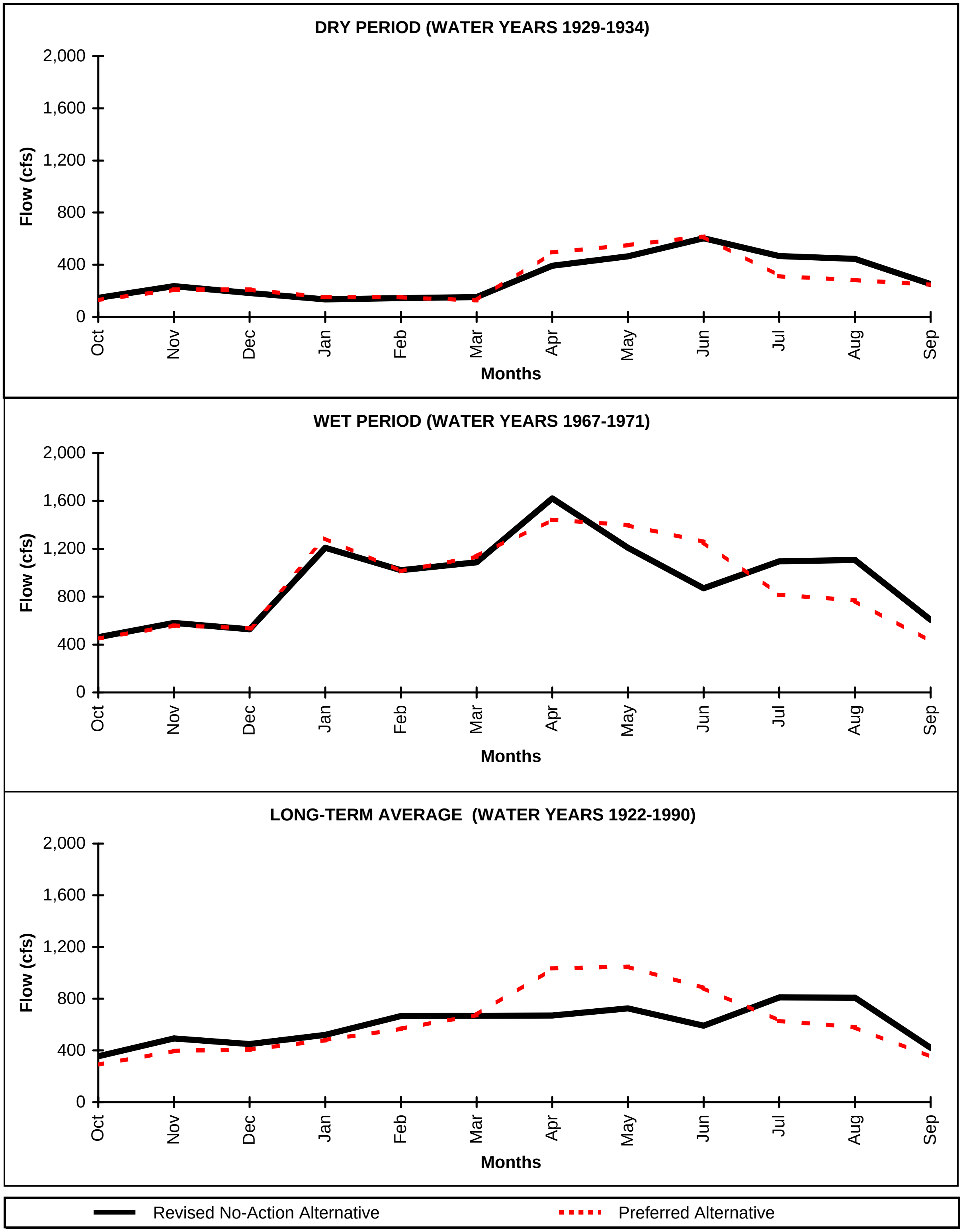


FIGURE IV-68
STANISLAUS RIVER BELOW GOODWIN
SIMULATED AVERAGE MONTHLY FLOWS

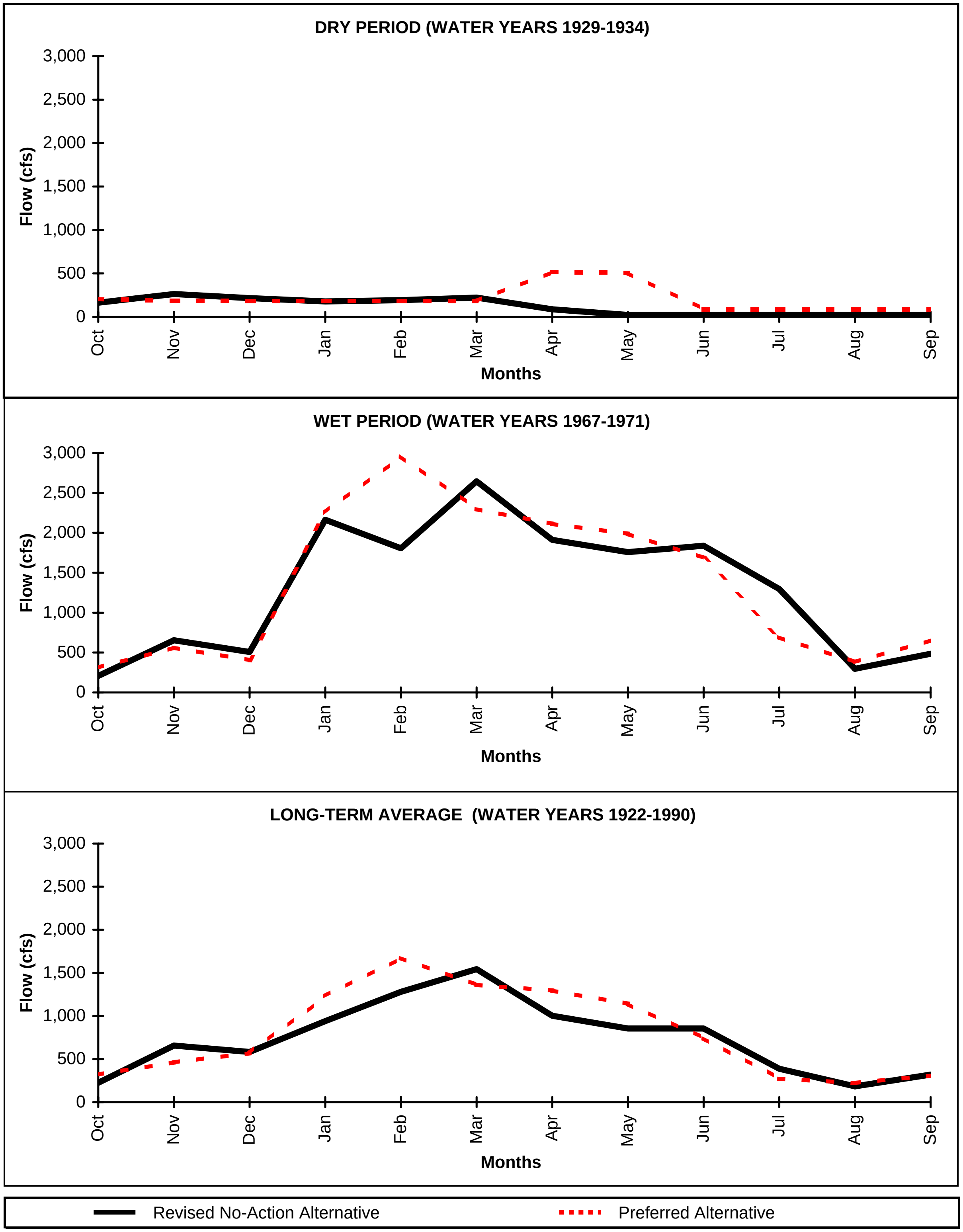


FIGURE IV-69
TUOLUMNE RIVER BELOW LAGRANGE
SIMULATED AVERAGE MONTHLY FLOWS

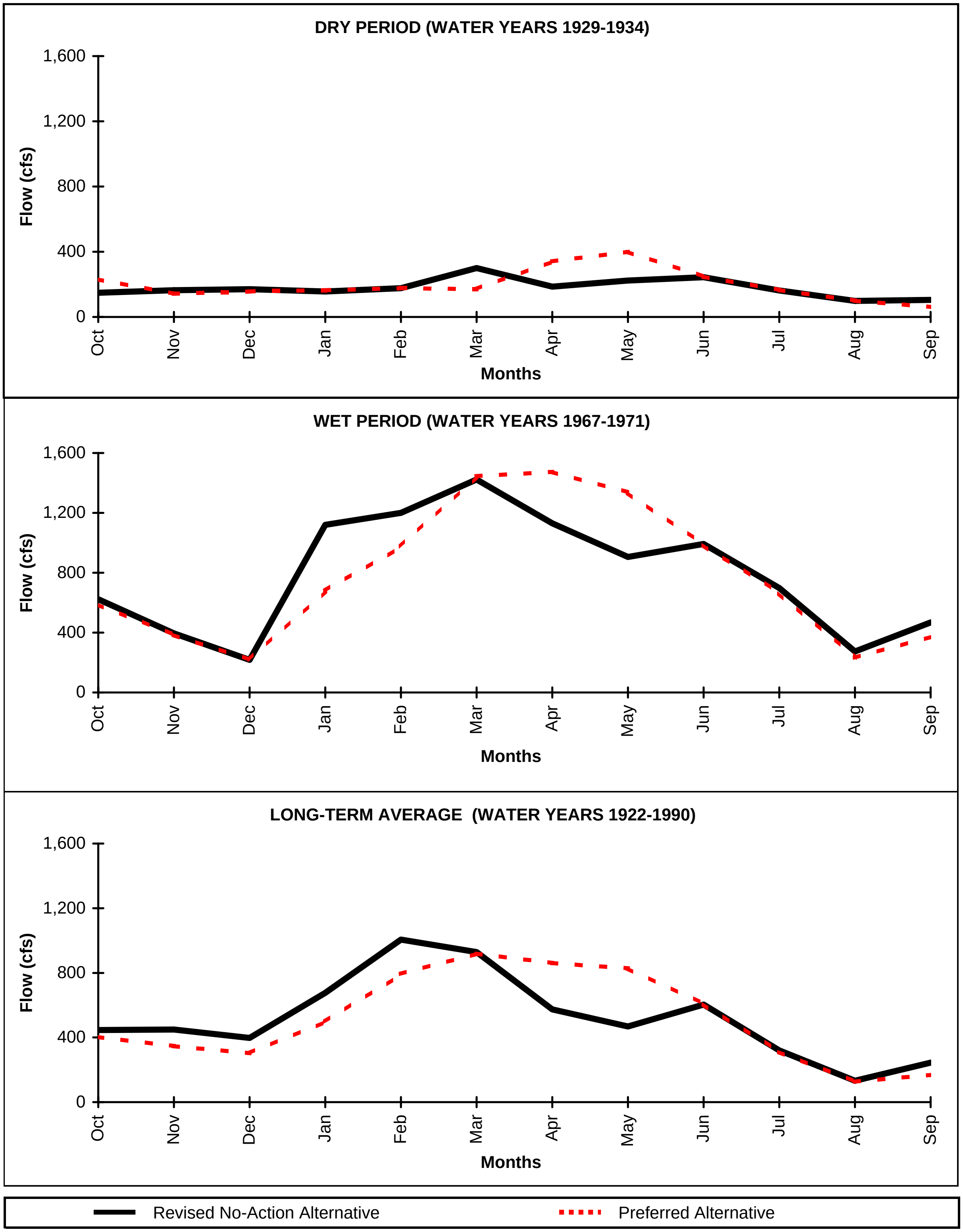


FIGURE IV-70
MERCED RIVER BELOW CROCKER HUFFMAN
SIMULATED AVERAGE MONTHLY FLOWS

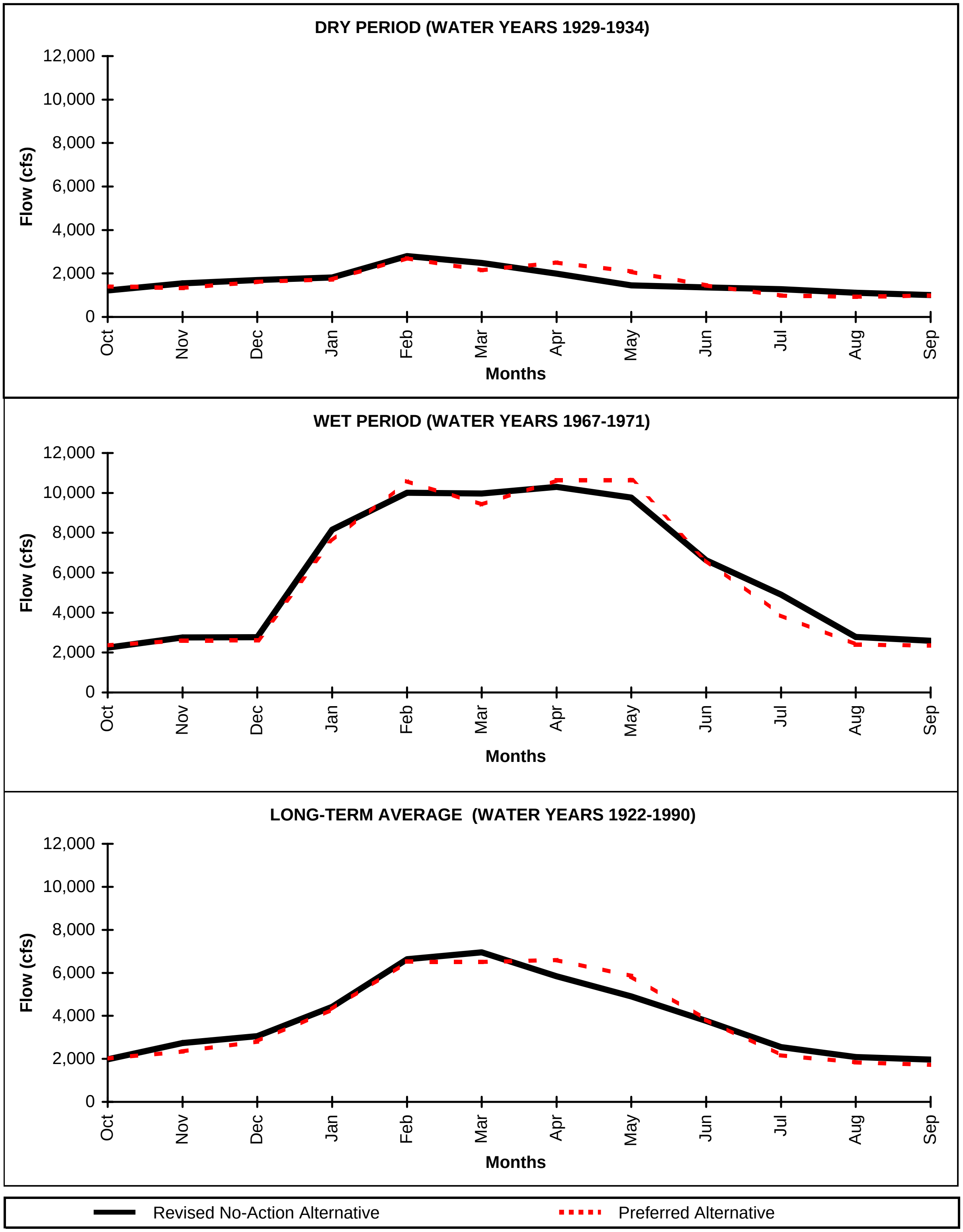


FIGURE IV-71
SAN JOAQUIN RIVER AT VERNALIS
SIMULATED AVERAGE MONTHLY FLOWS

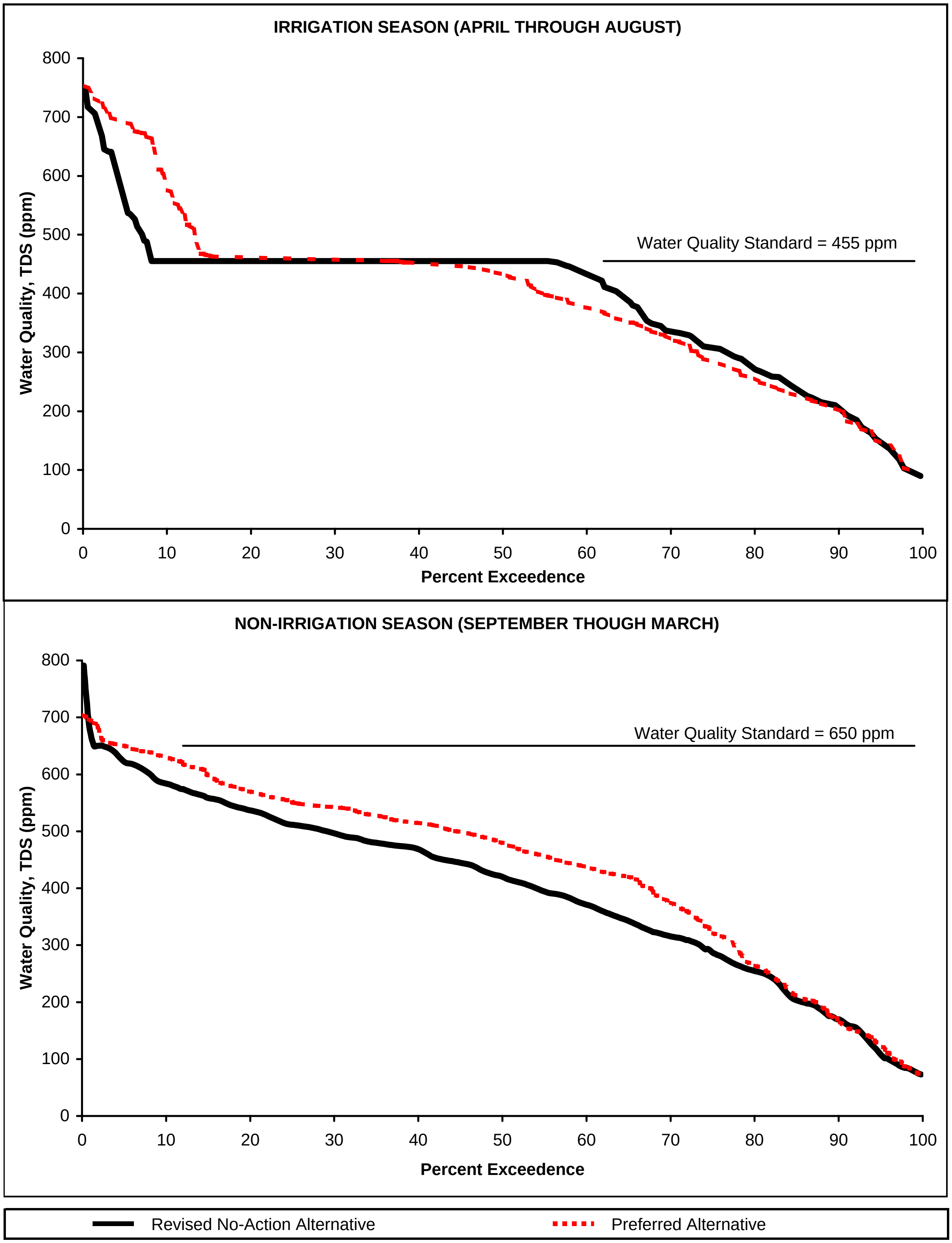


FIGURE IV-72
SIMULATED MONTHLY WATER QUALITY AT VERNALIS

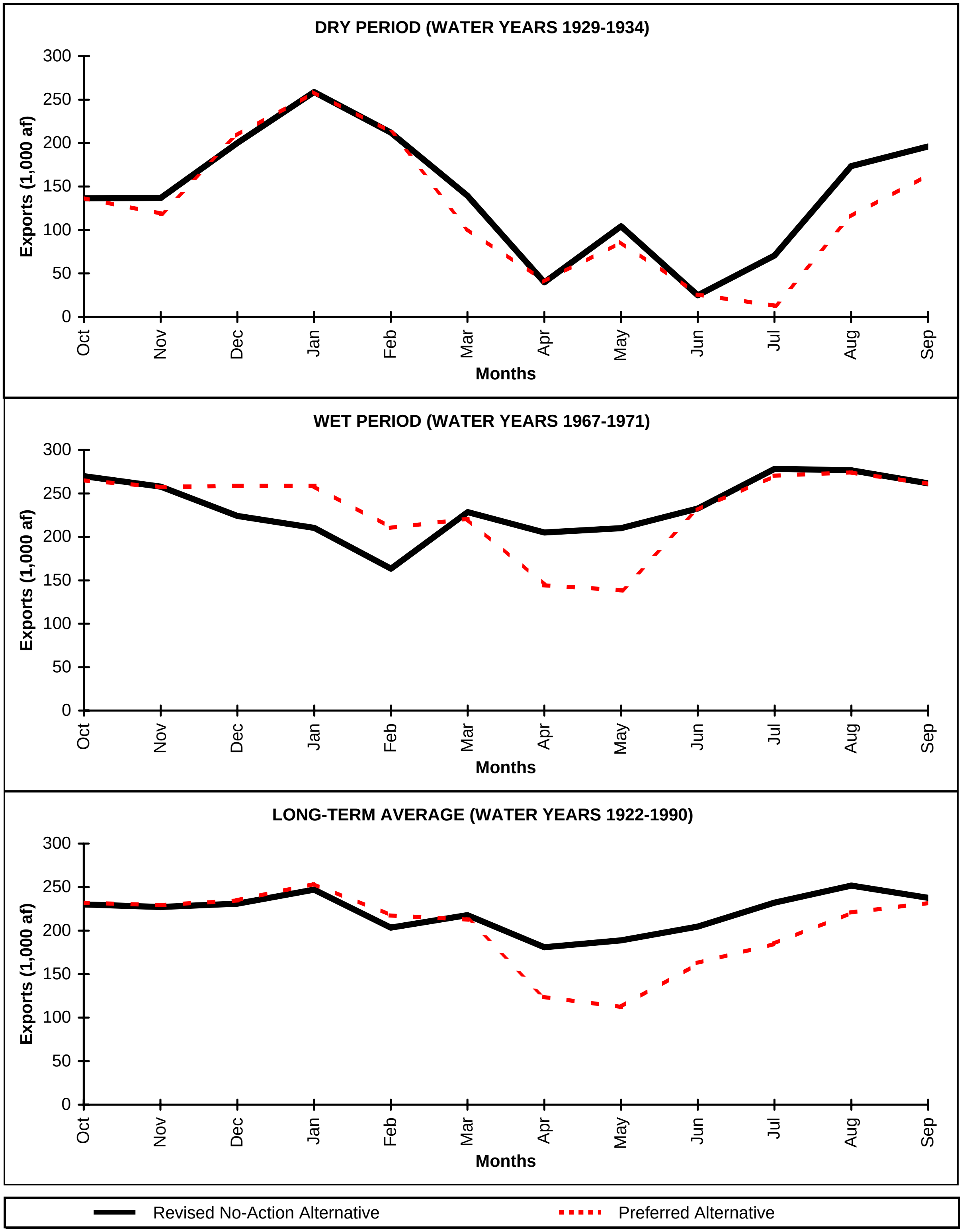


FIGURE IV-73
TRACY PUMPING PLANT
SIMULATED AVERAGE MONTHLY EXPORTS

export capacity of Tracy Pumping Plant and increase Delta outflow. During April and May, average monthly exports are often less than in the Revised No-Action Alternative due to the VAMP export restrictions specified in (b)(2) Water Management. From June through September, exports are often lower because of decreased diversions from the Trinity River Basin, decreased upstream CVP reservoir releases, and July export restrictions specified in (b)(2) Water Management. The net impact of these changes in exports is an average annual reduction of about 230,000 acre-feet or 9 percent over the long-term average period. During the dry period, average annual Tracy exports are reduced about 220,000 acre-feet or 14 percent due to decreased available water supply and July export restrictions. The frequency distribution in Figure IV-74 shows the decrease in annual exports through Tracy Pumping Plant in the Preferred Alternative as compared to the Revised No-Action Alternative.

In comparison to the Revised No-Action Alternative, average annual Delta outflow increases by approximately 100,000 acre-feet or 1 percent during the long-term average period and about 150,000 acre-feet or 3 percent during the dry period. In general, these increases occur during April and May when the VAMP export restrictions specified in (b)(2) Water Management are in effect. Average monthly Delta outflow is presented for the dry, wet, and long-term average periods in Figure IV-75. Monthly Delta outflow is presented for the dry and wet periods in Figure IV-76.

West San Joaquin Division. The changes in end-of-month CVP storage in San Luis Reservoir are the result of changes in exports through Tracy Pumping Plant. Decreased exports from April through September result in lower storages than in the Revised No-Action Alternative. Increased exports during the subsequent fall and winter months result in winter storages that are similar to the Revised No-Action Alternative. A comparison of long-term average end-of-month storage in the CVP portion of San Luis Reservoir is presented in Figure IV-74. In comparison to the Revised No-Action Alternative, end-of-water year storage is decreased by about 50,000 acre-feet or 22 percent over the long-term average and is similar during the dry period.

CVP Water Contract Deliveries. This section describes changes to CVP water contract deliveries in the Preferred Alternative as compared to the Revised No-Action Alternative. The discussion includes CVP deliveries to Sacramento River Water Rights Contractors, San Joaquin River Exchange Contractors, wildlife refuges, and CVP Agricultural and M&I Water Service Contractors north and south of the Delta. This section is divided into deliveries north of the Delta, deliveries south of the Delta, deliveries to the Eastside Division, and refuge deliveries. For the discussion of CVP water contract deliveries, the dry period is defined as 1928 through 1934 to characterize deliveries from the point at which the reservoirs are full, and thus have similar antecedent conditions, through the critical dry years in which maximum reservoir drawdown occurs. A summary comparison of deliveries to CVP contractors in the Revised No-Action Alternative and the Preferred Alternative is provided in Table IV-68.

CVP Water Deliveries North of the Delta. CVP deliveries north of the Delta include deliveries to Sacramento River Water Rights Contractors and to Agricultural and M&I Water Service Contractors. CVP deliveries to Sacramento River Water Rights Contractors do

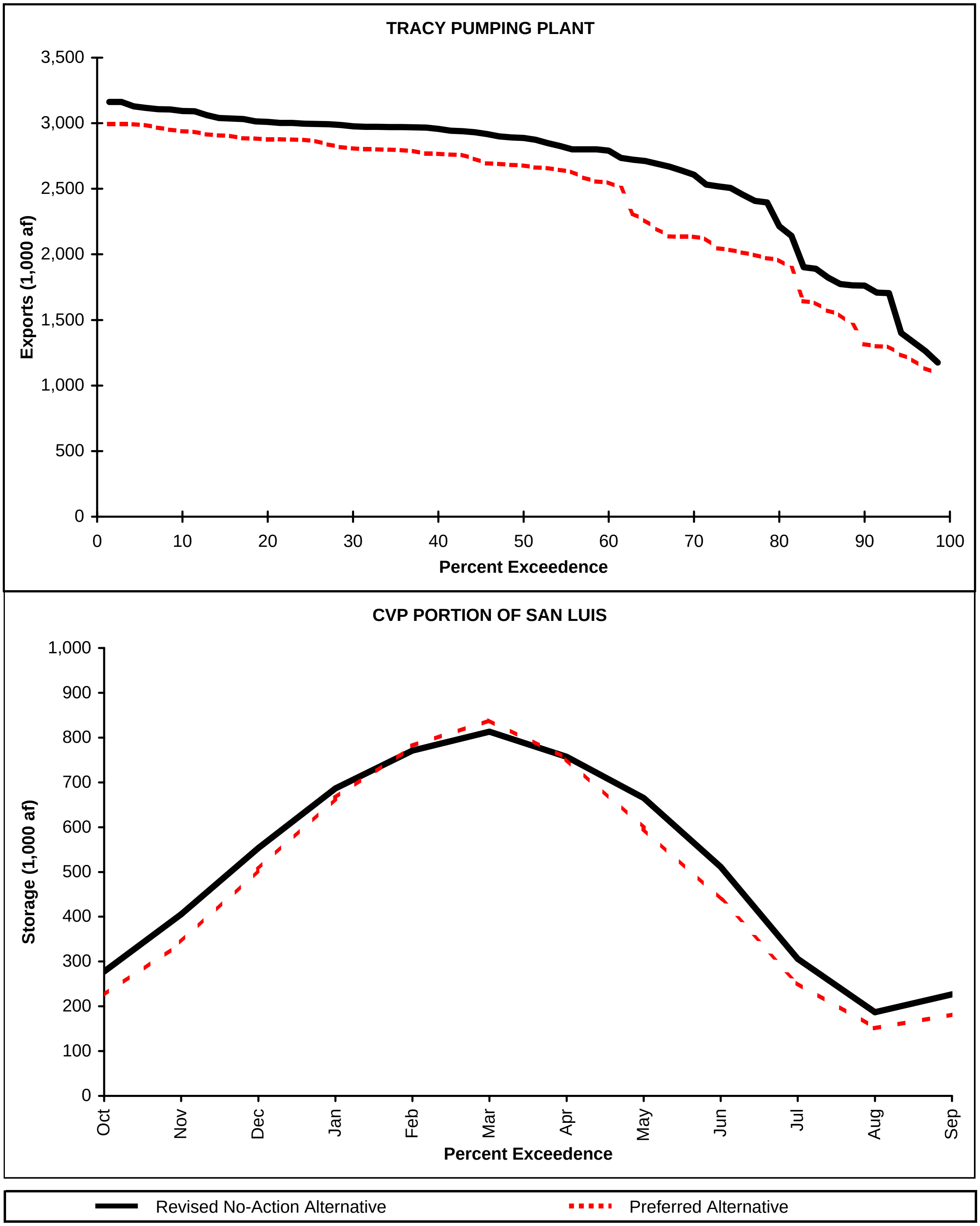


FIGURE IV-74
CVP SIMULATED ANNUAL EXPORTS (CONTRACT YEARS 1922-1990) AND AVERAGE END-OF-MONTH STORAGE FOR CVP PORTION OF SAN LUIS (WATER YEARS 1922-1990)

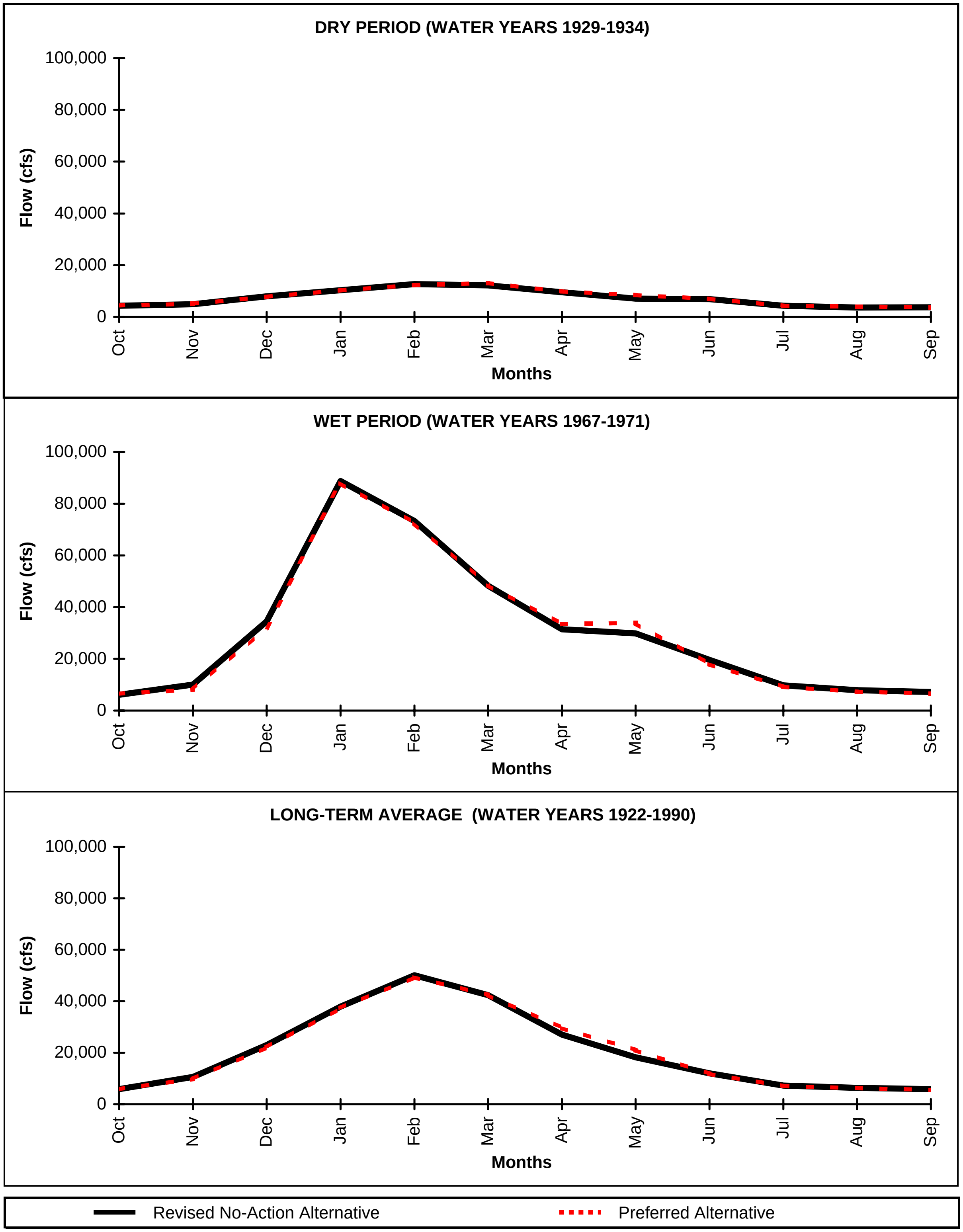


FIGURE IV-75
DELTA OUTFLOW
SIMULATED AVERAGE MONTHLY FLOWS

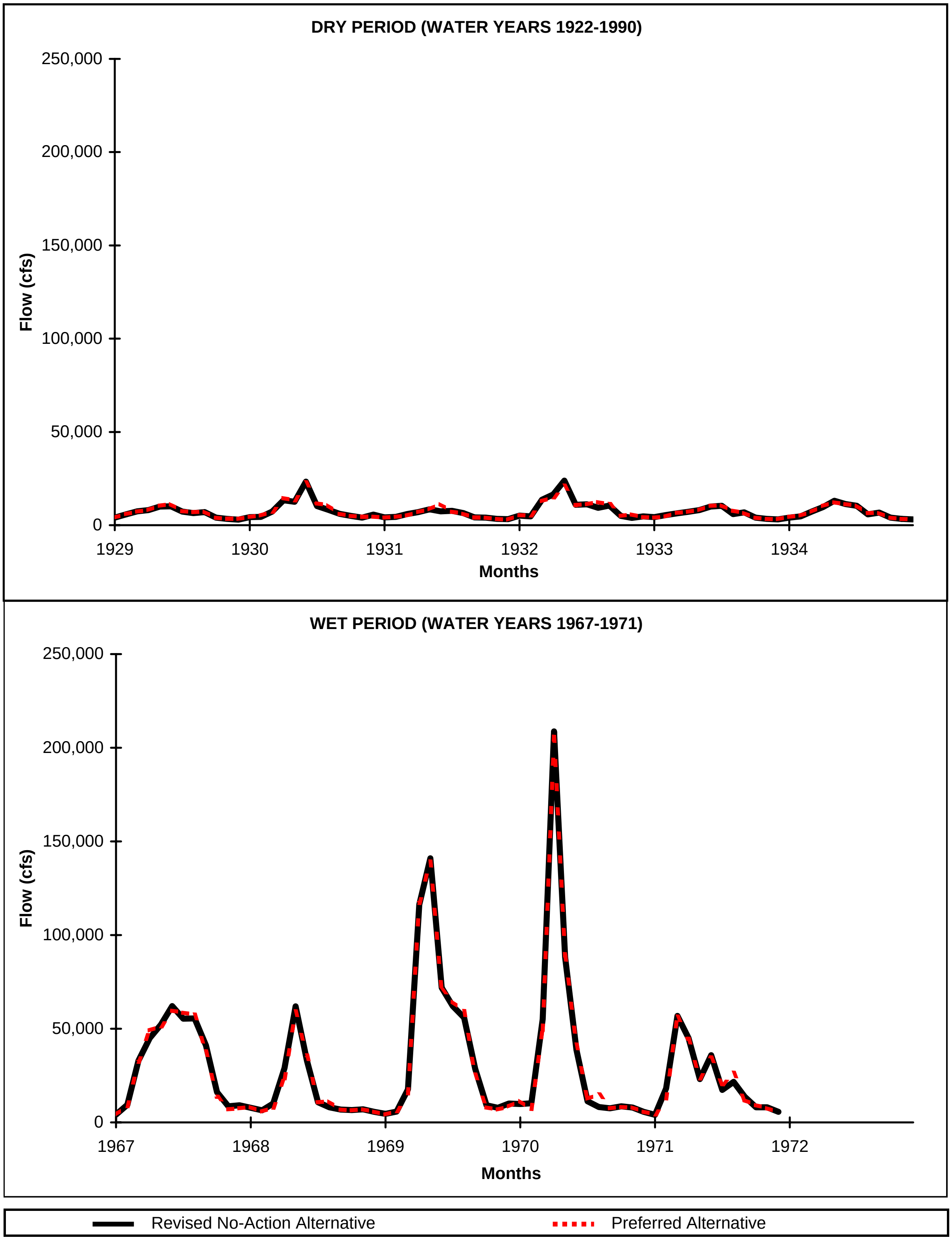


FIGURE IV-76
DELTA OUTFLOW
SIMULATED MONTHLY FLOWS

TABLE IV-68

COMPARISON OF CVP DELIVERIES IN THE PREFERRED ALTERNATIVE TO THE REVISED NO-ACTION ALTERNATIVE

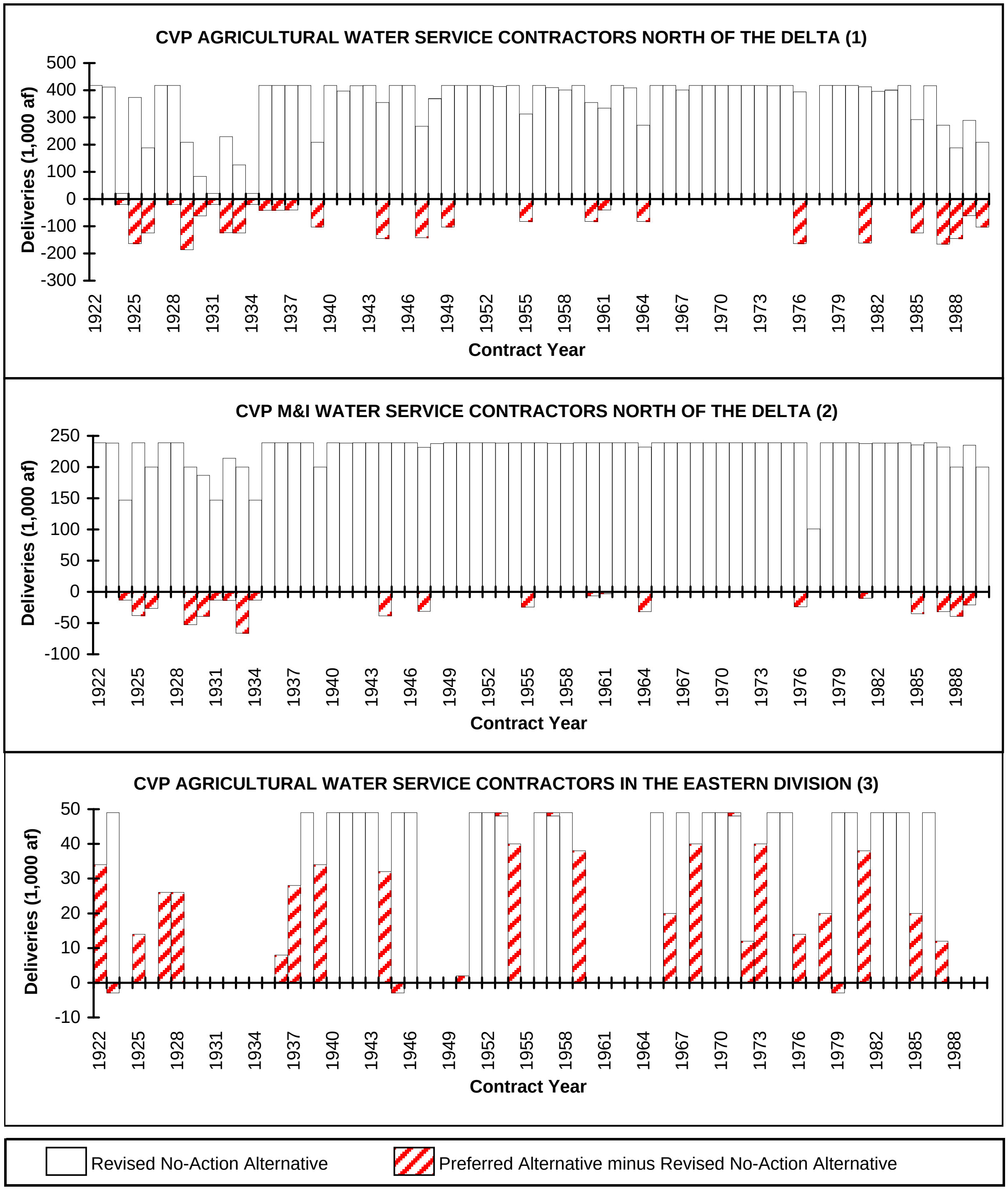
Contract Years	Type of Period	Simulated Average Annual CVP Deliveries (1,000 acre-feet)		Change from Revised No-Action Alternative	
		Revised No-Action Alternative	Preferred Alternative	1,000 acre-feet	Percent Change
1922 - 1990	Simulation Period	5,690	5,130	-560	-10%
1928 - 1934	Dry Period	4,260	3,720	-540	-13%
1967 - 1971	Wet Period	6,200	5,830	-370	-6%

NOTES:
CVP deliveries include deliveries to Agricultural and M&I Water Service Contractors north and south of the Delta (excluding Friant Service Area), Sacramento River Water Rights Contractors, other water rights contractors, San Joaquin River Exchange Contractors. CVP deliveries do not include refuge water supplies.

not change in the Preferred Alternative because their delivery deficiencies are based on the Shasta Criteria. The Shasta Criteria are a function of inflow to Shasta Lake, and this does not change between the Revised No-Action Alternative and the Preferred Alternative. Deliveries to Agricultural and M&I Water Service Contractors north of the Delta are a function of CVP available water supply. As available water supply is reduced by the use of CVP water for implementation of CVPIA and increased Trinity River instream fishery flows, there is a resulting decrease in water service contract deliveries.

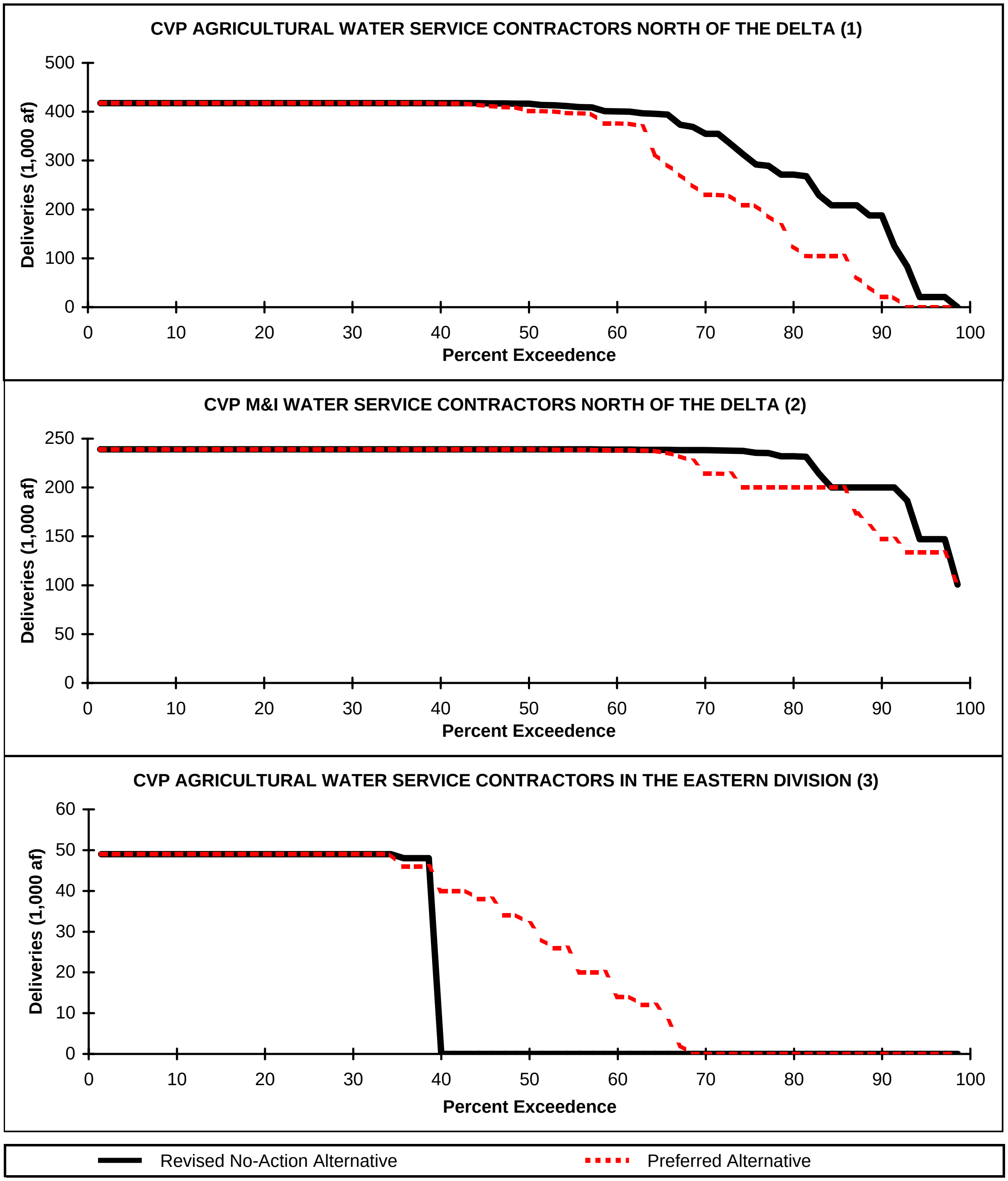
Figure IV-77 shows the decrease in simulated annual deliveries to Agricultural Water Service Contractors north of the Delta in the Preferred Alternative as compared to the Revised No-Action Alternative. The frequency distributions of annual deliveries are presented in Figure IV-78. The occurrence of full annual deliveries is reduced from 65 percent of the years in the Revised No-Action Alternative to 55 percent of the years in the Preferred Alternative. In both the Revised No-Action Alternative and the Preferred Alternative, the minimum annual delivery in the driest years is zero acre-feet, but this delivery occurs more frequently in the Preferred Alternative (5 percent of the years instead of 1 percent).

The reductions in simulated annual deliveries to M&I Water Service Contractors north of the Delta in the Preferred Alternative are shown in Figure IV-77. The occurrence of full annual deliveries is reduced from 75 percent of the years in the Revised No-Action Alternative to 65 percent of the years in the Preferred Alternative, as shown in the frequency distribution in Figure IV-78. Annual deliveries below 75 percent of the contract amount are made in about 5 percent of the years in the Revised No-Action Alternative and 15 percent of the years in the Preferred Alternative. A minimum delivery of 50 percent of the contract amount is made in 7 percent of the years in the Preferred Alternative as compared to 1 percent in the Revised No-Action



NOTE: (1) Includes Sacramento River and American River Divisions.
(2) Includes Sacramento River and American River Divisions plus Contra Costa exports.
(3) Firm contract deliveries to Central San Joaquin Irrigation District from the Stanislaus River.

FIGURE IV-77
SIMULATED ANNUAL CVP DELIVERIES
NORTH OF THE DELTA AND IN THE EASTSIDE DIVISION
CONTRACT YEARS 1922-1990



NOTE: (1) Includes Sacramento River and American River Divisions.
(2) Includes Sacramento River and American River Divisions plus Contra Costa exports.
(3) Firm contract deliveries to Central San Joaquin Irrigation District from the Stanislaus River.

FIGURE IV-78
SIMULATED FREQUENCY OF ANNUAL CVP DELIVERIES NORTH OF THE DELTA AND IN THE EASTSIDE DIVISION CONTRACT YEARS 1922-1990

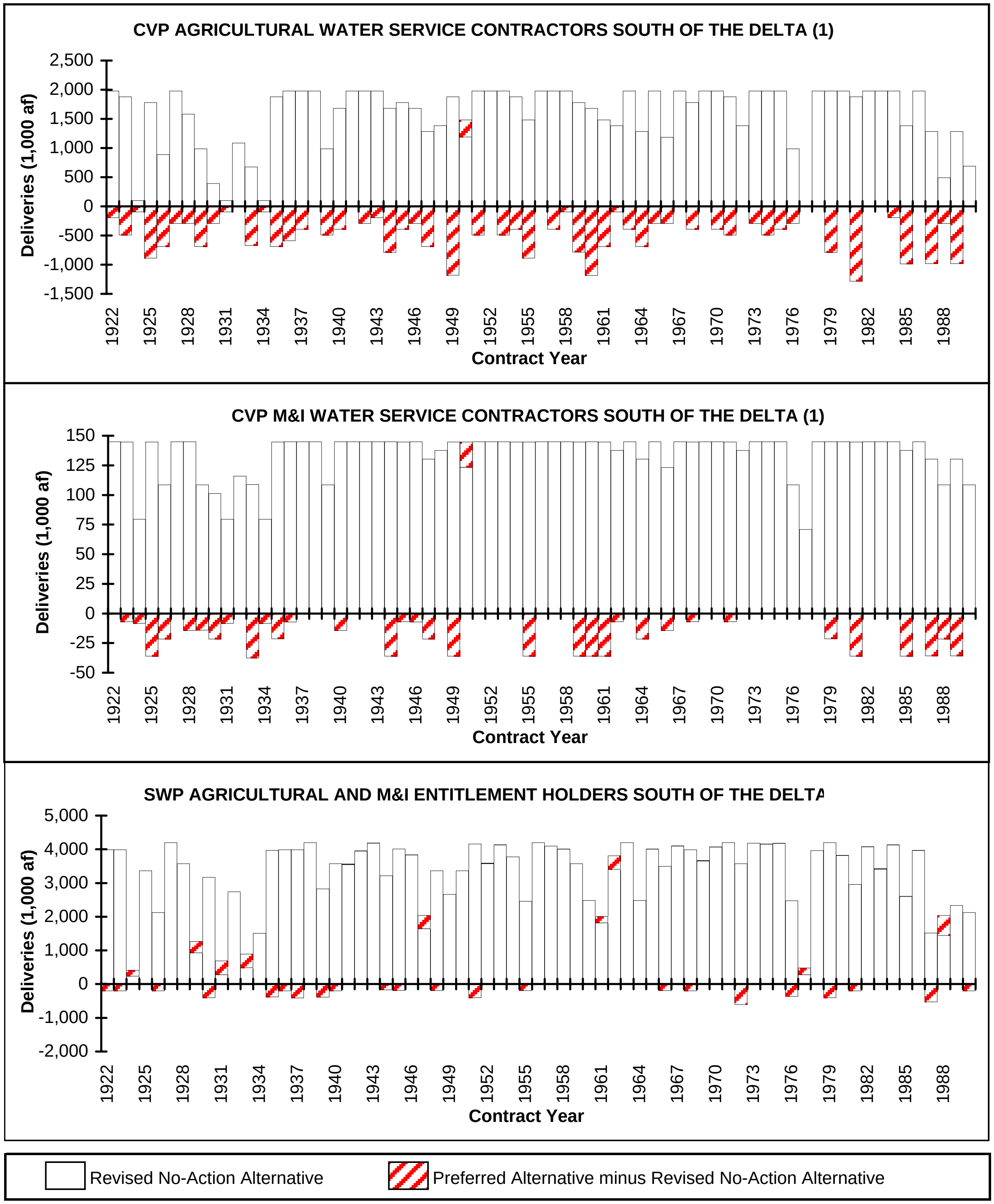
Alternative. In 1977 which is an extremely dry year, especially on the American River, American River Water Service Contract and water rights deliveries are reduced below minimum levels in both the Preferred Alternative and the Revised No-Action Alternative.

CVP Water Deliveries in the Eastside Division. Frequency distributions of the simulated annual deliveries to CVP agricultural water service contractors on the Stanislaus River are shown for the Revised No-Action Alternative and Preferred Alternative in Figure IV-78. As shown, the frequency of years in which water would be delivered to Eastside Division contractors would increase from about 40 percent in the Revised No-Action Alternative to 68 percent in the Preferred Alternative. Long-term annual water deliveries to Eastside Division contractors would increase from 19 TAF per year to 26 TAF per year. The increases in delivery frequency and long-term average amounts result from implementation of the New Melones water allocation criteria and water acquisitions included in the San Joaquin River Agreement.

CVP Water Deliveries South of the Delta. CVP deliveries south of the Delta include deliveries to San Joaquin River Exchange Contractors and Agricultural and M&I Water Service Contractors. CVP deliveries to San Joaquin River Exchange Contractors do not change in the Preferred Alternative because their delivery deficiencies are based on the Shasta Criteria. The Shasta Criteria are a function of inflow to Shasta Lake, and this does not change between the Revised No-Action Alternative and the Preferred Alternative. Deliveries to Agricultural and M&I Water Service Contractors south of the Delta are a function of available CVP water supply and the amount of water that may be exported through Tracy Pumping Plant. Exports are often restricted in April and May due to the VAMP export restrictions specified in (b)(2) Water Management. In general, there is a reduction in annual deliveries in all but the wettest years.

Figure IV-79 shows the reduction in simulated annual deliveries to CVP Agricultural Water Service Contractors south of the Delta in the Preferred Alternative as compared to the Revised No-Action Alternative. The frequency distributions for annual deliveries are presented in Figure IV-80. The occurrence of full annual deliveries is reduced from 40 percent of the years in the Revised No-Action Alternative to 15 percent of the years in the Preferred Alternative. In both the Revised No-Action Alternative and the Preferred Alternative, the minimum annual delivery in the driest years is zero acre-feet, but this delivery occurs more frequently in the Preferred Alternative (5 percent of the years instead of 1 percent).

The reduction in simulated annual deliveries to M&I Water Service Contractors south of the Delta in the Preferred Alternative as compared to the Revised No-Action Alternative is shown in Figure IV-79. The frequency distributions for annual deliveries are presented in Figure IV-80. The occurrence of full annual deliveries is reduced from 65 percent of the years in the Revised No-Action Alternative to 40 percent of the years in the Preferred Alternative. Annual deliveries below 75 percent of the contract amount are made in about 5 percent of the years in the Revised No-Action Alternative and 15 percent of the years in the Preferred Alternative. A minimum delivery of 50 percent of the contract amount is made in 7 percent of the years in the Preferred Alternative as compared to 1 percent in the Revised No-Action Alternative.



NOTE: (1) Includes Delta (DMC only), West San Joaquin, and San Felipe Divisions.

FIGURE IV-79
SIMULATED ANNUAL CVP AND SWP DELIVERIES SOUTH OF THE DELTA CONTRACT YEARS 1922-1990

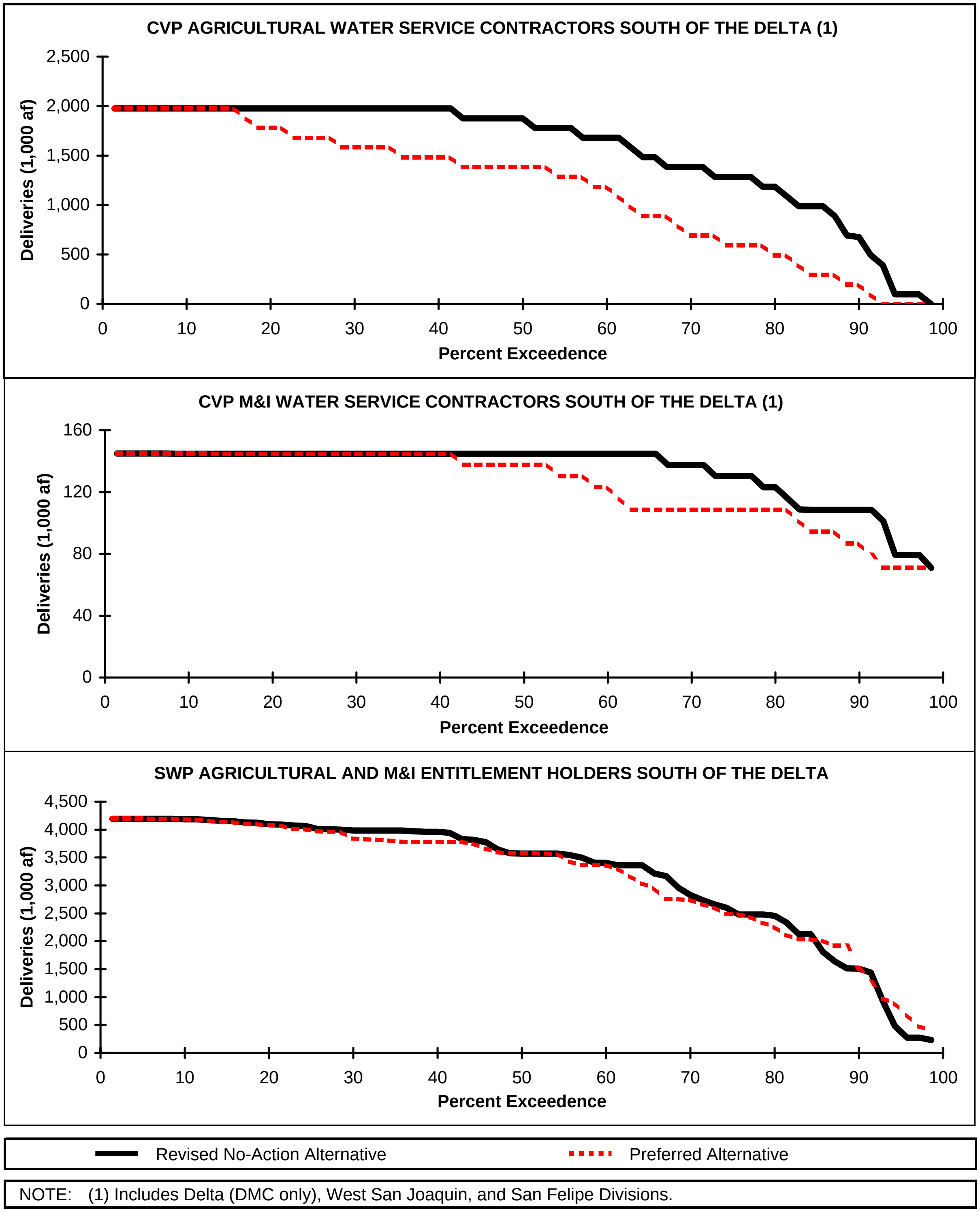


FIGURE IV-80
SIMULATED FREQUENCY OF ANNUAL CVP AND SWP DELIVERIES SOUTH OF THE DELTA CONTRACT YEARS 1922-1990

CVP Water Deliveries to Refuges. The Preferred Alternative includes provision of firm Level 2 refuge water supplies by the CVP and acquisition of Level 4 refuge water supplies from willing sellers. The firm Level 2 refuge water supplies are subject to a maximum shortage of 25 percent in critical dry years as defined per the 40-30-30 Index. The increment between Level 4 and firm Level 2 refuge water supply requirements would be acquired from willing sellers. As a condition of the acquisition of water from willing sellers, it is assumed that shortage criteria applied to the source of the water would also apply to the acquired quantities. The changes in simulated annual deliveries of refuge water supplies north and south of the Delta in the Preferred Alternative and the Revised No-Action Alternative are shown in Figure IV-81. The long-term average annual increase in refuge water deliveries is 380,000 acre-feet in the Preferred Alternative.

Impacts On SWP Operations and Deliveries

This section describes potential changes to the operation of SWP facilities, river flow regimes, and SWP water deliveries resulting from the Preferred Alternative.

SWP Operations. SWP operations are affected by the changes in seasonal releases from upstream CVP reservoirs for implementation of CVPIA and increased Trinity River instream fishery flows. These changes to CVP operations shift the timing of flow entering the Delta and affect the SWP responsibility to help meet in-basin water rights and Delta water quality requirements under the COA. It is assumed for the purposes of this analysis, that the SWP would cooperate with implementation of the Delta (b)(2) Water Management actions by reducing Banks Pumping Plant Exports during specified periods and making upstream releases to contribute to additional levels of Delta protection. A summary comparison of end-of-water year SWP reservoir storage and annual Delta export pumping in the Preferred Alternative and the Revised No-Action Alternative is provided in Table IV-69.

Lake Oroville and Feather River Operations. Differences in Lake Oroville operations are the result of changes in response to the availability of excess water in the Delta and the requirements of the Delta actions specified in (b)(2) Water Management.

The long-term average end-of-water year storage in Lake Oroville is similar to the Revised No-Action Alternative as shown in the average storage comparisons for the dry, wet, and long-term periods in Figure IV-82. During the dry period, the figure shows a slight increase in average end-of-water year storage of 80,000 acre-feet or 7 percent. In drier years, end-of-water year storage increases in the Preferred Alternative because Banks Pumping Plant has the available capacity to export water released from upstream CVP reservoirs for (b)(2) purposes that is in excess of the pumping capacity at Tracy Pumping Plant. The frequency distribution for end-of-water year Lake Oroville storage in Figure IV-67 shows reduced storage in some wet years due to the decrease in Banks exports of excess Delta water during the April and May, when VAMP export restrictions are specified under (b)(2) Water Management. The export restrictions cause additional water to be released from Lake Oroville in following months to compensate for the excess water that was not exported in April and May.

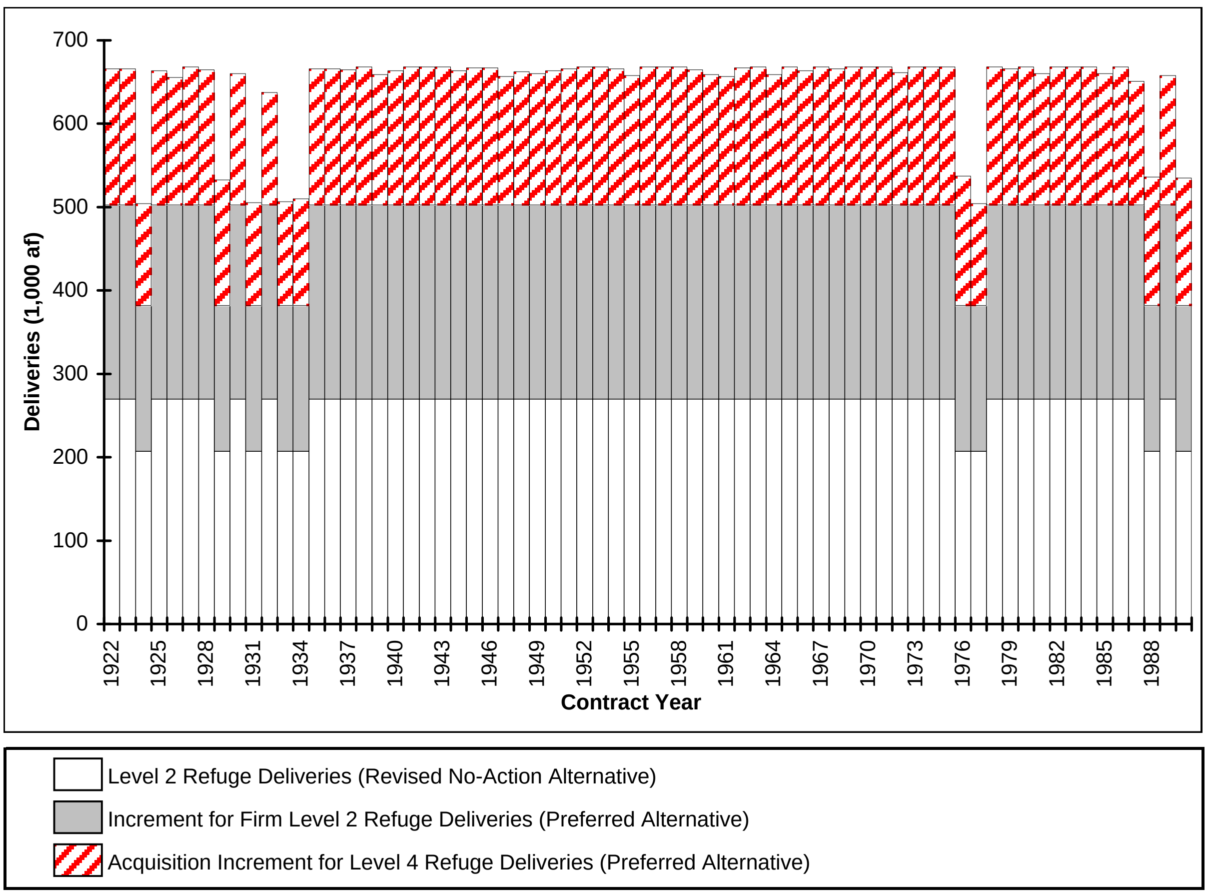


FIGURE IV-81
SIMULATED ANNUAL REFUGE DELIVERIES
CONTRACT YEARS 1922-1990

TABLE IV-69

COMPARISON OF END-OF-WATER YEAR SWP RESERVOIR STORAGE AND SWP EXPORT PUMPING IN THE PREFERRED ALTERNATIVE TO THE REVISED NO-ACTION ALTERNATIVE

	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Change from Revised No-Action Alternative	
			1,000 acre-feet	Percent Change
Average End-of-Water Year Storage				
Lake Oroville				
Simulation Period	2,040	2,020	-20	-1%
Dry Period	1,150	1,230	80	7%
Wet Period	2,510	2,480	-30	-1%
Average Annual Flows and Exports				
Exports through Banks Pumping Plant				
Simulation Period	3,330	3,260	-70	-2%
Dry Period	1,630	1,710	80	5%
Wet Period	4,060	3,970	-90	-2%

NOTES:
Simulation Period = 1922 through 1990;
Dry Period = 1929 through 1934;
Wet Period = 1967 through 1971.

Simulated average monthly flows in the Feather River below Nicolaus in the Revised No-Action Alternative and the Preferred Alternative are presented in Figure IV-83 for the dry, wet, and long-term average periods. The small differences in the flows reflect changes in Lake Oroville releases in response to Delta needs. However, the changes in flow are small in proportion to total flows below Nicolaus. Figure IV-84 shows comparisons of simulated monthly flows for the dry and wet periods.

Delta Operations. Figure IV-85 shows the change in simulated average monthly exports through Banks Pumping Plant for the dry, wet, and long-term average periods. As discussed above, to maintain SWP deliveries, exports are often decreased during certain months of the year and increased during others. The net impact of these increases and decreases in exports is an average annual reduction of about 70,000 acre-feet or 2 percent during the long-term average period and an average annual increase of about 80,000 acre-feet or 5 percent during the dry period. The frequency distribution in Figure IV-86 shows the decrease in annual exports through Banks Pumping Plant in the Preferred Alternative as compared to the Revised No-Action Alternative.

San Luis Reservoir Operations. The changes in end-of-month SWP storage in San Luis Reservoir are the result of changes in exports through Banks Pumping Plant. Decreased exports in April and May result in lower spring through fall storage levels than in the Revised No-Action Alternative. Increased exports during the fall and winter months generally offset the

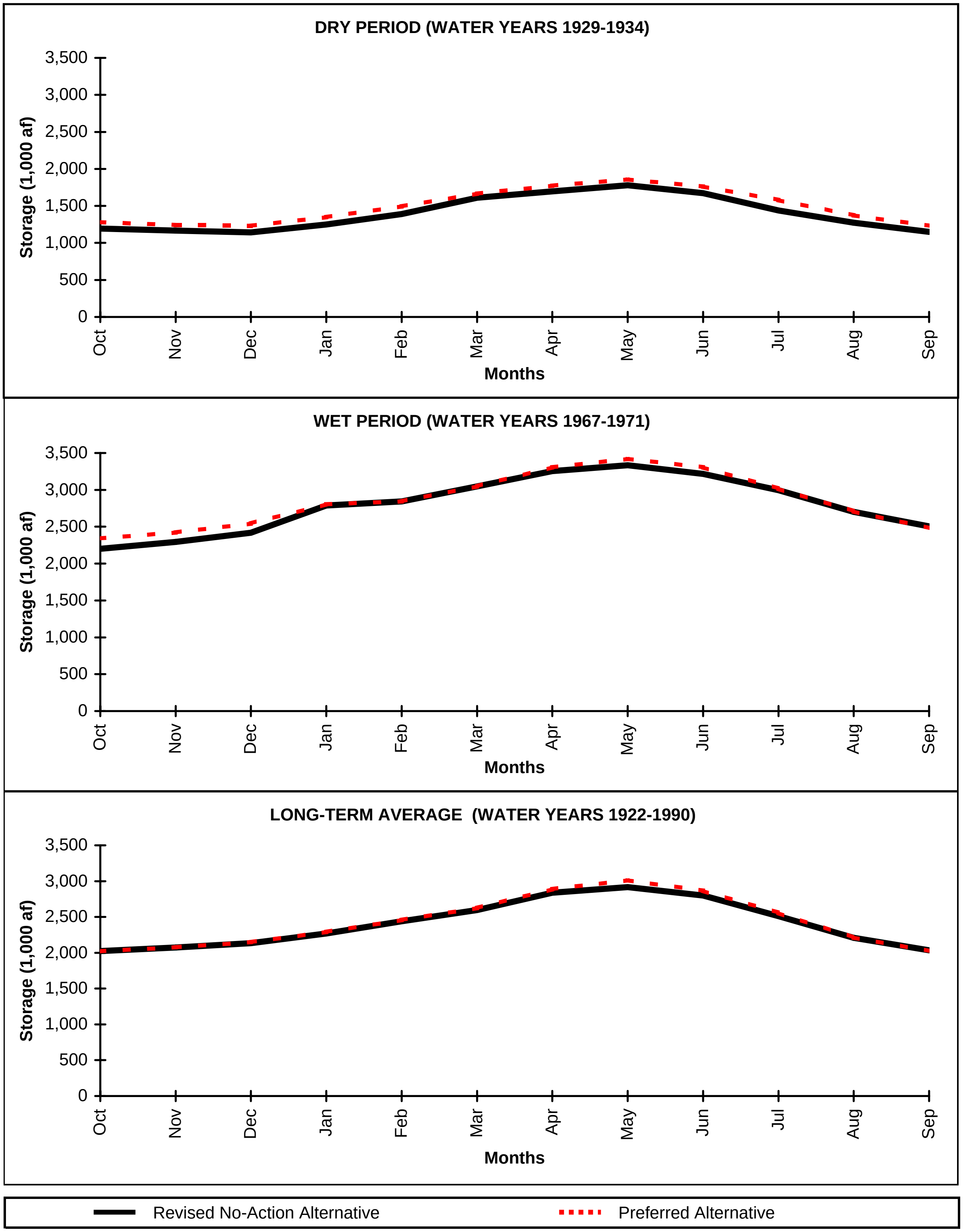


FIGURE IV-82
OROVILLE LAKE
SIMULATED AVERAGE END-OF-MONTH STORAGE

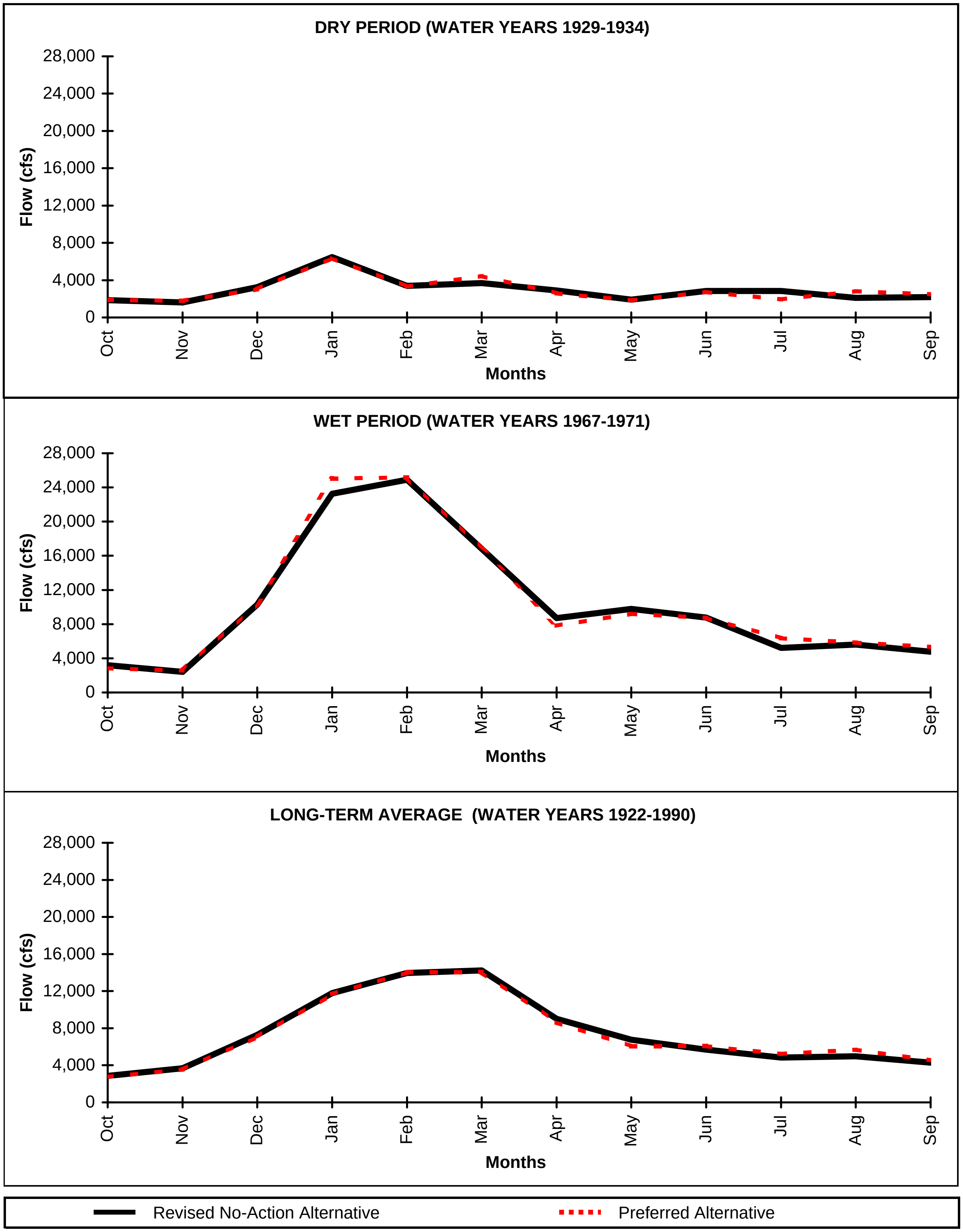


FIGURE IV-83
FEATHER RIVER BELOW NICOLAUS
SIMULATED AVERAGE MONTHLY FLOWS

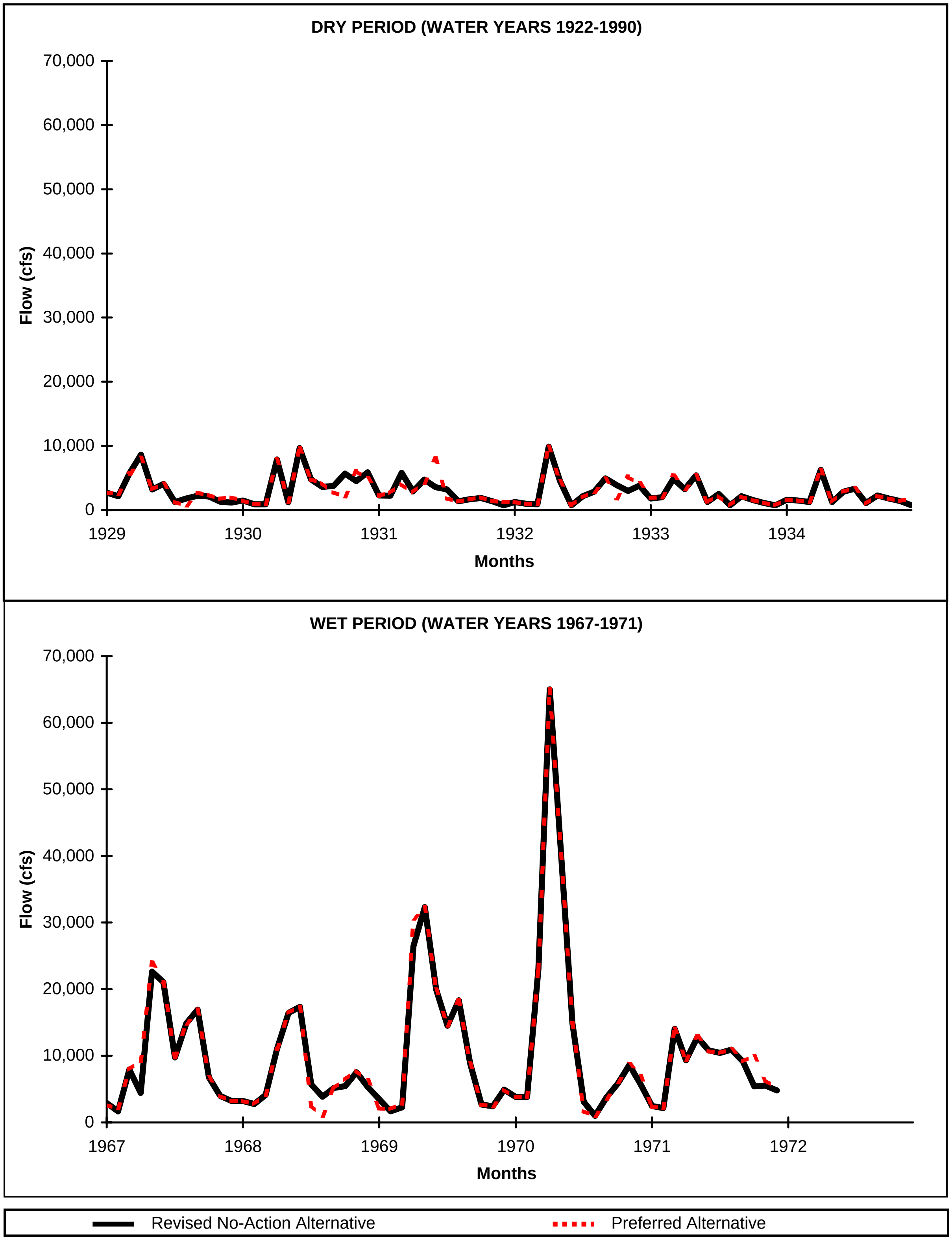


FIGURE IV-84
FEATHER RIVER BELOW NICOLAUS
SIMULATED MONTHLY FLOWS

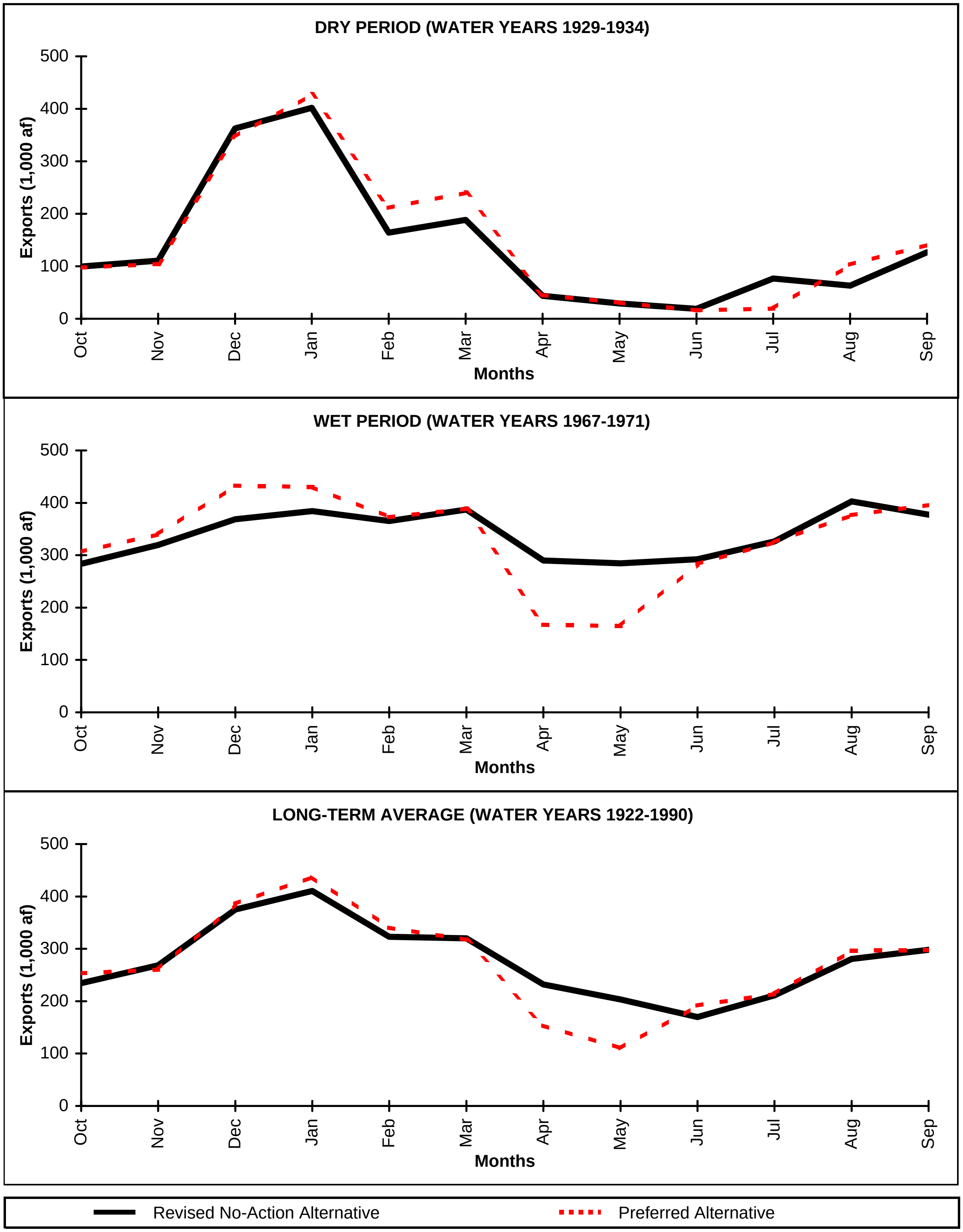


FIGURE IV-85
BANKS PUMPING PLANT
SIMULATED AVERAGE MONTHLY EXPORTS

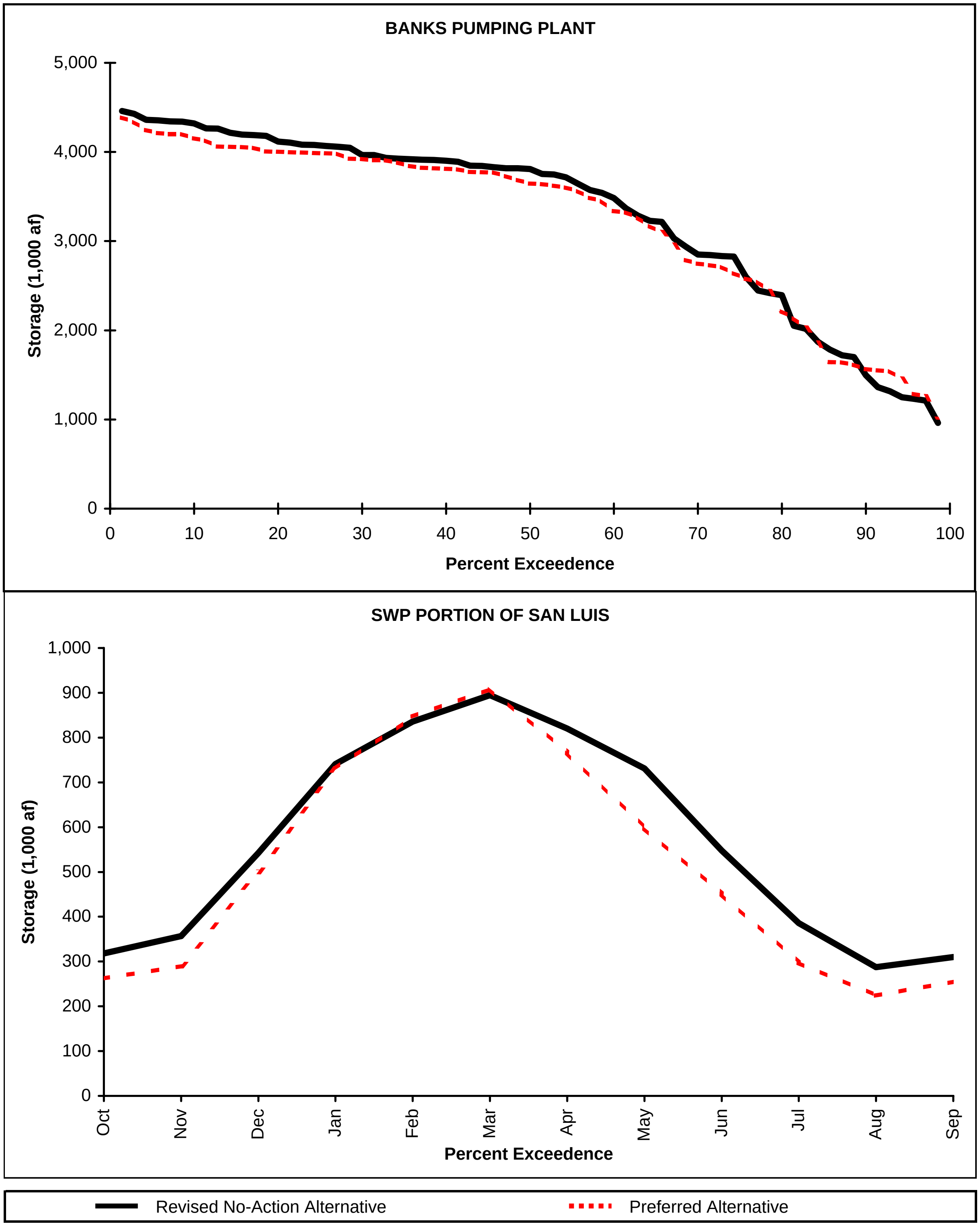


FIGURE IV-86
SWP SIMULATED ANNUAL EXPORTS (CONTRACT YEARS 1922-1990) AND AVERAGE END-OF-MONTH STORAGE FOR SWP PORTION OF SAN LUIS (WATER YEARS 1922-1990)

storage reductions caused by the decrease in April and May exports. A comparison of long-term average end-of-month storage in the SWP portion of San Luis Reservoir is presented in Figure IV-86. In comparison to the Revised No-Action Alternative, end-of-water year storage is decreased by about 50,000 acre-feet or 16 percent over the long-term average and is similar during the dry period.

SWP Entitlement Water Deliveries. Annual SWP deliveries to agricultural and M&I entitlement holders south of the Delta are a function of available SWP water supply and the amount of water that may be exported through Banks Pumping Plant. Deliveries to SWP contractors in the Preferred Alternative and the Revised No-Action Alternative are shown in Table IV-70.

TABLE IV-70

COMPARISON OF SWP DELIVERIES IN THE PREFERRED ALTERNATIVE TO THE REVISED NO-ACTION ALTERNATIVE

Contract Years	Type of Period	Simulated Average Annual SWP Deliveries (1,000 acre-feet)		Change from Revised No-Action Alternative	
		Revised No-Action Alternative	Preferred Alternative	1,000 acre-feet	Percent Change
1922 - 1990	Simulation Period	3,220	3,150	-70	-2%
1928 - 1934	Dry Period	1,810	1,910	100	6%
1967 - 1971	Wet Period	4,000	3,940	-60	2%

NOTES:
SWP deliveries include deliveries south of the Delta to entitlement holders. SWP deliveries do not include 20,000 acre-feet of assumed acquisition for Level 4 refuge water supplies.

In comparison to the Revised No-Action Alternative, the long-term average annual decrease in deliveries is about 50,000 acre-feet or 2 percent after accounting for an assumed acquisition of 20,000 acre-feet for Level 4 refuge deliveries. Figure IV-79 shows the changes in simulated annual deliveries in the Preferred Alternative and the Revised No-Action Alternative. The frequency distributions for annual deliveries are presented in Figure IV-80. In the Revised No-Action Alternative, full annual deliveries are made in 40 percent of the years. In the Preferred Alternative, full annual deliveries are made in 35 percent of the years.

GROUNDWATER

This section focuses on potential changes to groundwater conditions that would result from the implementation of the PEIS Preferred Alternative as compared to the Revised No-Action Alternative. Potential groundwater impacts, such as changes to groundwater elevations, land subsidence, and groundwater quality could occur as a result of pumping additional groundwater to compensate for decreased surface supplies.

Impact Assessment Methodology

The impact assessment methodology used to support the analysis presented in this section is based on the use of surface water, groundwater, and agricultural economics computer model analysis. Model simulations were conducted at a planning level, in accordance with the programmatic nature of the overall PEIS analysis. The model simulations for these analyses were conducted using historical hydrology for the period 1922 through 1990, adjusted to be representative of a projected 2020 level of development. The 2020 projected land use conditions were based on information developed for DWR Bulletin 160-93 (DWR, 1993) and are assumed to be constant over the simulation period.

For the Central Valley region, groundwater conditions were simulated using the Central Valley Groundwater-Surface Water Simulation Model (CVGSM), a monthly planning model developed by Reclamation, DWR, and the SWRCB for the Central Valley regional aquifer system. The CVGSM delineates the Central Valley into 21 subregions (see Figure IV-87). To summarize the results from this analysis, the Central Valley is organized into five larger regions: the Sacramento River Region (West), Sacramento River Region (East), the San Joaquin River Region, the Tulare Lake Region (North) and the Tulare Lake Region (South).

The CVGSM model uses surface water information from PROSIM and SANJASM in the form of reservoir releases and surface water deliveries. The groundwater analysis assumes groundwater pumping would change in response to changes in the surface water deliveries (i.e., a reduction in CVP deliveries would result in an increase in groundwater pumping). Impacts were summarized as changes to groundwater elevations, groundwater storage, land subsidence, and groundwater quality. Additional discussion of the approach, model characteristics, and data development is provided in the CVGSM Methodology/Modeling Technical Appendix.

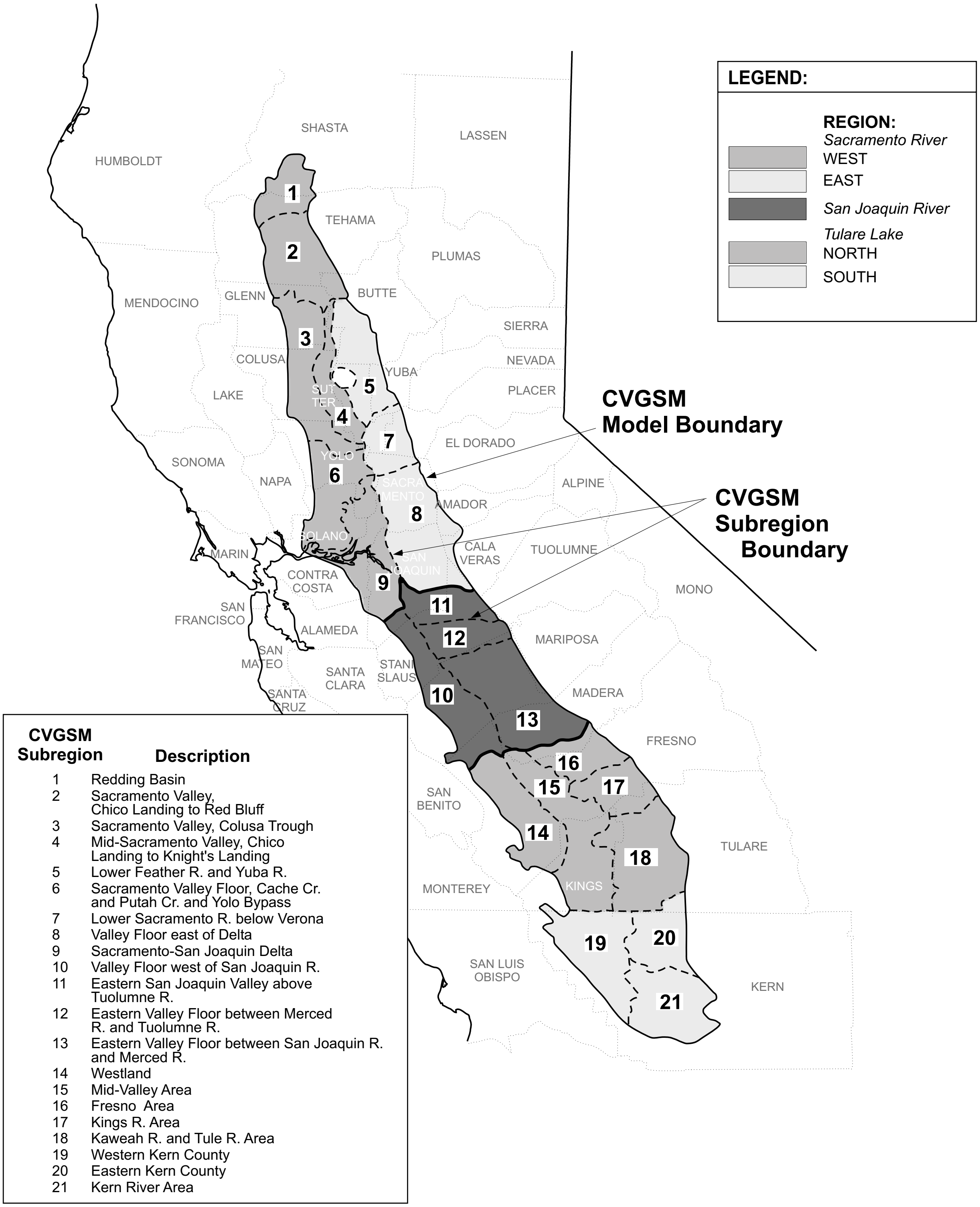
The groundwater impact assessment also evaluated the potential impacts to groundwater resources in the San Francisco Bay Region resulting from changes in CVP deliveries. This analysis was conducted qualitatively.

Sacramento River Region

Differences in groundwater levels for the Preferred Alternative as compared to the Revised No-Action Alternative are shown in Figure IV-88. Groundwater levels in areas along the west side would change very little as compared to the Revised No-Action Alternative with the exception of Subregion 3 where increase pumping due to reductions in CVP deliveries would cause a decline in groundwater levels. Along the east side of the Sacramento Valley, primarily in Subregion 8, groundwater levels would increase as a result of increased CVP deliveries.

Groundwater Storage and Production

Sacramento River Region (West). Average annual groundwater conditions for the Sacramento River Region (West) under the Preferred Alternative are presented in Table IV-71. Annual variations for groundwater pumping, recharge, and storage are very similar to the



CVGSM Subregion	Description
1	Redding Basin
2	Sacramento Valley, Chico Landing to Red Bluff
3	Sacramento Valley, Colusa Trough
4	Mid-Sacramento Valley, Chico Landing to Knight's Landing
5	Lower Feather R. and Yuba R.
6	Sacramento Valley Floor, Cache Cr. and Putah Cr. and Yolo Bypass
7	Lower Sacramento R. below Verona
8	Valley Floor east of Delta
9	Sacramento-San Joaquin Delta
10	Valley Floor west of San Joaquin R.
11	Eastern San Joaquin Valley above Tuolumne R.
12	Eastern Valley Floor between Merced R. and Tuolumne R.
13	Eastern Valley Floor between San Joaquin R. and Merced R.
14	Westland
15	Mid-Valley Area
16	Fresno Area
17	Kings R. Area
18	Kaweah R. and Tule R. Area
19	Western Kern County
20	Eastern Kern County
21	Kern River Area

FIGURE IV-87

GROUNDWATER STUDY AREA

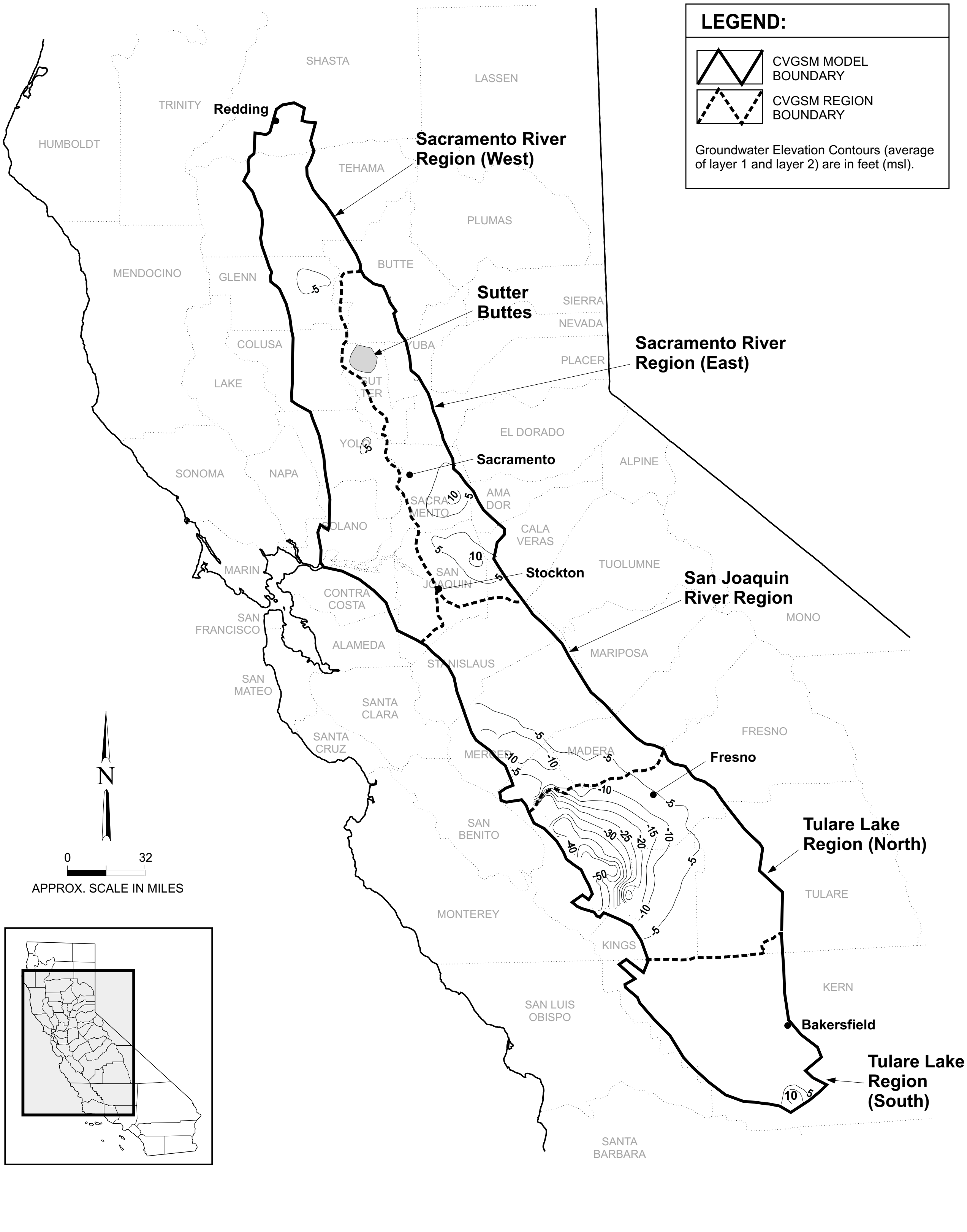


FIGURE IV-88
DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

TABLE IV-71

COMPARISON OF AVERAGE ANNUAL GROUNDWATER CONDITIONS FOR THE SACRAMENTO RIVER REGION (WEST) SIMULATION PERIOD 1922-1990

Condition	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Difference (1,000 acre-feet)
Recharge			
Deep Percolation	1,668	1,701	33
Gain from Streams	4,257	4,276	19
Recharge	31	30	-1
Boundary Inflows	77	86	9
Total Recharge	*2,034*	*2,094*	*60*
Discharge			
Groundwater Pumping	2,041	2,104	63
Total Discharge	*2,041*	*2,104*	*63*
Change in Groundwater Storage	-7	-10	-3

NOTES:
For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

Revised No-Action Alternative (see Figures IV-89 and IV-90). Increases in annual groundwater pumping for the Preferred Alternative would occur primarily in years of dry or critically dry hydrologic conditions. This increase in pumping is a direct response to reductions in CVP deliveries to this area and would contribute to the 201,000 acre-feet decline in long-term groundwater storage compared to No-Action Alternative (Figure IV-90).

Sacramento River Region (East). Average annual groundwater conditions for the Sacramento River Region (East) under the Preferred Alternative are presented in Table IV-72. The annual variations in groundwater pumping, recharge, and storage are similar to those under the Revised No-Action Alternative (Figures IV-91 and IV-92). Decreases in annual groundwater pumping for the Preferred Alternative would occur in the San Joaquin County area (Subregion 8). This reduction in pumping is a direct response to increases in CVP deliveries to this area (see previous discussion under Surface Water Supplies and Facilities Operations).

Groundwater Levels. Differences in the groundwater levels for the end of the 69-year simulation for the Preferred Alternative are shown in Figure IV-88. Groundwater conditions for the west side of the Sacramento River Region would be similar to those under the Revised No-Action Alternative. Groundwater levels would decline up to 5 feet in areas dependent upon CVP project water, such as areas served by the Tehama-Colusa Canal (or Subregion 3 of the groundwater study area).

Groundwater levels for the east side would be similar to those under the Revised No-Action Alternative in Subregions 5 and 7. However, in Subregion 8 regional groundwater levels would increase between 1 and 5 feet, with a maximum increase of up to 10 feet in areas receiving CVP project water. These changes are a result of a gradual increase in groundwater storage over the

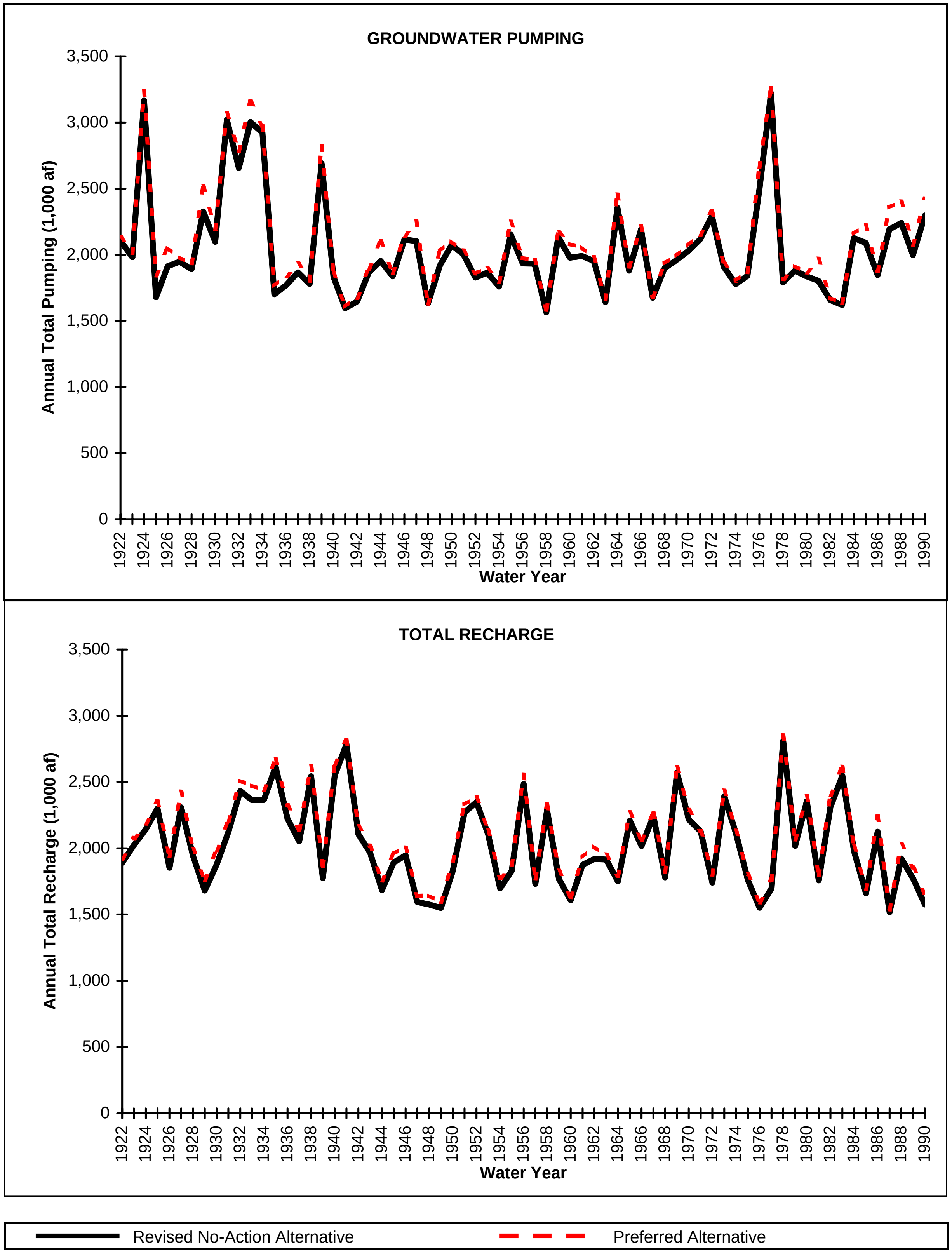


FIGURE IV-89
SIMULATED GROUNDWATER PUMPING AND RECHARGE FOR THE SACRAMENTO RIVER REGION (WEST)

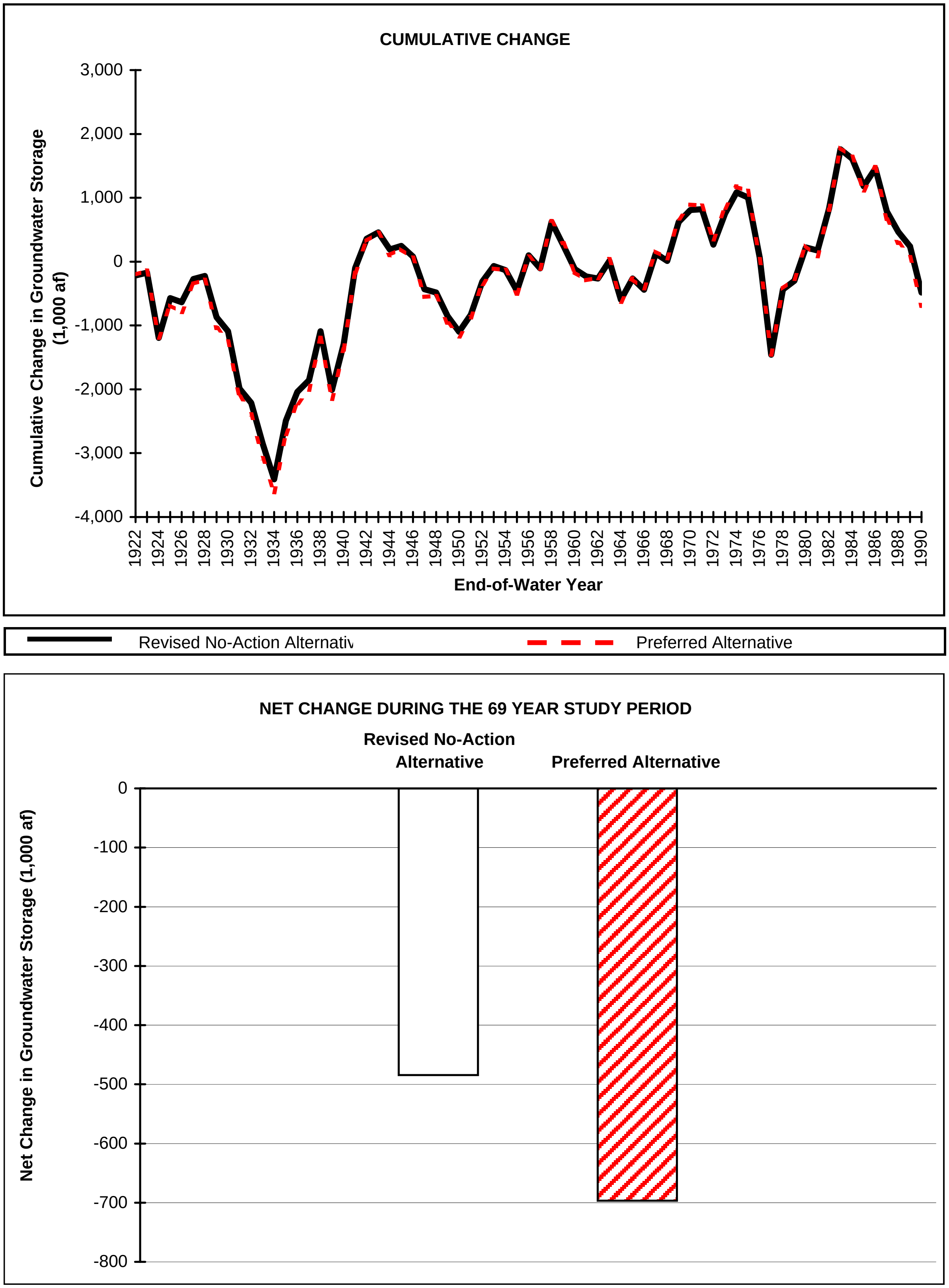


FIGURE IV-90
SIMULATED GROUNDWATER STORAGE CONDITIONS FOR THE SACRAMENTO RIVER REGION (WEST)

TABLE IV-72

COMPARISON OF AVERAGE ANNUAL GROUNDWATER CONDITIONS FOR THE SACRAMENTO RIVER REGION (EAST) SIMULATION PERIOD 1922-1990

Condition	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Difference (1,000 acre-feet)
Recharge			
Deep Percolation	819	828	9
Gain from Streams	517	533	16
Recharge	24	24	0
Boundary Inflows	366	347	-19
Total Recharge	*1,726*	*1,732*	*6*
Discharge			
Groundwater Pumping	1,787	1,791	5
Total Discharge	*1,787*	*1,791*	*5*
Change in Groundwater Storage	-61	-59	2

NOTES:
For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

69-year analysis period due to an average annual decrease in groundwater pumping of approximately 15 taf/yr. Another contributing factor to increased groundwater storage in this subregion is increased recharge from the eastside tributaries, which have greater flows under the Preferred Alternative. Both of these changes are a direct result of the shared allocation criteria used in evaluating water acquisitions in the San Joaquin tributaries. (For additional information, please refer to the previous discussion under Surface Water Supplies and Facilities Operations.)

Land Subsidence. Under the Preferred Alternative, with groundwater levels declining very little in areas subject to land subsidence, no additional land subsidence in comparison to the Revised No-Action Alternative would occur.

Groundwater Quality. Under the Preferred Alternative, with groundwater levels declining very little in areas subject to poor groundwater quality, it is expected that groundwater quality conditions in the Sacramento River Region would be similar to those under the Revised No-Action Alternative.

Agricultural Subsurface Drainage. Under the Preferred Alternative, with groundwater levels declining very little in areas subject to poor subsurface drainage conditions, it is expected that agricultural subsurface drainage problems in the Sacramento River Region would not change in comparison to the Revised No-Action Alternative.

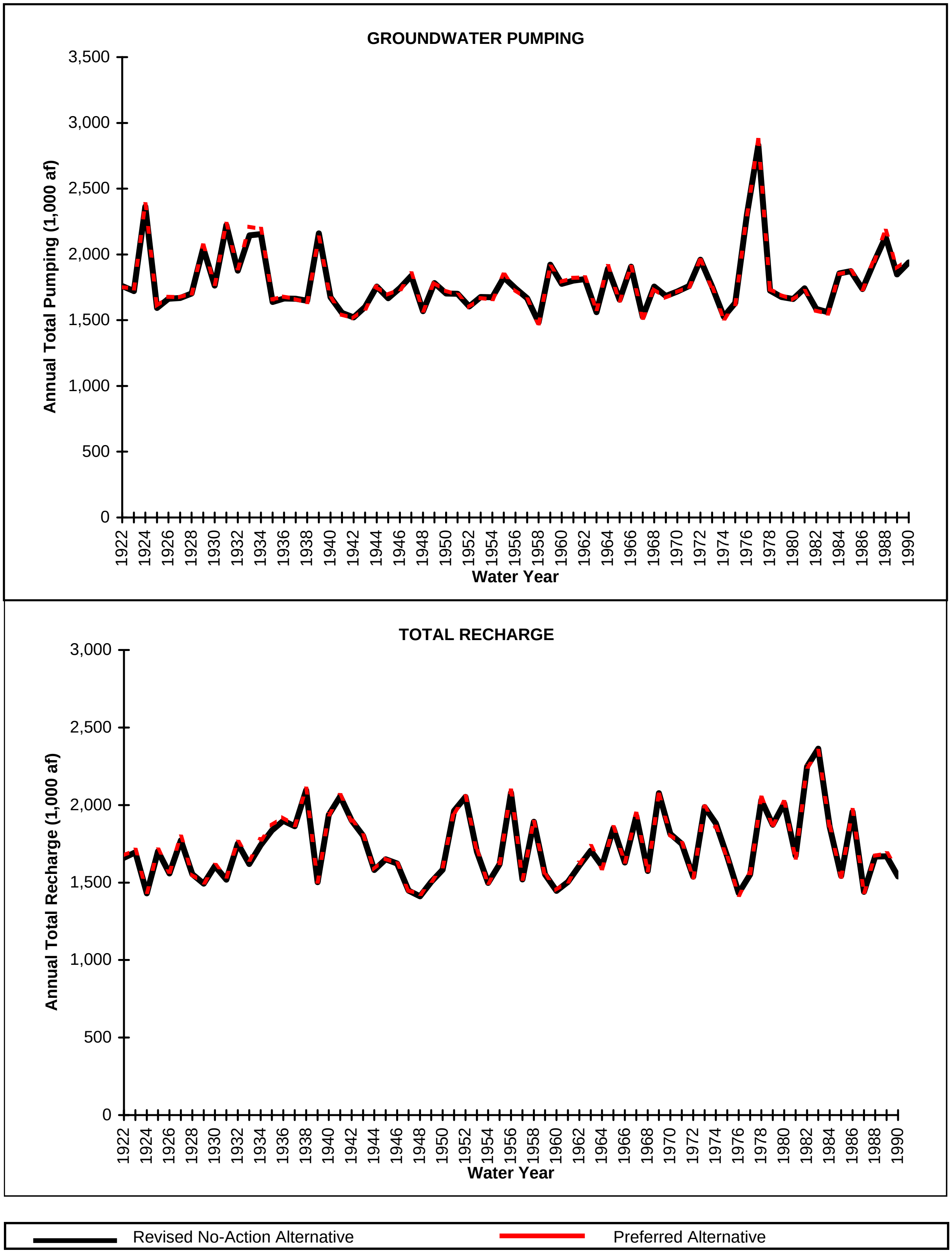


FIGURE IV-91
SIMULATED GROUNDWATER PUMPING AND RECHARGE FOR THE SACRAMENTO RIVER REGION (EAST)

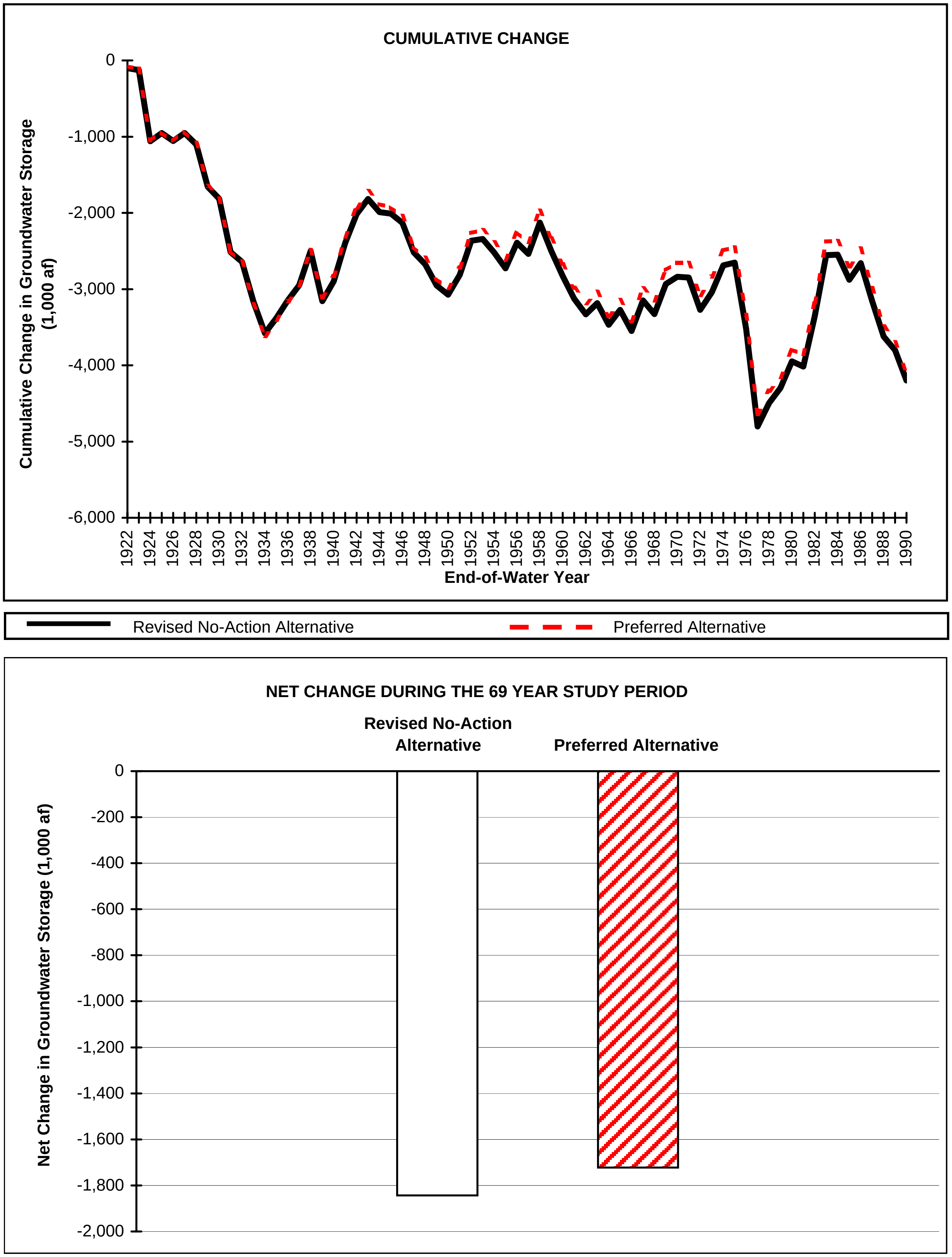


FIGURE IV-92
SIMULATED GROUNDWATER STORAGE CONDITIONS FOR THE SACRAMENTO RIVER REGION (EAST)

San Joaquin River Region

Differences in San Joaquin River Region groundwater levels for the end of the 69-year simulation period for Preferred Alternative are shown in Figure IV-88. In the southern half of the region, reduced CVP deliveries due to (b)(2) water in the Delta would cause groundwater levels to decline relative to the Revised No-Action Alternative.

Groundwater Storage and Production. Average annual groundwater conditions for the San Joaquin River Region under the Preferred Alternative are presented in Table IV-73. Groundwater storage conditions would declined in comparison to the Revised No-Action Alternative as a result of increased groundwater pumping primarily in Subregion 10. This would occur due to decreased CVP deliveries, relative to the Revised No-Action Alternative, in response to the use of additional (b)(2) water for Delta needs. The annual variation in groundwater pumping and recharge is very similar to that under the Revised No-Action Alternative (Figure IV-93). Increases in annual groundwater pumping for the Preferred Alternative would occur primarily in years of dry or critically dry hydrologic conditions. The net change in groundwater storage is 2,442,000 acre-feet, or an increase in groundwater depletion of 678,000 acre-feet in comparison to the Revised No-Action Alternative (Figure IV-94).

TABLE IV-73

COMPARISON OF AVERAGE ANNUAL GROUNDWATER CONDITIONS FOR THE SAN JOAQUIN RIVER REGION SIMULATION PERIOD 1922-1990

Condition	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Difference (1,000 acre-feet)
Recharge			
Deep Percolation	1,081	1,096	14
Gain from Streams	335	394	59
Recharge	430	437	6
Boundary Inflows	17	20	3
Total Recharge	*1,864*	*1,947*	*83*
Discharge			
Groundwater Pumping	1,889	1,982	93
Total Discharge	*1,889*	*1,982*	*93*
Change in Groundwater Storage	-26	-35	-10

NOTES:

For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

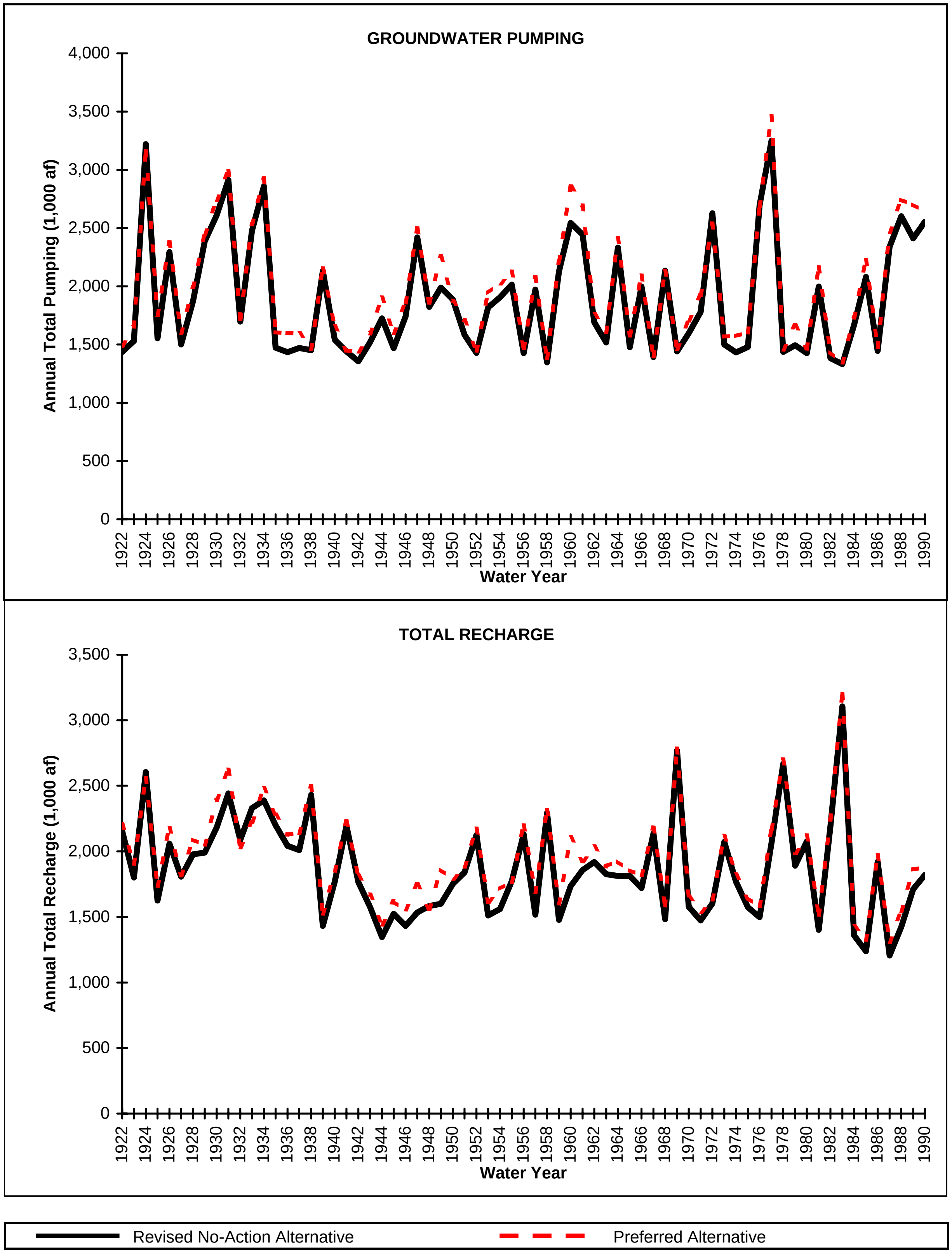


FIGURE IV-93
SIMULATED GROUNDWATER PUMPING AND RECHARGE FOR THE SAN JOAQUIN RIVER REGION

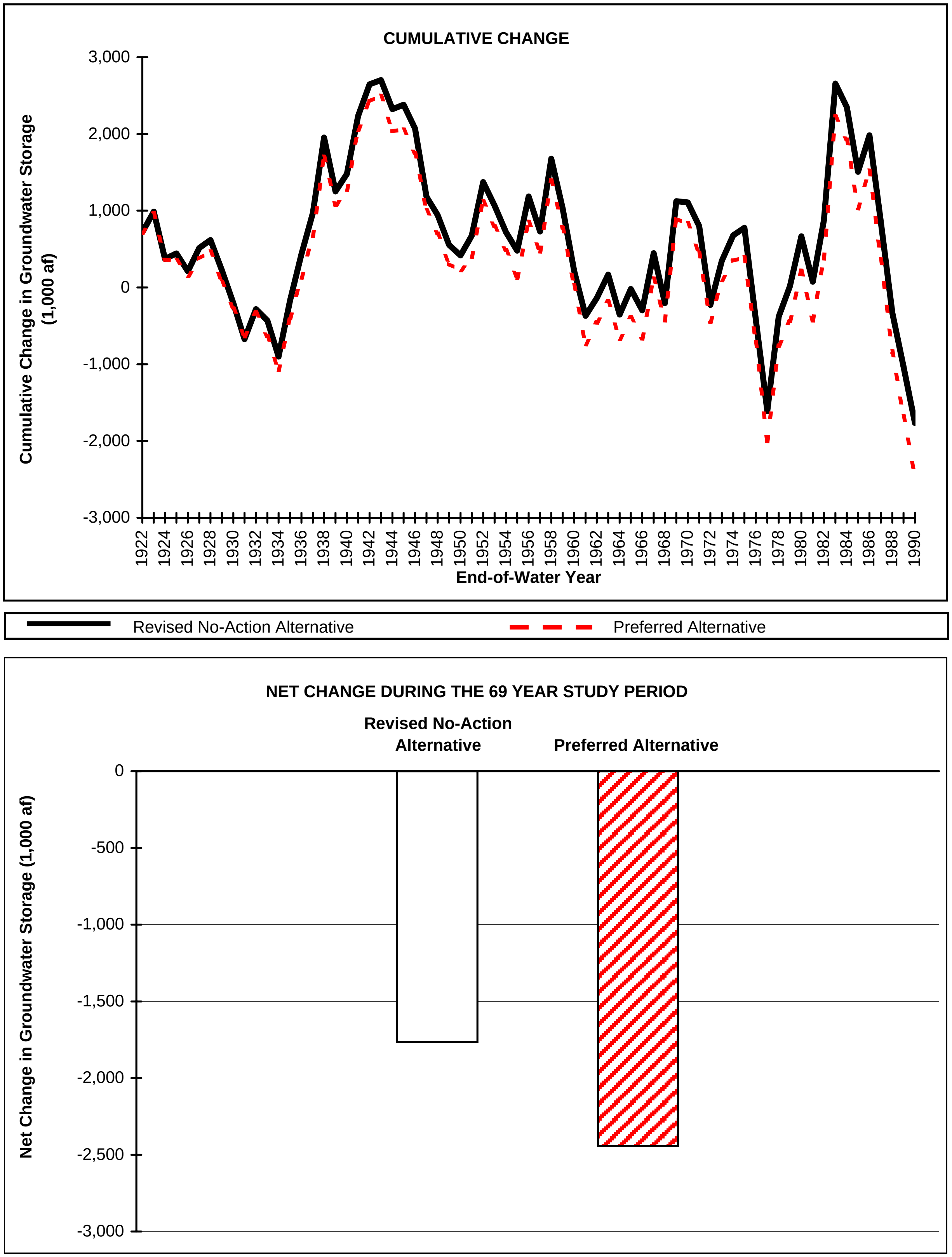


FIGURE IV-94
SIMULATED GROUNDWATER STORAGE CONDITIONS FOR THE SAN JOAQUIN RIVER REGION

Groundwater Levels. Differences in the groundwater levels under the Preferred Alternative for the end of the 69-year simulation would be similar to those under the Revised No-Action Alternative in the north half of the region (see Figure IV-88). However, in the southwestern portion of the region, groundwater levels under the Preferred Alternative would be lower by approximately 5-10 feet regionally. These declines would occur in response to increased groundwater pumping (primarily in CVP service areas withing Subregion 10), and increased subsurface flow south toward declining groundwater levels in the Tulare Lake Region. The interaction of surface water with underlying groundwater in the southeastern portion of the region would be affected as a result of declining groundwater levels, and would result in greater stream losses in this area.

Land Subsidence. Additional groundwater level declines observed in the Preferred Alternative in comparison to the Revised No-Action Alternative indicate that additional land subsidence would occur along the west side of the San Joaquin River Region. Figure IV-95 shows the range of differences in land subsidence occurring over the simulation period (shown as Preferred Alternative minus the Revised No-Action Alternative). The differences range between 1 and 5 feet, and occur in the southwestern portion of the region.

Groundwater Quality. With the exception of the southwestern corner of the region, groundwater levels would decline very little in this area, and it is expected that groundwater quality in the San Joaquin River Region would be similar to that under the Revised No-Action Alternative. However, additional groundwater pumping along the southwest side of the region could possibly result in upwelling of groundwater high in TDS into productive groundwater zones.

Agricultural Subsurface Drainage. Under the Preferred Alternative, agricultural subsurface drainage conditions in the San Joaquin River Region would improve relative to the Revised No-Action Alternative as a result of land retirement of approximately 1,200 acres in areas of poorly drained soils.

Tulare Lake Region

Differences in Tulare Lake Region groundwater levels for the end of the 69-year simulation period for the Preferred Alternative are shown in Figure IV-88. Groundwater levels would decline greatest in areas served by CVP supplies.

Groundwater Storage and Production

Tulare Lake Region (North). Average annual groundwater conditions in the Tulare Lake Region (North) for the Preferred Alternative are shown in Table IV-74. The annual variation in groundwater pumping and recharge are very similar to those under the Revised No-Action Alternative (Figure IV-96).

Groundwater storage declines (Figure IV-97) would be observed under the Preferred Alternative compared to Revised No-Action Alternative due to increased pumping in the region (primarily in Subregion 14). The increase in groundwater pumping in Subregion 14 is due primarily to

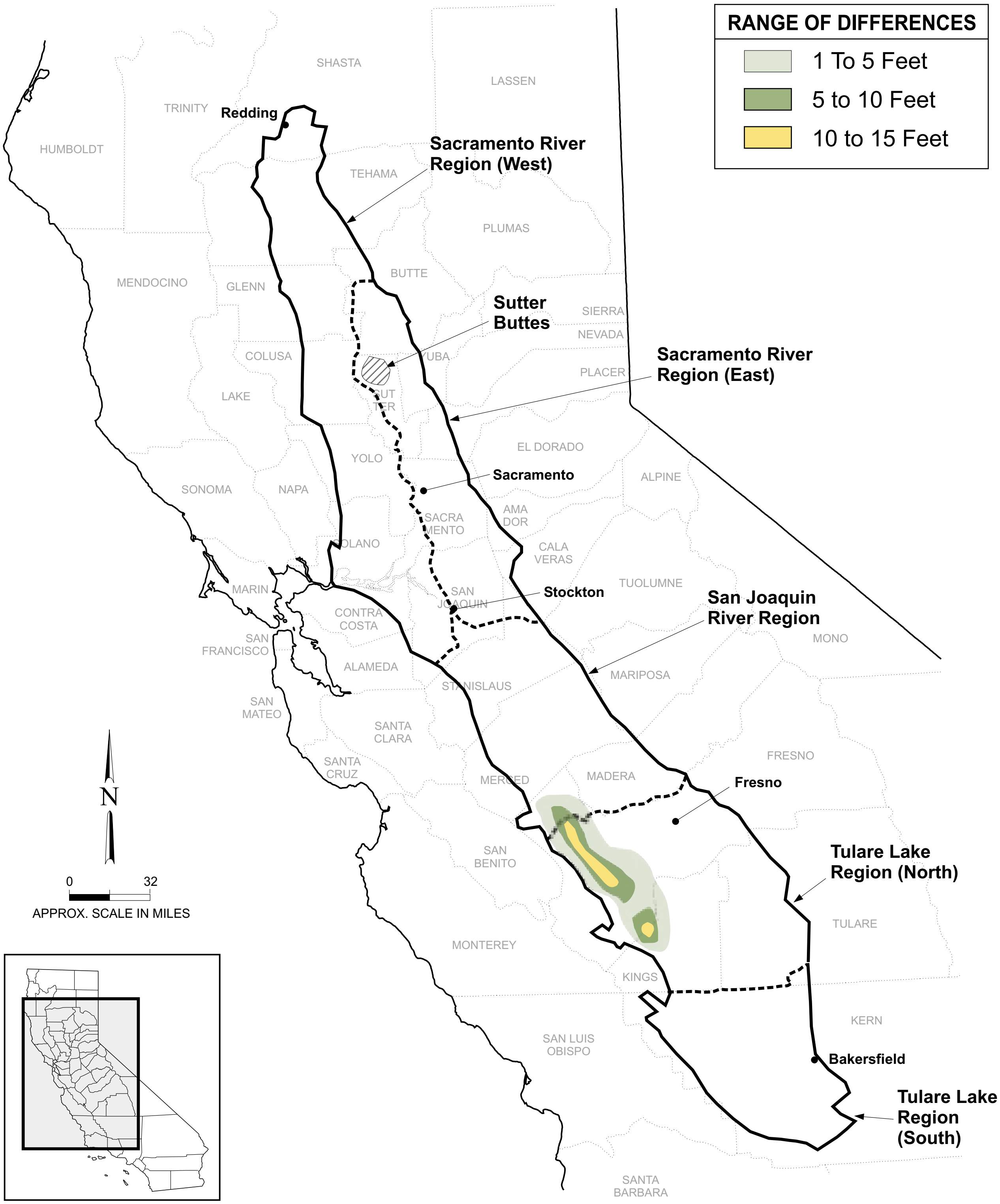


FIGURE IV-95
INCREASE IN SIMULATED LAND SUBSIDENCE
IN PREFERRED ALTERNATIVE FROM REVISED NO-ACTION ALTERNATIVE

TABLE IV-74

COMPARISON OF AVERAGE ANNUAL GROUNDWATER CONDITIONS FOR THE TULARE LAKE REGION (NORTH) SIMULATION PERIOD 1922-1990

Condition	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Difference (1,000 acre-feet)
Recharge			
Deep Percolation	1,692	1,646	-46
Gain from Streams	508	526	18
Recharge	397	410	13
Boundary Inflows	1,219	1,265	47
Total Recharge	*3,815*	*3,847*	*32*
Discharge			
Groundwater Pumping	4,068	4,165	98
Total Discharge	*4,068*	*4,165*	*98*
Change in Groundwater Storage	-252	-318	-66

NOTES:
For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

additional requirements of (b)(2) water for Delta needs, resulting in reductions in CVP deliveries from the San Luis Canal to the west side of this region. The net change in groundwater storage over the 69-year simulation period is 21,947,000 acre-feet, or an increase in groundwater depletion of 4,548,000 acre-feet in comparison to the Revised No-Action Alternative.

Tulare Lake Region (South). Average annual groundwater conditions for the Tulare Lake Region (South) under the Preferred Alternative are presented in Table IV-75. The annual variations in groundwater pumping, recharge, and storage are very similar to those under the Revised No-Action Alternative (Figures IV-98 and IV-99).

Groundwater Levels. Differences in groundwater levels under the Preferred Alternative in the southern half of the region would be similar to those under the Revised No-Action Alternative (see Figure IV-88). However, in the northern portion of the region, groundwater levels under the Preferred Alternative would be lower by approximately 5 to 30 feet regionally, and up to 60 feet in some locations. These declines would occur in response to increased groundwater pumping, primarily in CVP service areas within Subregion 14.

Land Subsidence. Additional groundwater level declines observed in the Preferred Alternative in comparison to the Revised No-Action Alternative indicate that additional land subsidence would occur along the west side of the Tulare Lake Region (North). Figure IV-95 shows the range of differences in land subsidence occurring over the simulation period (shown as

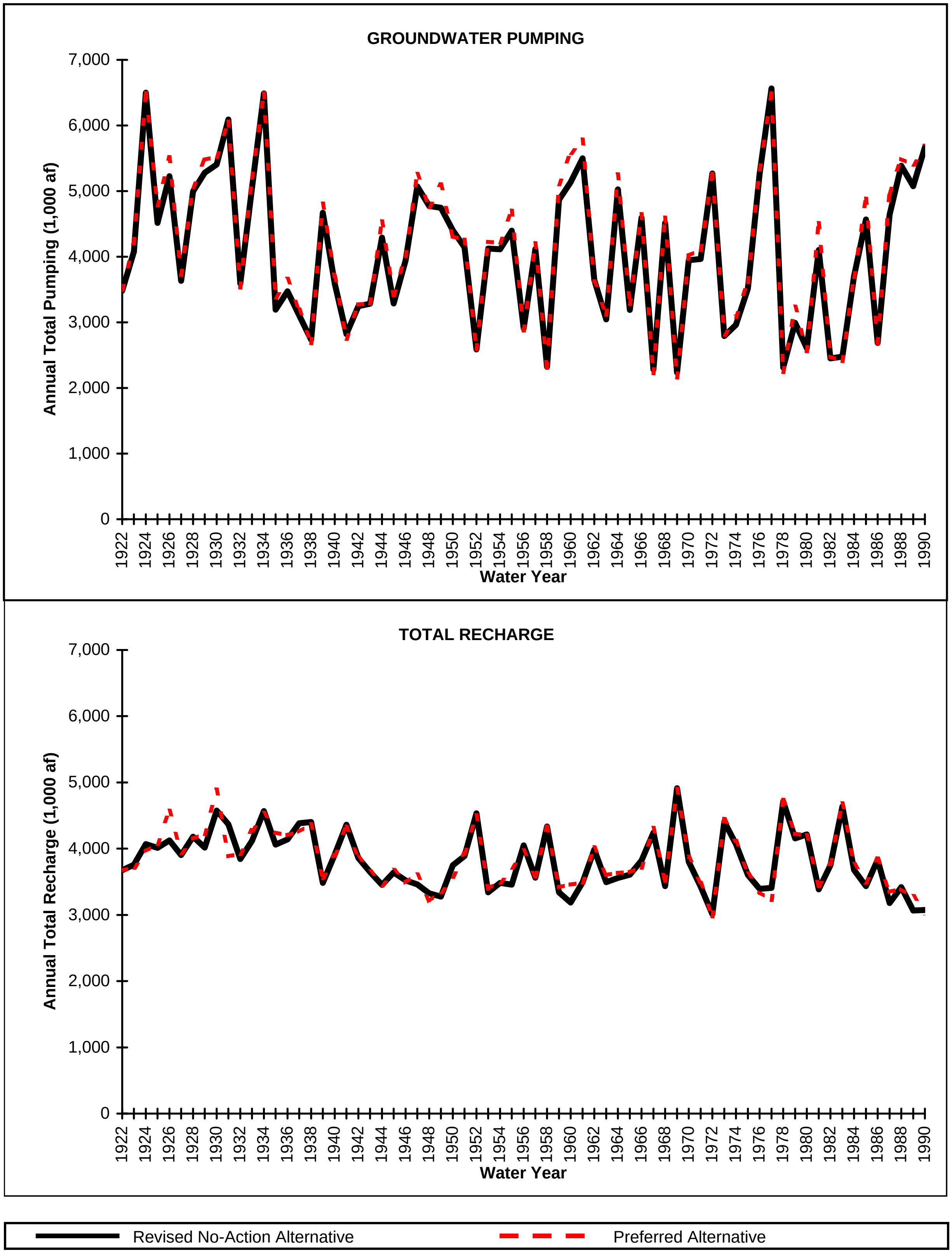


FIGURE IV-96
SIMULATED GROUNDWATER PUMPING AND RECHARGE FOR THE TULARE LAKE REGION (NORTH)

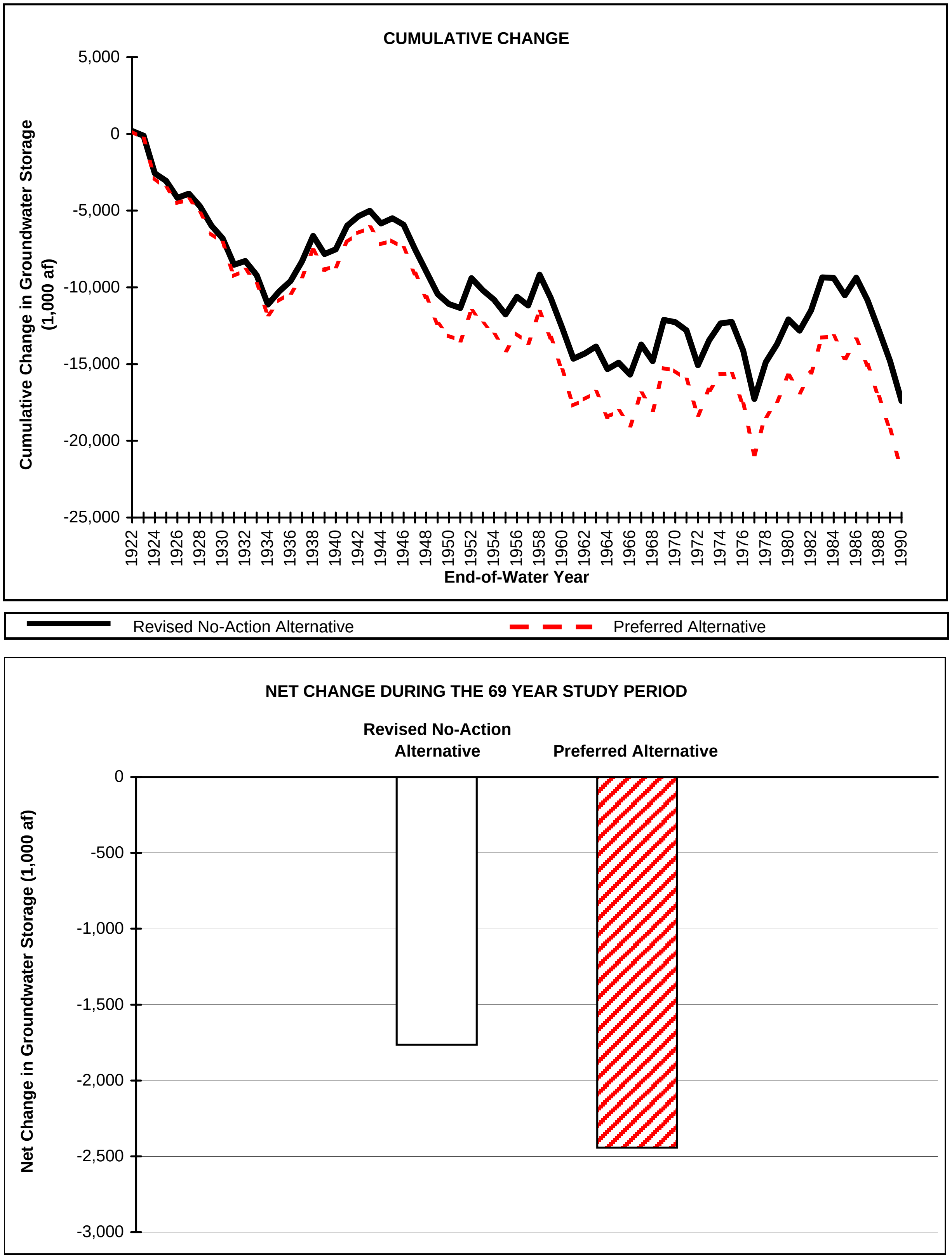


FIGURE IV-97
SIMULATED GROUNDWATER STORAGE CONDITIONS FOR THE TULARE LAKE REGION (NORTH)

TABLE IV-75

COMPARISON OF AVERAGE ANNUAL GROUNDWATER CONDITIONS FOR THE TULARE LAKE REGION (SOUTH) SIMULATION PERIOD 1922-1990

Condition	Revised No-Action Alternative (1,000 acre-feet)	Preferred Alternative (1,000 acre-feet)	Difference (1,000 acre-feet)
Recharge			
Deep Percolation	945	947	1
Gain from Streams	264	257	-7
Recharge	130	128	-2
Boundary Inflows	234	233	-1
Total Recharge	*1,572*	*1,565*	*-8*
Discharge			
Groundwater Pumping	1,483	1,474	-10
Total Discharge	*1,483*	*1,474*	*-10*
Change in Groundwater Storage	89	91	2

NOTES:
For the purposes of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

Preferred Alternative minus the Revised No-Action Alternative). The differences along the west side range between 5 to 10 feet, and are as high as 20 feet in some locations.

Groundwater Quality. Additional groundwater pumping along the west side of the region could possibly result in upwelling of groundwater high in TDS into productive groundwater zones. Groundwater quality conditions in other areas of the region would be similar to those under the Revised No-Action Alternative.

Agricultural Subsurface Drainage. Under the Preferred Alternative, agricultural subsurface drainage conditions in the Tulare Lake Region would improve relative to the Revised No-Action Alternative as a result of land retirement of approximately 28,800 acres in areas of poorly drained soils, and relative declines in groundwater levels.

San Francisco Bay Region

Under the Preferred Alternative, CVP deliveries to Santa Clara and San Benito counties would decrease on average 20,000 acre-feet per year relative to the Revised No-Action Alternative. Local regulation of groundwater extraction by means of pump taxes, such as those levied by the SCVWD, would discourage replacement of this CVP water with groundwater. For the purposes of this programmatic level of analysis, it is assumed that any increase in groundwater pumping to offset these reduced CVP deliveries would be minimal. A small impact on groundwater conditions could occur in the vicinity of spreading basins as a result of lost deep percolation associated with the reduced CVP deliveries.

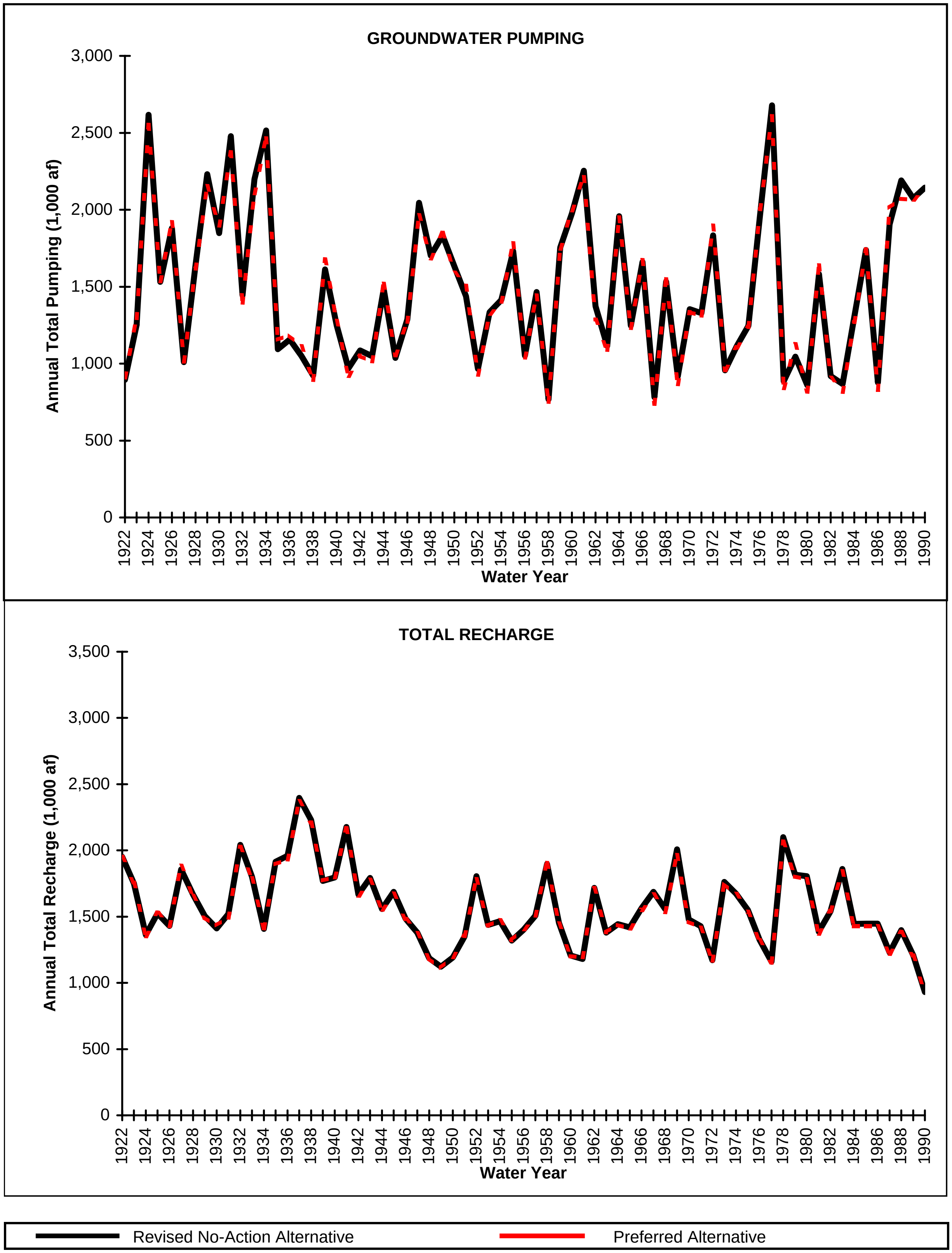


FIGURE IV-98
SIMULATED GROUNDWATER PUMPING AND RECHARGE FOR THE TULARE LAKE REGION (SOUTH)

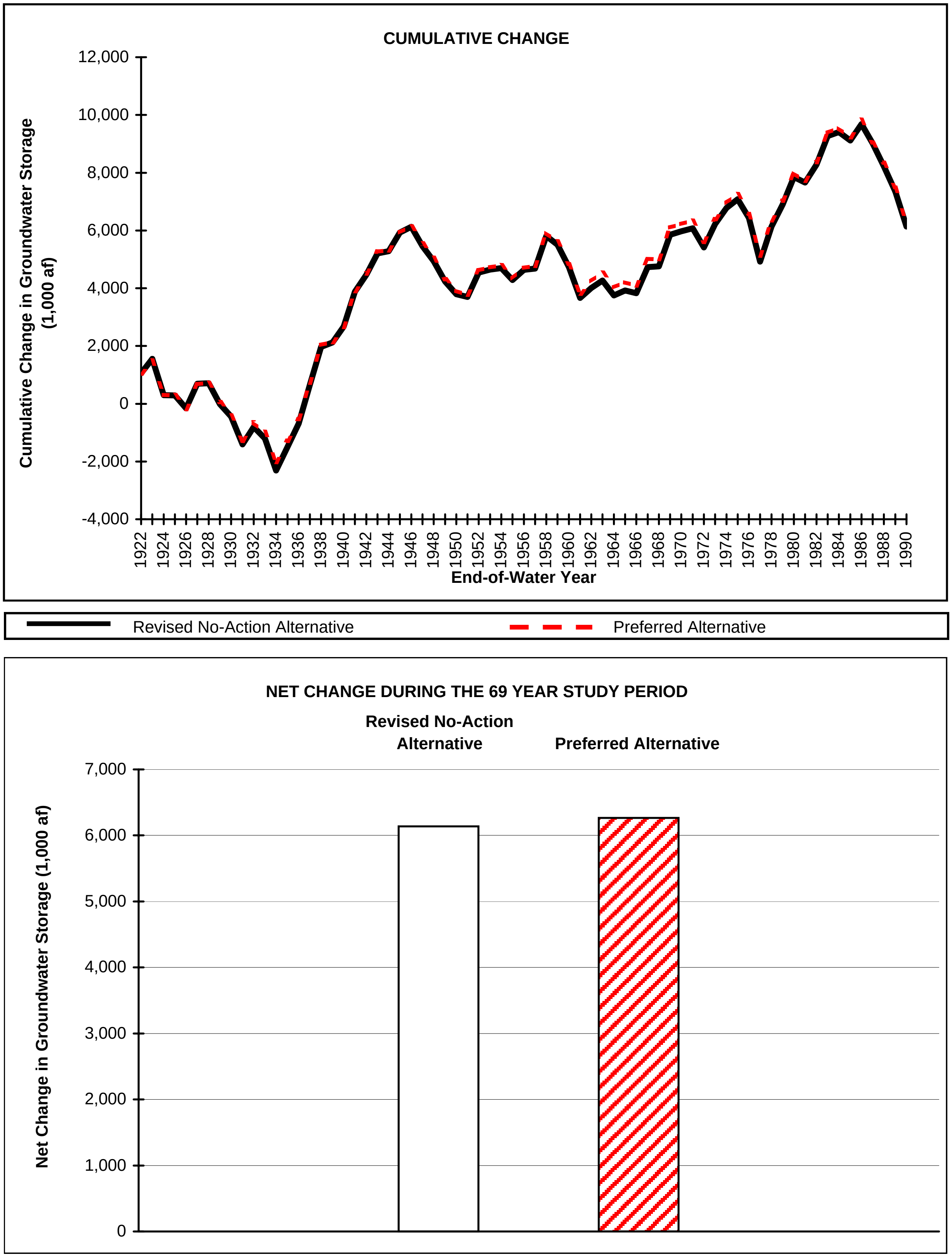


FIGURE IV-99
SIMULATED GROUNDWATER STORAGE CONDITIONS FOR THE TULARE LAKE REGION (SOUTH)

Under the Preferred Alternative, CVP deliveries to Alameda and Contra Costa counties would be similar to those under the Revised No-Action Alternative. Under these conditions no net impact to groundwater storage, levels, and quality would occur, and no additional land subsidence would occur in these areas.

FISHERY RESOURCES

Implementation of the Preferred Alternative would benefit all representative fish species by improving environmental conditions and increasing habitat availability. The Preferred Alternative includes all components of Alternative 2 plus some additional actions, as described in the Surface Water Supplies and Facilities Operations Section of this chapter. Acquired flows are also used to meet Delta flow needs, including increased Delta outflow.

The Preferred Alternative includes structural, habitat restoration, and flow-related actions. These actions would be implemented in Central Valley watersheds and provide enhanced ecosystem conditions for fish species using those watersheds. The impacts on representative species are identified in detail. The Preferred Alternative also implements (b)(2) Water Management actions in Clear Creek and the Sacramento, American, and Stanislaus rivers and the Delta as described in Attachment G-7 of the PEIS. These flow actions would increase the benefits provided by other CVPIA actions, such as structural and habitat restoration actions, by increasing the availability and abundance of fish habitat. An example would be the benefits observed when both flow actions and riparian corridor habitat restoration actions occur. The benefits would be much broader with flow actions that enhance the stream-riparian interface.

Response by Representative Species

Compared to the Revised No-Action Alternative, actions implemented under the Preferred Alternative would benefit all of the representative species.

Chinook Salmon. Effects on chinook salmon are discussed separately for fall-, late fall-, winter-, and spring-runs. All runs of chinook salmon would benefit from improved ecosystem conditions in the watersheds they use under implementation of the Preferred Alternative compared to the Revised No-Action Alternative.

Fall-Run Chinook Salmon. Compared to conditions under the Revised No-Action Alternative, implementation of the CVPIA actions under the Preferred Alternative would improve ecosystem conditions that benefit fall-run chinook salmon. However, higher water temperatures in the American River during October and November would adversely affect spawning success, and higher temperatures in the Sacramento River during May and June would adversely affect fall-run rearing and migration.

In the Sacramento-San Joaquin Delta Estuary, entrainment and impingement would be reduced by fish screen improvements and by reduced Delta diversion from April through June. For juvenile fall-run chinook salmon that migrate down the San Joaquin River, a higher QWEST from February through June would improve conditions potentially affecting movement toward

Suisun Bay. Juvenile fall-run originating in the Sacramento and Mokelumne rivers would also benefit.

Late Fall-Run Chinook Salmon. In the Sacramento-San Joaquin Delta Estuary, juvenile late fall-run chinook salmon would benefit from reduced Delta diversions from April through September. However, increased water temperatures in drier years in the Sacramento River from May through September would adversely affect rearing habitat for late fall-run chinook salmon.

Increases in QWEST during May and June would improve conditions potentially facilitating movement toward Suisun Bay for juvenile salmon in the central and south Delta, including juvenile late fall-run originating in the Sacramento River. Under the Preferred Alternative, DCC closure during November would reduce the presence of migrating juvenile late fall-run chinook salmon in the central Delta and further improve conditions affecting movement.

Winter-Run Chinook Salmon. Increased water temperature in drier years in the Sacramento River would adversely affect adult migration, spawning, and juvenile rearing. Please see the subsection on "Water Temperature" later in this section for more details.

In the Sacramento-San Joaquin Delta Estuary, juvenile winter-run chinook salmon would benefit from reduced Delta diversions in April and May. Flows through the DCC and Georgiana Slough decrease up to 40 percent from the Revised No-Action Alternative in December and January. The proportion of Sacramento River flow diverted through the DCC and Georgiana Slough decreases in December and January by about 10 to 15 percent. Therefore, survival of migrating juvenile winter-run chinook salmon should increase. A higher QWEST from December through June, compared to the Revised No-Action Alternative, would improve conditions potentially affecting movement through the Delta.

Spring-Run Chinook Salmon. Increased water temperature in drier years in the Sacramento River during May through September would adversely affect adult migration, spawning, and juvenile rearing.

In the Sacramento-San Joaquin Delta Estuary, spring-run chinook salmon would benefit from reduced Delta diversion in March and April compared to the Revised No-Action Alternative. Flow through the DCC and Georgiana Slough in November to January would decrease by up to 40 percent compared to flows in the Revised No-Action Alternative. The proportion of Sacramento River flow diverted through the DCC and Georgiana Slough decreases in November to January by about 10 to 15 percent. Therefore, migrating juvenile spring-run chinook salmon would experience increased survival because movement toward Suisun Bay would be enhanced.

Steelhead Trout. Beneficial effects of Delta and upstream life stages are the same as described for spring-run salmon. As with late fall- and spring-run chinook salmon, increased water temperature in drier years in the Sacramento River would adversely affect juvenile rearing during May through September. Water temperature conditions for spawning may also be adversely affected during May. Increased water temperatures also occur in the drier years in the American River.

Sturgeon. Implementation of the actions under the Preferred Alternative would benefit green and white sturgeon through improved habitat conditions, compared to conditions under the Revised No-Action Alternative. In the Sacramento-San Joaquin Delta Estuary, rearing adults and juveniles and migrating juveniles would benefit from reduced Delta diversions from April through September.

American Shad. Benefits to American shad in the Sacramento-San Joaquin Delta Estuary would accrue during all life stages in response to reduced pollutant levels, reduced diversions, and improved quantity and quality of habitat and food web support. Under the Preferred Alternative, Delta diversions during April through June would generally decrease, leading to decreased entrainment of eggs and larvae. Juvenile shad would benefit from reduced Delta diversions from June through September. Reduced diversions would lead to reduced diversion-related losses and improvement of conditions potentially affecting movement through the Delta.

Striped Bass. Striped bass would benefit from CVPIA actions implemented under the Preferred Alternative. In addition to the benefits previously described for Alternatives 1 through 3, reduced Delta diversions from April through September under the Preferred Alternative would lead to reduced entrainment and impingement of egg, larval, and juvenile striped bass. Conditions potentially affecting movement through the Delta would improve, compared to the Revised No-Action Alternative, primarily because QWEST would be higher from February through October and because estuarine salinity would be further downstream in all months.

Delta Smelt. Delta smelt would also benefit from CVPIA actions implemented under the Preferred Alternative. Reduced Delta diversions under the Preferred Alternative from April through September would reduce losses of larval, juvenile, and adult delta smelt. Conditions potentially affecting movement toward Suisun Bay would be improved, compared to the Revised No-Action Alternative, primarily in response to a higher QWEST from April through July and because estuarine salinity would be further downstream in all months.

Longfin Smelt. Longfin smelt would benefit from CVPIA actions implemented under the Preferred Alternative. Reduced Delta diversions from April through July under the Preferred Alternative would reduce entrainment and impingement of all life stages. A higher QWEST, slightly increased Delta outflow, and reduced diversions would improve conditions, potentially affecting movement of larvae and juveniles toward Suisun Bay and reducing diversion mortality from December through June.

Sacramento Splittail. Implementation of CVPIA actions under the Preferred Alternative would provide overall benefits to the Sacramento splittail. Adult and juvenile splittail would benefit from reduced diversions in the Delta from April through September as well as reduced diversion mortality attributable to fish screen improvements. Downstream shift in estuarine salinity during all months would increase spawning and rearing habitat availability and increase food web support.

Reservoir Species. The beneficial and adverse impacts of actions implemented under the Preferred Alternative are similar to those described for Alternative 2, except for Shasta Lake and

San Luis reservoirs. Lower surface elevations from April through the fall would adversely affect habitat availability and food web support.

Response by Environmental Condition

The following sections describe, for each environmental condition, the species responses to CVPIA and restoration actions included in the Preferred Alternative.

Water Temperature. Water temperatures would increase in the Sacramento River below Keswick during May through September primarily in dry years. This would lead to increases in the frequency, duration, and magnitude of violations of the temperature criteria contained in the 1993 Winter-Run Chinook Salmon Biological Opinion. The increase in water temperature would adversely affect winter-, late fall-, and spring-run chinook salmon and steelhead. Water temperature would also increase in drier years in the American River below Nimbus from June through November. Increased water temperature in the American River would adversely affect fall-run chinook salmon and steelhead.

Diversion. Improvements due to fish screening on river diversions are similar to those described under Alternative 1.

Compared to the Revised No-Action Alternative, diversions from the Delta (primarily through the CVP and SWP pumping facilities) would decrease from April through September and increase from November through March. Decreased diversion compared to the Revised No-Action Alternative from April through September, would reduce entrainment and impingement of striped bass (eggs, larvae, and juveniles); delta smelt (adult, larvae, and juveniles); longfin smelt (adult, larvae and juveniles); American shad (eggs, larvae, and juveniles); juvenile steelhead trout; juvenile chinook salmon from all runs; juvenile sturgeon; and splittail (juvenile and adult). From December through March, increased Delta diversions would increase losses of juvenile striped bass; juvenile and adult delta smelt; adult longfin smelt; juvenile American shad; juvenile steelhead trout; and juvenile late fall-, winter-, and spring-run chinook salmon. Fish screen improvements and improved conditions affecting movement, however, would minimize any losses attributable to higher diversions.

Compared to the Revised No-Action Alternative, conditions affecting movement would partially determine the effects of diversion and the potential benefit of reduced diversion in the Delta (see the “Movement” section, below). Flow conditions affecting movement may reduce the presence of juvenile chinook salmon and larval and juvenile striped bass and delta smelt in the central and south Delta from June through August and November through January, further reducing diversion mortality.

Change in Water Surface Level. In rivers, the effects of implementing the Preferred Alternative would be similar to those described for Alternative 1. In reservoirs, simulated drawdowns are similar to those described for Alternative 1 except for San Luis Reservoir. Under the Preferred Alternative, lower water surface elevation in San Luis Reservoir during spring, summer, and fall would increase the loss of spawning, incubation, and rearing life stages of resident reservoir species.

Pollutants. Changes in pollutant conditions would be similar to those described for Alternative 1.

Predation. Changes in predation conditions would be similar to those described for Alternative 1.

Movement. Conditions affecting movement in riverine systems would be similar to those described for Alternative 1.

Flow conditions potentially affecting movement out of the central Delta and toward Suisun Bay would improve in response to reduced Delta diversions and reduced flow down the DCC and Georgiana Slough. The Old River flow diversion under the Preferred Alternative would be essentially the same as under Alternative 1.

The proportion of Sacramento River flow entering the DCC and Georgiana Slough would be similar to the proportion under Alternative 1, except from November through January, when closure of the DCC gates would block flow from the Sacramento River. Reduced flow in the DCC and Georgiana Slough would reduce movement of organisms from the Sacramento River into the central Delta. Therefore, compared to the Revised No-Action Alternative, conditions affecting movement from October through January would be improved, which would have a beneficial impact on juvenile chinook salmon, primarily spring-run and winter-run salmon.

Net Delta channel flow toward Suisun Bay is assumed to provide cues that increase movement of organisms out of unproductive habitat in the central and south Delta. Under the Preferred Alternative, a higher QWEST compared to the Revised No-Action Alternative would increase movement of larval and juvenile striped bass and delta smelt and juvenile chinook salmon and steelhead trout. Increased movement out of the central and south Delta and toward Suisun Bay from April through September would improve habitat quality and quantity.

Quantity and Quality of Habitat. In rivers, the effects of implementing the Preferred Alternative would be the same as those described for Alternative 1. The Preferred Alternative includes the acquisition of water from willing sellers to provide additional instream flow toward meeting AFRP target flows on the Stanislaus, Tuolumne, and Merced rivers, as well as Sacramento River tributaries.

In the Delta, the effects of habitat restoration actions are the same as described for Alternative 1, but flow effects would differ, resulting in greater habitat benefits. Effects of Delta flow conditions on the quantity and quality of habitat under the Preferred Alternative are described in this section.

Simulated reservoir surface elevations are roughly the same as those described for Alternative 1, except for Lake Shasta, Folsom Reservoir, and San Luis Reservoir.

Sacramento-San Joaquin Delta Estuary. Changes in Delta outflow may affect habitat through effects on estuarine salinity. Higher outflow and the location of X2 downstream of the Delta in Suisun Bay would increase habitat availability. Compared to the Revised No-Action Alternative, X2 would shift farther downstream year round and would increase slightly the availability and quality of spawning and early rearing habitat for Sacramento splittail, delta smelt, and longfin smelt.

Reservoirs. Operations under the the Preferred Alternative would reduce surface elevations compared to the Revised No-Action Alternative at Shasta Lake, Folsom Lake, and San Luis Reservoir. Lower surface elevation would reduce habitat available for spawning and rearing by largemouth and spotted bass.

Food Web Support. The response of fish species, described in the preceding sections, generally applies to food web organisms as well. Changes in food web support for rivers would be similar to those described for Alternative 1. In the Delta, the effects of habitat restoration actions are the same as those described for Alternative 1, but flow and diversion effects differ.

Changes in entrainment in Delta diversions under the Preferred Alternative would affect food web support. Compared to the Revised No-Action Alternative, diversions from the Delta (primarily through the CVP and SWP pumping facilities) would decrease from April through September and increase from November through March. Decreased diversion would reduce losses of food web organisms, nutrients, and organic carbon from April through September, a primary period of production in the Delta. As indicated by a higher QWEST, flow conditions under the Preferred Alternative may increase movement of food web organisms out of the central and south Delta and toward Suisun Bay.

Special-Status Species

The impacts to special-status species have been described above. The Revised No-Action Alternative implements provisions designed to protect special-status species using tributaries of the Sacramento-San Joaquin Delta. The 1993 Winter-Run Chinook Salmon Biological Opinion identifies habitat requirements (water temperature and operation requirements in the Sacramento River) to protect this species. These requirements may contribute in varying degrees to the protection of other special-status species using the Sacramento River, including spring-run chinook salmon and steelhead trout. However, analysis of the Preferred Alternative indicates that water temperatures in the Sacramento River would increase from May through September, adversely affecting habitat conditions for winter-run chinook salmon, steelhead, and spring-run chinook salmon. In the American River, increased water temperature from June through November would adversely affect juvenile steelhead rearing.

The Delta Smelt Biological Opinion identifies habitat requirements for delta smelt and provides habitat and transport conditions for estuarine species. These provisions also contribute to the protection of other Delta species, such as longfin smelt, which is listed as a species of concern.

AGRICULTURAL ECONOMICS AND LAND USE

The following are the key features and assumptions of the Preferred Alternative that distinguish it from the Revised No-Action Alternative with respect to agricultural economics and land use conditions:

- Dedication of water for fish and wildlife purposes: The Preferred Alternative implements the CVPIA provisions for dedicating water for fish and wildlife restoration. This reallocation of project yield reduces supplies available for delivery to agricultural users.

- CVP tiered water pricing: Section 3405(d) of CVPIA requires that water rates charged to contractors be based on a tiered structure. The first 80 percent of contract total is charged at not less than the cost-of-service rate, the next 10 percent at not less than the average of cost-of-service and full cost (as defined in the Reclamation Reform Act), and water delivered above 90 percent of contract total at not less than the full-cost rate. The Preferred Alternative assumes that water rates are set using the minimum levels defined: cost-of-service and full cost.

- Restoration charges: A $6 per acre-foot restoration charge (1992 dollars) is imposed on all CVP agricultural water service contracts. In addition, CVPIA imposes a $4 to $7 per acre-foot surcharge on deliveries to the Friant Division. For the year 2020 evaluation, the $7 per acre-foot surcharge is used for a total CVPIA charge of $13 (1992 dollars) per acre-foot to Friant Division water users.

- Ability-to-pay policy: This analysis assumes that the policy remains in effect, and estimates appropriate water rates using payment capacities from a 1992 planning-level study prepared by Reclamation (1992b). This study estimated payment capacity (before district costs) at about $11 per acre-foot north of Delta and $70 per acre-foot for deliveries south of Delta. CVPIA also directs Reclamation to reduce some or all of the $6 per acre-foot restoration charge if payment capacity is exceeded. The implementation of tiered pricing under payment capacity limits assumes that only the restoration charge and principal on capital can be forgiven. The price increases in the higher price tiers are due to interest on capital, and are not forgiven under current policy. The result is that the ability-to-pay policy may reduce water price up to the restoration charge plus principal on capital, and the amount of the reduction is the same in each price tier.

- Land Retirement Program: The Preferred Alternative assumes that 30,000 acres of irrigated land are retired in order to implement the San Joaquin Valley Drainage Program recommendations. This is in addition to the lands that DWR Bulletin 160-93 already assumed had been retired. These lands are on the west side and southern portion of the San Joaquin Valley, with about 14,400 acres in the San Joaquin River Region and 15,600 acres in the Tulare Lake Region.

The Preferred Alternative also includes the acquisition of water for instream flow and wildlife refuges. By assumption, b(3) water is acquired from willing sellers. Acquisition in the San Joaquin River tributaries is defined by the recommendations in the Vernalis Adaptive Management Plan. Under this plan, water would be acquired in a way that minimizes the need for fallowing existing agricultural lands. This assumption is also made for other instream flow acquisitions in the San Joaquin River and Sacramento River regions.

Irrigated Land Use

Starting from the baseline land use described in Bulletin 160-93, the water supplies estimated in the surface water and groundwater analysis were used to estimate resulting irrigated land use. Results are summarized for the three Central Valley regions and the San Felipe Division and compared to the Revised No-Action Alternative in Table IV-76.

Changes from the Revised No-Action Alternative are determined by land targeted for the retirement program and by the dedicated water plus lands fallowed due to water acquisition. The San Joaquin River Region shows the largest decline in acreage, about 31,000 acres (1.2 percent), followed by Tulare Lake Region, which declines 14,000 acres (0.7 percent). Sacramento River Region shows a decline of about 400 acres (.02 percent). Total reduction in the Central Valley is about 45,000 acres, or less than one percent of the irrigated acreage in the Revised No-Action Alternative.

San Joaquin River Region's decline is a combination of the Land Retirement Program, additional fallowing due to reduced CVP delivery, and fallowing due to water acquisition. The predominance of cotton as the crop most affected is largely a result of the areas targeted for retirement and those losing CVP delivery: both of these occur in areas where cotton is the predominant field crop. A decline of 27,300 acres represents about 4 percent of Revised No-Action Alternative cotton acreage in the Central Valley. Pasture, alfalfa hay, and field crops decline primarily as part of east side water acquisition. In the Sacramento River Region, about 300 acres of rice (less than 1 percent) account for most of the estimated acreage decline.

San Felipe Division acreage declines about 9,000 acres as a result of CVP water supply reduction. This represents about 36 percent of land supplied by CVP water, or about 9 percent of the almost 100,000 acres irrigated by water from all sources in San Benito and Santa Clara Counties.

Gross Revenue from Irrigated Lands

Central Valley reduction in gross revenue is estimated to be $43.3 million per year. This estimate accounts for crop price increases expected to occur because production has declined. (Without this price increase, the gross revenue would decline another $0.5 million per year.) Most of the decline is in cotton and other field crop categories, consistent with the change in acreage. The total decline in Central Valley gross revenue represents less than one percent of the Revised No-Action Alternative value. Table IV-77 summarize the changes from the Revised No-Action Alternative in the gross revenue by region and crop.

San Felipe Division gross revenue is estimated to decline about $30 million on average, with most of that resulting from reduced vegetable production.

TABLE IV-76

CHANGE IN IRRIGATED ACREAGE, PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

Crop	Average (1922-90)	Dry (1928-34)	Wet (1967-71)
Sacramento River Region			
Pasture	0.0	-0.2	0.3
Alfalfa	0.1	-1.1	0.4
Sugar Beets	0.0	-0.3	0.0
Other Field Crops Crops	-0.1	-1.9	0.2
Rice	-0.3	-2.5	-0.4
Truck Crops	0.0	0.0	0.0
Tomatoes	0.0	-0.2	0.1
Deciduous Orchard	0.0	0.0	0.0
Small Grain	-0.1	-1.4	0.3
Grapes	0.0	0.0	0.0
Subtropical Orchard	0.0	0.0	0.0
Subtotal	**-0.4**	**-7.6**	**0.9**
San Joaquin River Region			
Pasture	-1.1	-0.4	-0.8
Alfalfa	-2.8	-1.8	-2.6
Sugar Beets	-0.2	-0.1	-0.2
Other Field Crops Crops	-3.3	-2.5	-3.3
Rice	-0.1	-0.1	-0.1
Truck Crops	-0.6	-0.5	-0.6
Tomatoes	-1.8	-1.6	-1.8
Deciduous Orchard	-0.1	-0.1	-0.1
Small Grain	-1.8	-1.3	-1.9
Grapes	-0.1	-0.1	-0.1
Cotton	-18.7	-16.0	-18.6
Subtropical Orchard	0.0	0.0	0.0
Subtotal	**-30.6**	**-24.5**	**-30.1**
Tulare Lake Region			
Pasture	-0.2	-0.1	-0.2
Alfalfa	-2.3	-1.6	-2.5
Sugar Beets	-0.1	-0.1	-0.1
Other Field Crops Crops	-1.6	-0.9	-1.7
Rice	0.0	0.0	0.0
Truck Crops	-0.3	-0.2	-0.3
Tomatoes	0.0	0.0	0.0
Deciduous Orchard	-0.1	-0.1	-0.1
Small Grain	-0.7	-0.1	-0.8
Grapes	-0.1	-0.1	-0.1
Cotton	-8.6	-6.3	-9.6
Subtropical Orchard	0.0	0.0	0.0
Subtotal	**-14.0**	**-9.5**	**-15.4**
San Felipe Division			
Pasture and Hay	-0.6	-0.5	-0.3
Other Field Crops	-1.2	-1	-0.6
Vegetable	-4.3	-3.7	-2.2
Tree and Vine	-2.6	-2.6	-2.6
Subtotal	**-8.7**	**-6.9**	**-5.7**
Total	**-53.7**	**-48.5**	**-52.1**

NOTE: All values in thousands of acres.

TABLE IV-77

CHANGE IN GROSS REVENUE, PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

Crop	Average (1922-90)	Dry (1928-34)	Wet (1967-71)
Sacramento River Region			
Pasture	0.05	-0.01	0.07
Alfalfa	0.28	-0.40	0.41
Sugar Beets	0.00	-0.20	0.04
Other Field Crops Crops	-0.05	-0.85	0.12
Rice	-0.24	-2.05	-0.33
Truck Crops	0.04	0.01	0.05
Tomatoes	0.37	0.08	0.46
Deciduous Orchard	0.04	0.04	0.04
Small Grain	-0.02	-0.41	0.09
Grapes	0.01	0.01	0.01
Subtropical Orchard	0.00	0.00	0.00
Subtotal	**0.48**	**-3.78**	**0.96**
San Joaquin River Region			
Pasture	-0.22	-0.07	-0.16
Alfalfa	-1.34	-0.78	-1.24
Sugar Beets	-0.14	-0.11	-0.15
Other Field Crops Crops	-1.99	-1.49	-1.99
Rice	-0.08	-0.04	-0.06
Truck Crops	-3.35	-3.01	-3.50
Tomatoes	-2.31	-2.05	-2.32
Deciduous Orchard	-0.12	-0.12	-0.12
Small Grain	-0.94	-0.62	-0.98
Grapes	-0.04	-0.04	-0.04
Cotton	-20.49	-17.70	-20.36
Subtropical Orchard	-0.01	-0.01	-0.01
Subtotal	**-31.03**	**-26.04**	**-30.93**
Tulare Lake Region			
Pasture	-0.03	-0.02	-0.04
Alfalfa	-1.06	-0.67	-1.21
Sugar Beets	-0.11	-0.09	-0.12
Other Field Crops Crops	-1.01	-0.60	-1.08
Rice	0.00	0.00	0.00
Truck Crops	-1.44	-1.14	-1.60
Tomatoes	-0.02	0.00	-0.03
Deciduous Orchard	-0.10	-0.10	-0.10
Small Grain	-0.36	-0.05	-0.42
Grapes	-0.13	-0.13	-0.13
Cotton	-8.43	-6.03	-9.49
Subtropical Orchard	-0.03	-0.03	-0.03
Subtotal	**-12.72**	**-8.86**	**-14.25**
San Felipe Division			
Pasture and Hay	-0.14	-0.10	-0.07
Other Field Crops	-0.71	-0.61	-0.36
Vegetable	-25.84	-22.33	-13.36
Tree and Vine	-3.69	-3.69	-3.69
Subtotal	**-30.37**	**-26.73**	**-17.48**
Total	**-73.64**	**-65.41**	**-61.70**

NOTE: All values in millions of dollars.

Net Income from Irrigated Lands

The estimated change in net farm income associated with the irrigated crops in each region includes several components:

- Net income from a change in acreage irrigated. This includes net income directly attributed to an increase or decrease in acreage, plus the effect of crop price changes on all lands in production. These two effects may move in the same or in opposite directions.
- Change in the cost of groundwater pumping.
- Change in the cost of irrigation systems and management.
- Change in the cost of CVP water, including tiered prices, restoration charge, and Friant-Kern surcharge.

In addition to these components, the Preferred Alternative also includes water acquired for restoration purposes, and the revenue from this water becomes another component of income to the agricultural sector. For purposes of analysis, only water acquired by fallowing land is displayed here as agricultural income. Table IV-78 summarizes these components for the average 1922-1990 condition. Dry and wet conditions would show similar relationships to average.

TABLE IV-78

CHANGE IN NET REVENUE, PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

COMPONENT	Sacramento River Region	San Joaquin River Region	Tulare Lake Region	San Felipe Division	Total
Fallowed Land	-0.0	-3.6	-1.7	-2.9	-8.2
Groundwater Pumping	-0.5	-10.0	-3.0	0.0	-13.5
Irrigation Cost	-0.3	-4.2	-1.2	0.0	-5.7
CVP Water Cost	-0.1	-3.5	-15.3	-0.3	-19.2
Total Reduction	-0.9	-21.3	-21.2	-3.2	-46.6
Increase From Higher Crop Prices	0.1	0.2	0.2	0.0	0.5
Increase From Land Retirement	0.0	0.9	1.1	0.0	2.0
Increase From Water Sales	1.2	6.4	2.6	0.0	10.2
Combined Net Revenue Change	0.4	-13.8	-13.5	-3.2	-33.9
NOTE: All values in millions of dollars.					

Approximately $47 million in lost net income is offset by about $0.5 million increase from higher crop prices, $2 million in annual payments for land retirement, and $10.2 million in revenue from selling water for restoration purposes. The net result is a decline in net income of about $34 million per year. Most of this ($19 million) is a result of higher CVP water cost.

The net income estimates are not detailed by crop because the analysis treats the farm as an entire operation. Different water sources are not designated for specific crops, so an increase in water cost cannot be apportioned to individual water districts, farms, or crops.

Agricultural Water Use

Water use reported here represents an estimate of the change in water actually applied to the field for crop growth, rather than diversions or deliveries to contractors. The numbers in Table IV-79 represent the net effect of reductions in CVP delivery, increases in SWP delivery in Tulare Lake Region, reductions due to water acquisition, and changes in groundwater use.

Some water is acquired in all three regions for Level 2 refuge water supply. A portion of the water purchased for instream flow in the San Joaquin River Region is estimated to result in some land fallowing. As shown in Table IV-79, net delivery fell by 10,000 acre-feet in Sacramento River Region, 178,000 acre-feet in San Joaquin River Region, and 67,000 acre-feet in Tulare Lake Region.

TABLE IV-79

CHANGE IN IRRIGATION WATER APPLIED, PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

Source	Average (1922-90)	Dry (1928-34)	Wet (1967-71)
Sacramento River			
Surface Water	-58	-99	-57
Groundwater	48	62	50
Total Applied	-10	-37	-7
San Joaquin River			
Surface Water	-345	-296	-261
Groundwater	167	128	90
Total Applied	-178	-168	-171
Tulare Lake			
Surface Water	-75	-18	-71
Groundwater	8	-40	1
Total Applied	-67	-58	-70
San Felipe Division			
CVP Water	-17.4	-15.5	-11.5
Total			
Surface Water	-495	-429	-401
Groundwater	223	150	141
Total Applied	-272	-279	-260
NOTE: All values in thousands of acre-feet/year.			

Groundwater use increases by 223,000 af in the three Central Valley regions compared to the Revised No-Action Alternative. This occurs because of a shift of acreage from the areas selling water for restoration, where groundwater substitution is not allowed, to areas not selling water, where Interior has no means to prevent additional groundwater pumping.

Table IV-80 shows estimated average irrigation efficiency by region. Average irrigation efficiency changes little under the Preferred Alternative compared to the Revised No-Action Alternative, with a valley-wide increase of 0.4 percent. The San Joaquin River Region has the largest change, increasing by 0.7 percent in the Preferred Alternative as compared to the Revised No-Action Alternative.

TABLE IV-80

IRRIGATION WATER USE AND EFFICIENCY UNDER THE PREFERRED ALTERNATIVE

Region	Applied Water (a)	ET of Applied Water (a)	Percent Irrigation Efficiency
Sacramento River	7,264	4,812	66.2
San Joaquin River	7,431	5,282	71.1
Tulare Lake	6,054	4,383	72.4
Total	20,749	14,477	69.8

NOTE: (a) All values in thousands of acre-feet.

Average CVP delivery in the San Felipe Unit is estimated to decline by about 17,000 acre-feet on average, and 15,500 acre-feet in a dry condition. This occurs in a managed groundwater basin, so by assumption it is not replaced by additional groundwater pumping.

Impacts on Consumers

Using surplus to consumers of Central Valley produce as a measure of losses caused by lower supply and higher prices of farm goods, losses are estimated to be about $3.7 million per year.

The reduction in hay and pasture in the Preferred Alternative represents about 0.8 percent of Central Valley production. If all the reduction is replaced by forage from outside the Central Valley, which costs about 30 percent more, forage cost would increase 0.25 percent (30 percent of 0.8 percent). Feed cost represents about 50 percent of the total cost of milk production, so the impact on the cost of producing milk would be less than 1 percent.

Federal Commodity Payments

The Preferred Alternative would decrease agricultural revenues from USDA farm programs because retired land would lose eligibility for farm program payments. These revenues are an expense for the Federal government. Table IV-81 shows agricultural commodity acreage idled by the Preferred Alternative and the direct reduction of about $3.3 million in annual farm program costs. Cost savings are estimated based on average deficiency payment rates over the 1987 to 1990 period. Most of the cost savings is associated with the retirement or permanent fallowing of cotton acreage. Some additional savings may also result indirectly from higher crop prices.

TABLE IV-81

ACREAGE OF COMMODITY CROPS RETIRED AND CORRESPONDING REDUCTION IN FEDERAL FARM PROGRAM COSTS UNDER THE PREFERRED ALTERNATIVE

Region	Commodity Acreage Retired (1,000 acres)	Farm Program Cost Savings (million $ per year)
Sacramento Valley	0.5	$0.1
San Joaquin Valley	23.9	$2.2
Tulare Basin	10.9	$1.0
Total	35.3	$3.3

The 1996 Farm Bill revised the way commodity payments are determined, and decouples the size of the payment from the actual production level. There remains, however, some uncertainty about how USDA will handle lands that are part of a grower’s base acreage yet are retired or fallowed as CVPIA is implemented. We assume that USDA will remove such lands from the grower’s base acreage and reduce the deficiency payment accordingly.

Variability, Risk, and Uncertainty

Most of the impacts from risk and uncertainty in the Preferred Alternative are the same as those described in Revised Alternative 1. Additional risk or uncertainty might occur due to water acquisition. Land fallowing or retirement, if concentrated in a small area, could threaten the infrastructure of suppliers, farm labor, and processors available to the remaining producers. Some additional uncertainty is placed on those who divert downstream from areas selling water for restoration. Changes in the timing of streamflows and availability of irrigation return flows could also affect some growers’ pattern or costs of diversion.

Growers who sell water may be able to reduce financial risk. A steady income from water sales can combine with more variable crop revenues to provide a less risky income stream. Water sold can also be used to finance other production costs that otherwise would be funded through borrowing.

Land Values

Land values in areas of higher water costs or losses of supply would be affected as in Alternative 1. Average reduction in land values in the most affected region under the Preferred Alternative, San Joaquin River Region, could be $320 per acre based on the regional change in net income.

Areas selling water would either be unaffected or increase in land value, as long as the water remained attached, or allocated, to the land. In other words, if the right to sell water depends on ownership or control of the land, then profit from selling the water would be capitalized into the price of the land. For example, if water is sold for $10 more per acre-foot than its net value in producing crops, then at 3 acre-feet per acre, profit would increase by $30 per acre and land value might increase by $750 per acre (capitalizing the annual profit at a 4 percent real rate). But if the right to sell water is separated from ownership of land, then the price of that land could fall (though the decline would be more than compensated by the stream of profits on water sales).

Finance and Credit

Availability of credit for farming depends largely on the expected profitability of production, the risk or variability of profitability, and the collateral available to secure the lender's money. Therefore, changes in conditions that reduce profit, increase risk, or reduce the value of land can be expected to reduce lenders' willingness to lend money or to increase the interest rate they charge, and vice versa. The same potential increases in risk and reduction in profit discussed in Revised Alternative 1 also apply to the Preferred Alternative.

Growers able to sell water for restoration can potentially increase net income and reduce risk, which would increase credit worthiness.

Costs of Water Conservation and Measurement

Conservation and measurement costs for the Preferred Alternative would be similar to those described for Revised Alternative 1. In summary, net costs of conservation provisions will probably not be significant for districts that already measure water to customers. For districts that do not currently measure delivery to each customer, the cost per acre could be $4 to $33 per year. With the exception of measurement, most mandatory provisions are either inexpensive or would be required even without the CVPIA. Discretionary provisions may be avoided if their costs are burdensome or far exceed the benefits.

MUNICIPAL AND INDUSTRIAL LAND USE AND DEMOGRAPHICS

As previously discussed in this chapter, the total projected 2020 water use requirements exceed the maximum CVP delivery of water for M&I users in all counties. The CVP is a supplemental water supply, and other local water supplies will be provided to meet full M&I demands. It is anticipated that M&I users will substitute other supplies for CVP supplies, especially during periods of time when CVP water supplies are reduced more than 25 percent of the total contract amount under the Revised No-Action Alternative. The PROSIM model predicts that this condition could occur 15 percent of the time (based on 70 years of analysis) for CVP municipal water service contractors located north of the Delta, and 20 percent of the time for CVP municipal water service contractors located south of the Delta. Because opportunities for conservation, wastewater reuse, and water transfers could be implemented, as described under the Municipal Water Costs impact assessment, this analysis assumes that M&I land uses and population conditions would not change under the Revised No-Action Alternative as compared to the Draft PEIS No-Action Alternative.

Under the Preferred Alternative, deficiencies in deliveries of CVP water supplies to M&I users in the Central Valley and San Francisco Bay Regions would occur more frequently than under the Revised No-Action Alternative, as presented in the Surface Water Supplies and Facility Operations analysis. It is anticipated that the efforts implemented during years with CVP deficiencies under the Revised No-Action Alternative would also be implemented during years of similar water contract deficiency under the Preferred Alternative. Therefore, M&I land uses and population conditions under all the alternatives would not change as compared to the Revised No-Action Alternative.

VEGETATION AND WILDLIFE RESOURCES

Revised No-Action Alternative

Conditions under the Revised No-Action Alternative are similar to conditions described under the Draft PEIS No-Action Alternative, especially along the riparian corridors.

Preferred Alternative

Table IV-82 summarizes the changes in acreages of important habitats in the Central Valley under the Preferred Alternative compared to the Revised No-Action Alternative. No changes in urban land use are projected under the Preferred Alternative as compared to the No-Action Alternative.

Natural Terrestrial and Agricultural Habitats

Common Species. Under the Preferred Alternative, it was assumed that no new agricultural lands would be put into production, so no impacts on natural and terrestrial habitats would occur as a result of this mechanism. In the Sacramento River Region, the number of acres planted in pasture, grain, and rice would not change compared with acres planted in these crops under the Revised No-Action Alternative. These lands would be fallowed for water acquisition, and in response to reduced water supply reliability under the Preferred Alternative as compared to the Revised No-Action Alternative as compared to the Revised No-Action Alternative.

It was assumed that the amount of cotton grown in the Sacramento Valley would not increase from the Revised No-Action Alternative. Changes in agricultural habitats would not change the distribution or number of common wildlife in the Sacramento River Region.

TABLE IV-82

CHANGES IN ACREAGES OF HABITAT TYPES UNDER THE PREFERRED ALTERNATIVE AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

Habitat Type	Sacramento River Region	Sacramento-San Joaquin Delta Region	San Joaquin River Region	Tulare Lake Region
Rice	0.0	0.0	-0.1	-.0
Pasture and grains	0.0	-0.1	-4.0	-2.5
Potential habitat from land fallowing	0.0	+0.1	+30.6	+13.9
Potential habitat from retirement of drainage lands	0.0	0.0	+14.4	+15.6
Wetlands on refuges	+5.3	NA	+31.6	+12.4
Field flooding	+54.0	+13.0	+13.0	0.0

NOTE:
The values shown represent the differences between acreages under the Revised No-Action Alternative and the Preferred Alternative (e.g., -1 represents a loss of 1,000 acres under the Preferred Alternative compared with the acreage under the Revised No-Action Alternative).
All values in thousands of acres.

LEGEND:
NA = Not applicable.

Cropping patterns in the Delta Region would change less than 1 percent under the Preferred Alternative compared with patterns under the Revised No-Action Alternative as a result of fallowing. These changes would have little effect on the distribution or number of common wildlife in the Delta Region.

The number of acres of all crops in the San Joaquin River and Tulare Lake regions would be reduced by 44,500 acres, compared with the number of acres under the Revised No-Action Alternative, as a result of land fallowing. This reduction in agricultural habitats would improve the distribution and number of common wildlife in the region.

It was assumed that urban development would not change compared with urban development under the Revised No-Action Alternative.

Special-Status Species. Urban development under the Preferred Alternative would not change compared with urban development under the Revised No-Action Alternative; therefore, no additional impacts on special-status plants would result from urban development.

Approximately 31,000 acres of pasture and grain would be fallowed in the Sacramento River, Delta, and San Joaquin River regions which could support special-status species. The loss of approximately 2 percent of potential agricultural habitat would not affect the Aleutian Canada goose because implementation of the b(1) "other" program would reduce this impact. Effects on Swainson's hawks would be similar to those described for Alternative 2.

The potential beneficial impact under the Preferred Alternative associated with long-term colonization of retired lands by special-status plants and potential habitat for special-status species in the San Joaquin River and Tulare Lake regions would be identical to the potential beneficial impact described for Supplemental Analysis 1h.

Pesticide Use

Common Species. Under the Preferred Alternative, the fallowing of agricultural land would reduce the use of herbicides and insecticides and provide a minor benefit to common wildlife. Reductions in the acreage of orchards (400) and use of rodenticides would be too small to have substantial beneficial effects on rodents.

Special-Status Species. The reduction in agricultural acreage under this alternative could provide a minor benefit to special-status plants, the valley elderberry longhorn beetle, special-status rodents, the blunt-nosed leopard lizard, and the San Joaquin kit fox. Potential impacts of pesticide use on special-status species could be reduced by implementation of the b(1) "other" program.

Effects of Changes in Hydrology on Riparian Communities

Common Species. Changes from the Revised No-Action Alternative in the extent and condition of riparian communities resulting from these generally small changes in Sacramento River hydrology would be minor. Water levels in September of dry years in the American River would be approximately 19% lower than under the Revised No-Action Alternative, which approaches the threshold above which mitigation may be recommended.

The extent and condition of riparian communities in the Tulare Lake Region under the Preferred Alternative would not differ from those under the Revised No-Action Alternative.

The potential beneficial impact in the San Joaquin River Region would be similar to the potential beneficial impact described under Alternative 3.

Special-Status Species. Under The Preferred Alternative, changes in river stages in the Sacramento River and Tulare Lake regions would be minor compared with stages under the Revised No-Action Alternative and would not affect habitat for special-status plant and wildlife species.

The potential beneficial impact would be similar to the potential beneficial impact described for Alternative 3.

Effects of Restoration on Riparian Communities

Common Species. The potential benefit impacts on common species under the Preferred Alternative associated with restoration of riparian habitat would be similar to the potential beneficial impacts described for Alternative 1.

Special-Status Species. The potential beneficial impacts on special-status species under the Preferred Alternative associated with restoration of riparian habitat would be similar to the potential beneficial impacts described for Alternative 1.

Effects of Changes in Reservoir Drawdown Zones on Riparian Vegetation

Common Species. Under the Preferred Alternative, water-level conditions affecting riparian vegetation would be essentially the same as those described for Alternative 1, except at Lake Shasta, which would experience dry years elevations below those under the Revised No-Action Alternative. No substantial changes in riparian vegetation extent or condition would occur.

Special-Status Species. Special-status species that use riparian habitats in reservoir drawdown zones would not be affected under the Preferred Alternative as compared to the Revised No-Action Alternative.

Effect of Changes in Hydrology on Wetland Communities

Common Species. Under the Preferred Alternative, hydrologic conditions in wetlands associated with riparian communities in the Sacramento River Region would not differ from those described previously for riparian communities. Changes in the extent and condition of wetland communities in the riparian zone resulting from changes in hydrology would be minor, though water levels in the American River in September of dry years would approach levels at which wetland mitigation may be recommended. Common wetland plants and common wildlife using wetland habitats would not be affected.

The extent and condition of wetland communities in the Tulare Lake Region under the Preferred Alternative would not differ from those under the Revised No-Action Alternative.

The potential beneficial impact would be similar to the potential beneficial impact described for Alternative 3.

Special-Status Species. Special-status wetland species in the Sacramento River and Tulare Lake regions would not be affected under the Preferred Alternative.

The potential beneficial impact would be similar to the potential beneficial impact described for Alternative 3.

Effects of Changes in Salinity on Wetland Communities

Common Species. Under the Preferred Alternative, salinity changes at Chipps Island in the Delta and at Port Chicago and Benicia west of the Delta boundary, compared with salinity under the Revised No-Action Alternative. Although no detailed analysis was done, changes in salinity levels would probably be minor and would probably not affect wetland communities.

Special-Status Species. Freshwater, brackish water, and salt marshes would not be affected by salinity changes under this alternative, and no effects on special-status species would be associated with these habitats.

River and Reservoir Aquatic Habitats

Common Species. Under the Preferred Alternative, restoration of riparian habitat and spawning gravel in the Sacramento River and many of its tributaries, in the Delta, and in the San Joaquin River and its tributaries would increase salmonid fish in these rivers and streams. The availability of additional fish would benefit wildlife that feed on fish.

There would be no change in the amounts of shallow water, deep water, or open water habitat available at reservoirs in the Sacramento River and San Joaquin River regions under the Preferred Alternative compared with the amounts available under the Revised No-Action Alternative. Additionally, the availability of fish in reservoirs would not change. Therefore, fall and winter waterbird use would not change compared with use under the Revised No-Action Alternative.

Special-Status Species. Riverine habitat quality in the Sacramento River and the San Joaquin River regions under the Preferred Alternative would improve, compared with riverine habitat quality under the Revised No-Action Alternative, and would benefit special-status species. Reservoir habitat quality would not change; therefore, nesting or wintering bald eagles would not be affected.

Waterfowl and Shorebirds

Refuges - Common Species. The potential beneficial impacts under the Preferred Alternative of increases in water delivery to refuges and increased acreages of managed permanent ponds, seasonal marshes, and watergrass would be similar to the potential beneficial impacts described for Alternative 2.

Field Flooding

The potential beneficial impact under the Preferred Alternative of additional flooded agricultural fields in the Sacramento River, Delta, and San Joaquin River regions would be similar to the potential beneficial impact described for Alternative 1.

Special-Status Species

The potential beneficial impacts under the Preferred Alternative on special-status species would be similar to the potential beneficial impacts described for Alternative 2.

Duck Clubs and Other Private Lands

The potential impacts on duck clubs and other private lands under the Preferred Alternative would be similar to the potential impacts described for Alternative 1.

Evaporation Ponds

The number of acres of evaporation ponds would be the same as under the Revised No-Action Alternative.

CENTRAL VALLEY PROJECT POWER RESOURCES

This section summarizes potential changes to CVP power generation, Project Use, and market value of CVP power that would result from the implementation of the CVPIA PEIS Preferred Alternative as compared to the Revised No-Action Alternative.

Currently, CVP power is marketed under Contract 2948A, as described in the Affected Environment section. This contract provides for the integrated operation of the CVP generation with the PG&E system. The contract expires at the end of 2004 and is not expected to be renewed. While the CVP has historically been operated, to the extent possible, to meet the requirements of this contract and to receive the benefits thereof, it is not expected to continue to be operated in this manner after contract termination in 2004. For the purposes of the PEIS, it has been assumed that the CVP will be operated to meet authorized project purposes, which include flood control as a primary purpose; providing water deliveries to water users and fish and wildlife protection, restoration, and mitigation as secondary purposes; and enhancing fish and wildlife and generating power as third purposes. Within given operating constraints, the CVP will be operated to maximize the value in meeting load requirements of the CVP Project Use and Preference Customers.

Impact Assessment Methodology

The impacts associated with each alternative were viewed from the perspective of the change in available CVP power production and the change in the market value of the CVP power generated. The difference in power generation; monthly on- and off-peak Project Use capacity and energy; and value of power generated, between the Preferred Alternative and the Revised No-Action Alternative, was evaluated in order to estimate the impacts associated with the Preferred Alternative.

CVP Operations. The Project Simulation Model (PROSIM) and San Joaquin Area Simulation Model (SANJASM) were used to simulate monthly CVP water facility operations. The model simulations were carried out for the period 1922 through 1990, using historical hydrology adjusted for a projected 2022 level of development. The power module of the PROSIM model was used to calculate monthly CVP generation, available capacity, and CVP Project Use energy and capacity. The simulation of CVP water facilities was conducted on a monthly time step using generalized reservoir operating rules and system criteria. The power information computed for the Preferred Alternative and the Revised No-Action Alternative should only be interpreted in a comparative manner, and is only intended to provide an indication of the potential changes to CVP power generation, available capacity, and Project Use that would result from the implementation of the Preferred Alternative in the PEIS.

Market Value of Power. Western's electric production cost model, PROSYM, uses the output from the PROSIM power module to estimate the annual change in the market value of CVP power production for the Preferred Alternative as compared to the Revised No-Action Alternative. PROSYM provides results for the average condition over the simulated 69 years. In addition, PROSYM results are presented for a synthetic dry year to simulate a "worst-case" condition. A synthetic dry year is comprised of months that have a modeled level of generation that is exceeded 90 percent of the hydrologic records for that month. For example, January in the synthetic dry year has generation values that are less than most of the January values used in the calculation.

PROSYM is used to calculate the on- and off-peak distribution of energy and the load-carrying capability available in the synthetic dry year. Load-carrying capability , also referred to as "capacity supported with energy," is the maximum rate of sustainable energy production, given flow constraints, that efficiently supplies electricity to meet system demands. In contrast, PROSIM capacity is calculated as the instantaneous generation at a given elevation of water behind the powerplant.

The value of energy produced by the CVP was estimated using a marginal unit efficiency approach, meaning that as energy production from low-cost resources is decreased, higher-cost resources are brought on-line as they become economically viable. Value was assigned to generation based on the month and time of day in order to assess on-peak and off-peak generation.

For the purposes of assessing impacts, Western's preference power customers were categorized into two groups: average customers and high allocation customers. Average customers are defined as those customers who use Western power for approximately 14 percent of their overall power supply. High allocation customers are defined as those customers who use Western power for approximately 85 percent of their power supplies.

Revised No-Action Alternative

Under the Revised No-Action Alternative, the CVP power generation facilities are operated in a manner similar to the operations discussed under the Affected Environment. CVP system operations are consistent with the criteria defined in the Long-Term Central Valley Project Operations Criteria and Plan (October 1992). The details of the assumptions and criteria used in the simulation of CVP facilities in the Revised No-Action Alternative are discussed in the Surface Water Supplies and Facilities Operations Section.

Power Generation. Simulated average annual generation at CVP powerplants for the 69-year simulation period is shown in Figure IV-100 and presented in Table IV-83. Simulated average

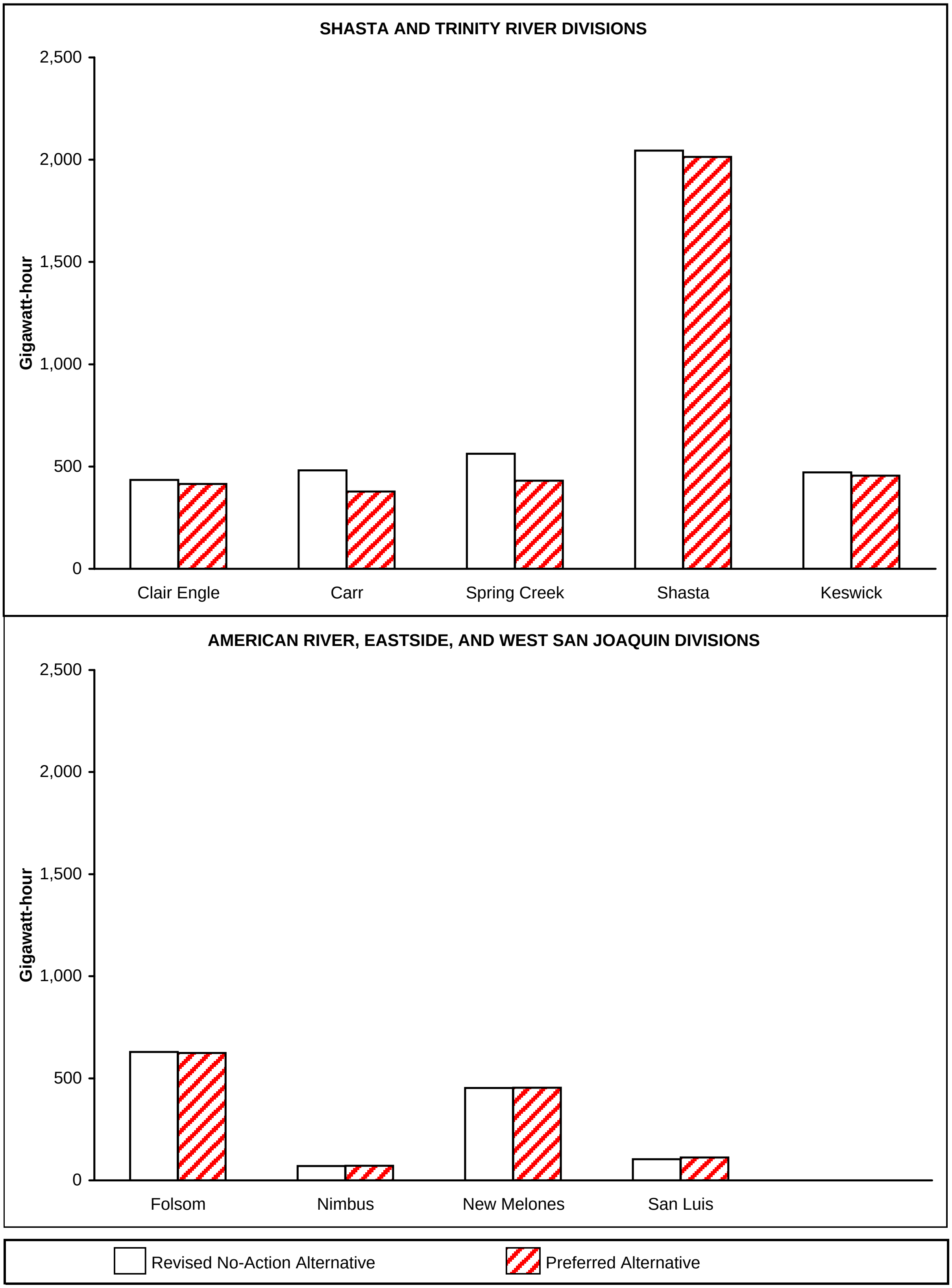


FIGURE IV-100
SIMULATED AVERAGE ANNUAL GENERATION AT CVP POWERPLANTS
CALENDAR YEARS 1922-1990

TABLE IV-83

COMPARISON OF SIMULATED AVERAGE ANNUAL GENERATION AT CVP POWERPLANTS

LONG-TERM AVERAGE (CALENDAR YEARS 1922-1990) (GWh)				
Powerplant	**Revised No-Action Alternative**	**Preferred Alternative**	**Difference**	**Percent Difference**
Clair Engle	435	415	-21	-5%
Carr	481	378	-103	-21%
Spring Creek	563	431	-132	-23%
Shasta	2,045	2,014	-30	-1%
Keswick	471	455	-16	-3%
Folsom	629	624	-6	-1%
Nimbus	71	71	1	1%
New Melones	453	454	1	0%
San Luis	103	113	9	9%
DRY PERIOD (CALENDAR YEARS 1929-1934) (GWh)				
Powerplant	**Revised No-Action Alternative**	**Preferred Alternative**	**Difference**	**Percent Difference**
Clair Engle	221	197	-23	-11%
Carr	237	190	-47	-20%
Spring Creek	248	185	-64	-26%
Shasta	1,179	993	-186	-16%
Keswick	321	311	-10	-3%
Folsom	348	328	-20	-6%
Nimbus	45	45	-0	-1%
New Melones	289	274	-15	-5%
San Luis	104	107	2	2%

annual generation at CVP powerplants for the dry period, calendar years 1929-1934, is presented in Table IV-83. Total CVP power generation includes generation at Clair Engle Lake, Judge Francis Carr (Carr), Spring Creek Tunnel (Spring Creek), Shasta Lake, Keswick Reservoir (Keswick), Folsom Lake, Lake Natoma (Nimbus), New Melones Lake, and San Luis Reservoir powerplants and includes estimated transmission losses. Simulated average monthly total CVP generation for the long-term average, calendar years 1922-1990, and dry period, is shown in Figure IV-101 and presented in Table IV-84. The average annual total CVP generation for the long-term average for the Revised No-Action Alternative is 5,169 gigawatt-hours (GWh). The average annual total CVP generation for the dry period for the Revised No-Action Alternative is 2,946 Gwh.

Available Capacity. Simulated average monthly available capacity in the Revised No-Action Alternative for the long-term average and dry period is shown in Figure IV-102 and presented in Table IV-85. The simulated average annual available capacity for the long-term average for the Revised No-Action Alternative is 19,868 Megawatts (MW). The simulated average annual available capacity for the dry period for the Revised No-Action Alternative is 16,843 MW.

CVP Project Use Energy and Project Use Capacity. Simulated average monthly Project Use energy for the long-term average and dry periods is shown in Figure IV-103 and presented in Table IV-86. The simulated average annual Project Use energy for the long-term average for the Revised No-Action Alternative is 1,394 GWh. The simulated average annual Project Use energy for the dry period for the Revised No-Action Alternative is 901 GWh. Simulated average monthly on- and off-peak CVP Project Use energy for the long-term average is shown in Figure IV-104 and presented in Table IV-87. Simulated average monthly on- and off-peak CVP Project Use energy for the dry period is shown in Figure IV-105 and presented in Table IV-87. Simulated average monthly on- and off-peak CVP Project Use capacity requirements for the long-term average are shown in Figure IV-106 and presented in Table IV-88. Simulated average monthly on- and off-peak CVP Project Use capacity requirements for the dry period are shown in Figure IV-107 and presented in Table IV-88.

Market Value of Power. For the evaluation of the market value of energy, the long-term average energy available from PROSIM was used. The capacity values were based on the synthetic dry year discussed earlier in this section. PROSIM generation and Project Use values used in the synthetic year for the Revised No-Action Alternative analysis are presented in Tables IV-89 and IV-90. The annual energy available and capacity available for sale, based on the synthetic year, are presented in Table IV-91. The average annual energy available for sale under the Revised No-Action Alternative is 3,779 GWh. Based on the 90 percent exceedence synthetic dry year, the capacity for sale with energy for the Revised No-Action Alternative is 747 MW and the capacity for sale without energy was 739 MW.

Preferred Alternative

Power Generation. Simulated average annual generation at each powerplant for the long-term average under the Preferred Alternative is shown in Figure IV-100 and presented in Table IV-83. Generation decreases at Carr and Spring Creek powerplants. The Trinity River minimum instream flow requirements are greater under the Preferred Alternative as compared to the

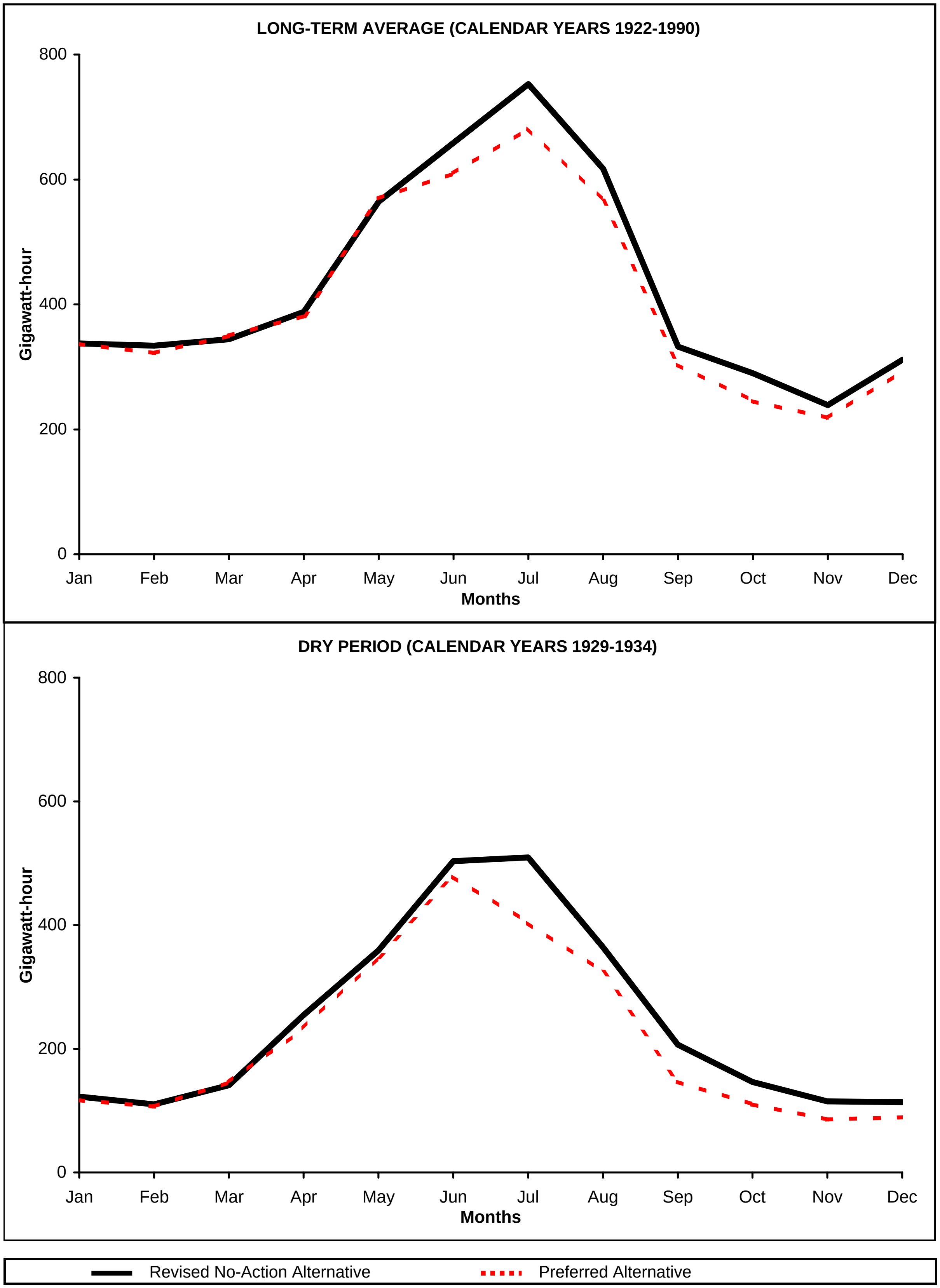


FIGURE IV-101
SIMULATED AVERAGE MONTHLY CVP GENERATION

TABLE IV-84

COMPARISON OF SIMULATED AVERAGE MONTHLY CVP GENERATION

	Long-term Average Calendar Years 1922-1990 (GWh)			Dry Period Calendar Years 1922-1990 (GWh)		
	Revised No-Action Alternative	**Preferred Alternative**	**Difference**	**Revised No-Action Alternative**	**Preferred Alternative**	**Difference**
Jan	338	337	-1	122	117	-5
Feb	334	322	-12	110	106	-4
Mar	344	350	6	141	146	5
Apr	388	381	-7	255	233	-21
May	564	570	5	359	348	-11
Jun	659	610	-49	503	478	-25
Jul	753	682	-71	509	404	-106
Aug	617	566	-51	364	324	-40
Sep	332	303	-29	207	147	-60
Oct	290	245	-45	146	110	-36
Nov	239	218	-21	115	85	-29
Dec	311	294	-18	114	89	-24
Average Annual Total	5,169	4,877	-291	2,946	2,589	-357
Percent Change from RNAA		-6%			-12%	

Notes:
Facilities include: Clair Engle, Carr, Spring Creek, Shasta, Keswick, Folsom, Nimbus, New Melones, and San Luis powerplants. Simulated generation includes losses.
RNAA - Revised No-Action Alternative

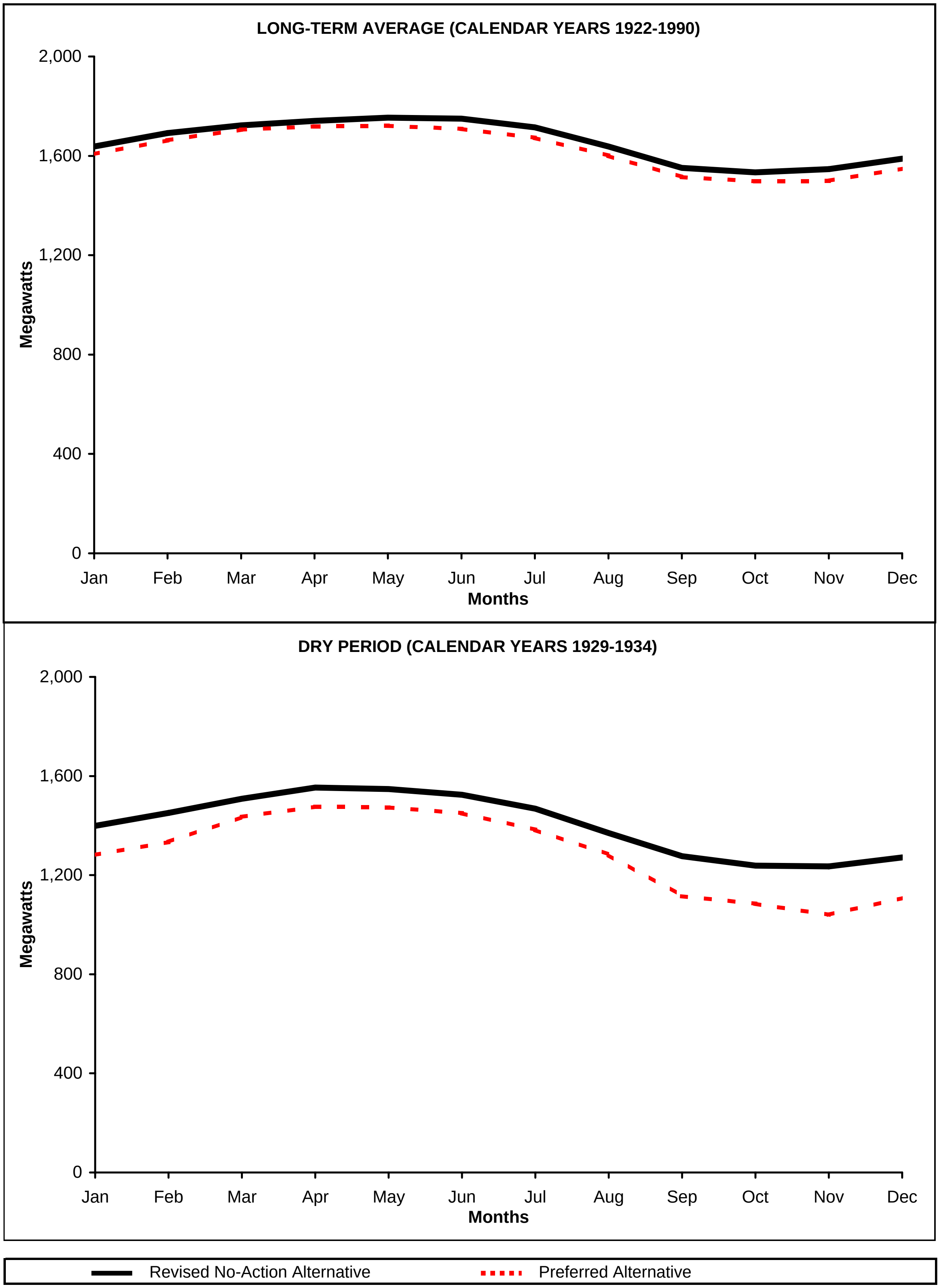


FIGURE IV-102
SIMULATED AVERAGE MONTHLY AVAILABLE CAPACITY

TABLE IV-85

COMPARISON OF SIMULATED AVERAGE MONTHLY AVAILABLE CAPACITY

	Long-term Average Calendar Years 1922-1990 (MW)			Dry Period Calendar Years 1922-1990 (MW)		
	Revised No-Action Alternative	**Preferred Alternative**	**Difference**	**Revised No-Action Alternative**	**Preferred Alternative**	**Difference**
Jan	1,638	1,607	-31	1,399	1,282	-117
Feb	1,691	1,663	-28	1,451	1,334	-117
Mar	1,723	1,706	-17	1,508	1,435	-74
Apr	1,741	1,719	-21	1,553	1,477	-77
May	1,753	1,720	-33	1,548	1,473	-75
Jun	1,750	1,709	-42	1,525	1,450	-75
Jul	1,714	1,673	-41	1,468	1,383	-85
Aug	1,637	1,601	-37	1,369	1,282	-87
Sep	1,552	1,514	-37	1,277	1,115	-162
Oct	1,534	1,498	-36	1,239	1,085	-154
Nov	1,547	1,500	-47	1,236	1,039	-196
Dec	1,588	1,549	-39	1,271	1,108	-164
Average Annual Total	19,868	19,458	-410	16,843	15,462	-1,381
Percent Change from RNAA		-2%			-8%	

TABLE IV-86

COMPARISON OF SIMULATED AVERAGE MONTHLY CVP PROJECT USE

	Long-term Average Calendar Years 1922-1990 (GWh)			Dry Period Calendar Years 1922-1990 (GWh)		
	Revised No-Action Alternative	**Preferred Alternative**	**Difference**	**Revised No-Action Alternative**	**Preferred Alternative**	**Difference**
Jan	147	149	2	151	147	-4
Feb	118	124	6	122	123	1
Mar	114	113	-1	73	51	-22
Apr	90	62	-28	35	25	-9
May	97	64	-33	51	38	-13
Jun	114	93	-22	39	29	-10
Jul	133	106	-27	56	30	-26
Aug	123	105	-18	75	50	-25
Sep	108	98	-10	86	59	-26
Oct	101	96	-5	45	38	-8
Nov	118	109	-9	65	46	-20
Dec	133	130	-3	104	100	-5
Average Annual Total	1,394	1,248	-147	901	735	-166
Percent Change from RNAA		-11%			-18%	

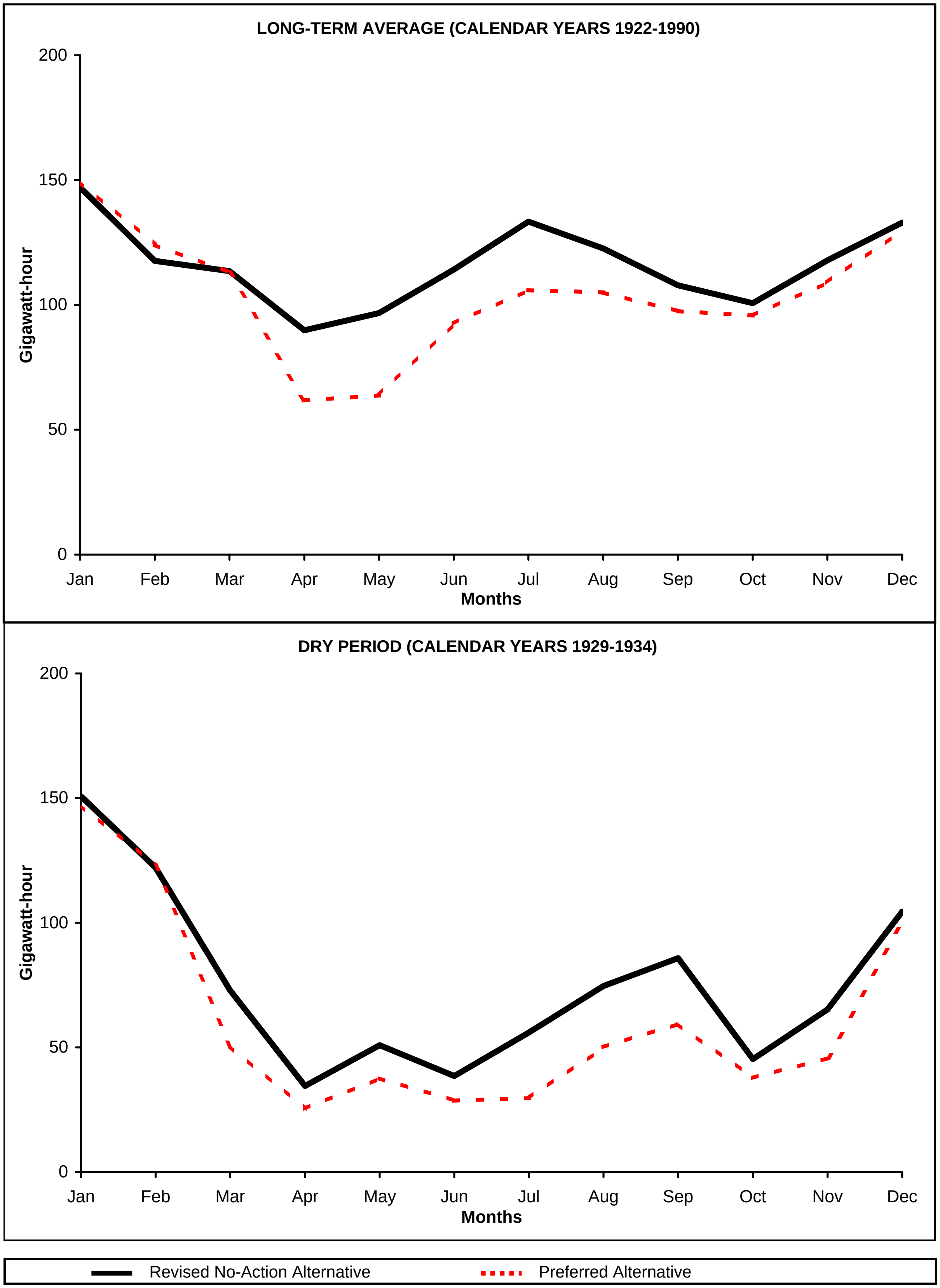


FIGURE IV-103
SIMULATED AVERAGE MONTHLY CVP PROJECT USE ENERGY

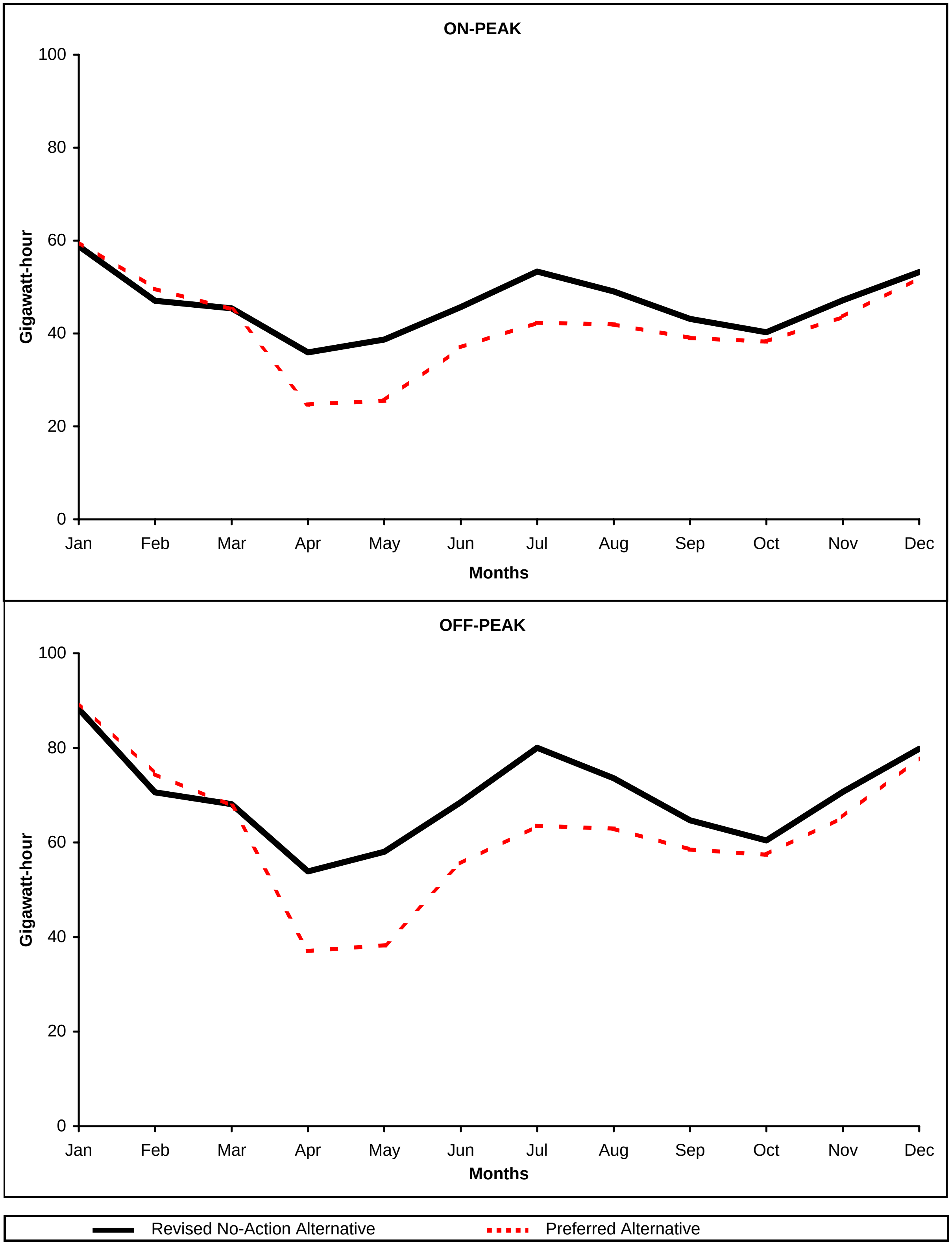


FIGURE IV-104
SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK
CVP PROJECT USE ENERGY
LONG-TERM AVERAGE - CALENDAR YEARS 1922-1990

TABLE IV-87

COMPARISON OF SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK CVP PROJECT USE ENERGY

ON-PEAK (GWh)	Long-term Average Calendar Years 1922-1990			Dry Period Calendar Years 1929-1934		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	59	60	1	60	59	-1
Feb	47	50	3	49	49	0
Mar	45	45	-0	29	20	-9
Apr	36	25	-11	14	10	-4
May	39	26	-13	20	15	-5
Jun	46	37	-9	15	11	-4
Jul	53	42	-11	22	12	-11
Aug	49	42	-7	30	20	-10
Sep	43	39	-4	34	24	-11
Oct	40	38	-2	18	15	-3
Nov	47	44	-4	26	18	-8
Dec	53	52	-1	42	40	-2
Average Annual Total	558	499	-59	360	294	-67
Percent Change from RNAA		-11%			-18%	

OFF-PEAK (GWh)	Long-term Average Calendar Years 1922-1990			Dry Period Calendar Years 1929-1934		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	88	90	1	90	88	-2
Feb	71	74	4	73	74	0
Mar	68	68	-0	44	30	-13
Apr	54	37	-17	21	15	-5
May	58	38	-20	31	23	-8
Jun	69	56	-13	23	17	-6
Jul	80	64	-16	34	18	-16
Aug	74	63	-11	45	30	-15
Sep	65	59	-6	51	36	-16
Oct	60	57	-3	27	23	-5
Nov	71	65	-5	39	27	-12
Dec	80	78	-2	63	60	-3
Average Annual Total	837	749	-88	541	441	-100
Percent Change from RNAA		-11%			-18%	

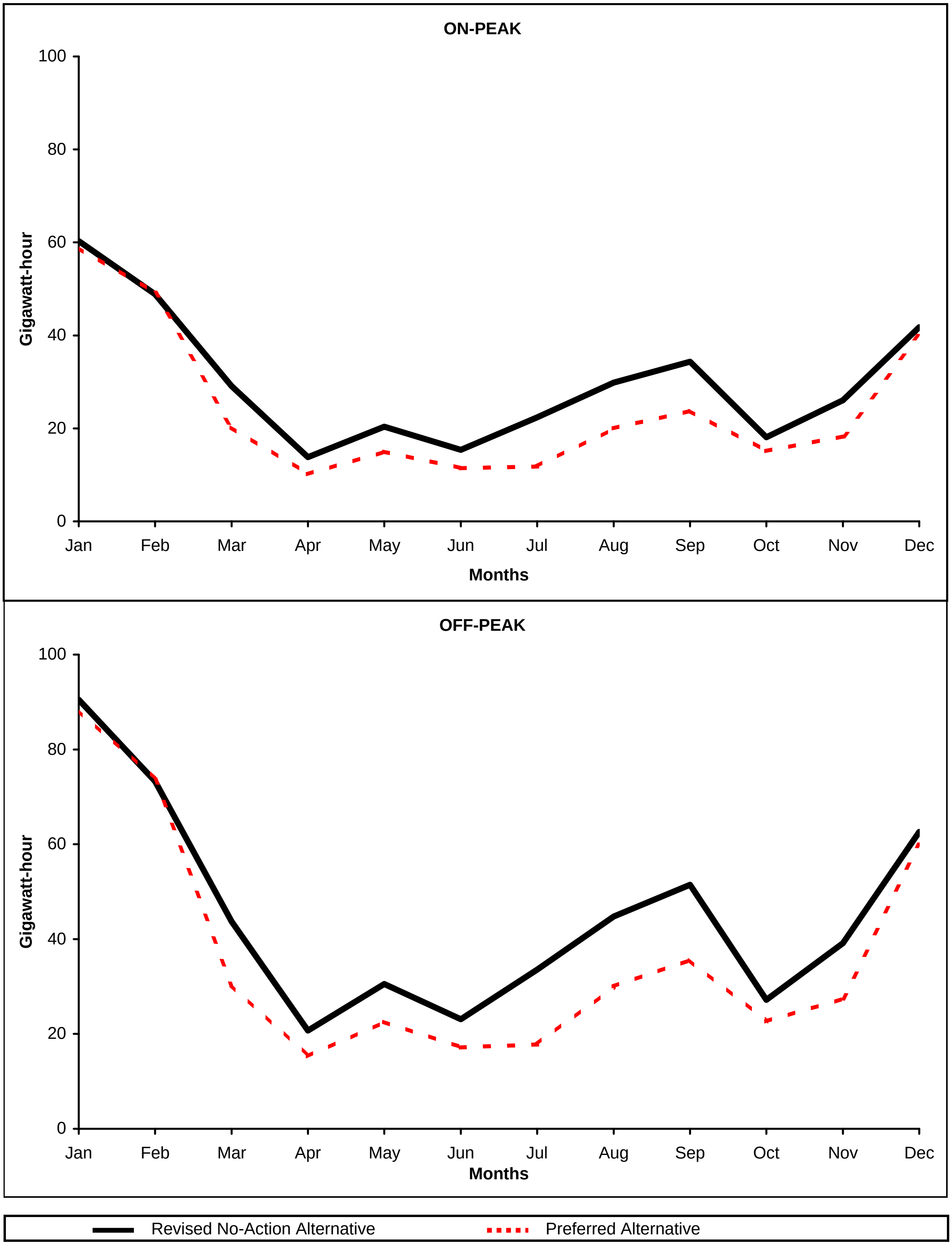


FIGURE IV-105
SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK
CVP PROJECT USE ENERGY
DRY PERIOD - CALENDAR YEARS 1929-1934

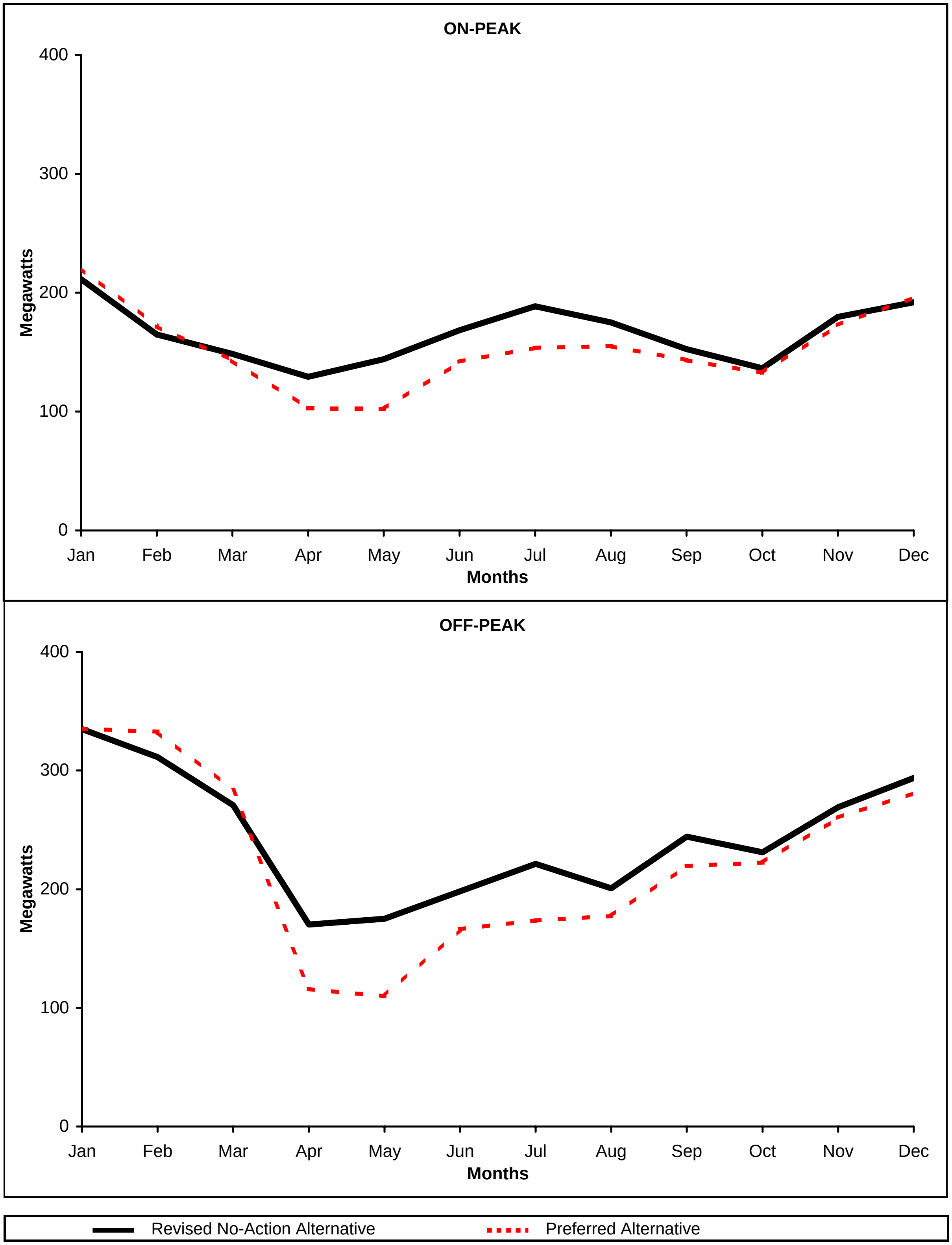


FIGURE IV-106
SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK
CVP PROJECT USE CAPACITY
LONG-TERM AVERAGE - CALENDAR YEARS 1922-1990

TABLE IV-88

COMPARISON OF SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK CVP PROJECT USE CAPACITY

ON-PEAK (MW)	Long-term Average Calendar Years 1922-1990			Dry Period Calendar Years 1929-1934		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	211	221	9	236	231	-5
Feb	165	172	7	176	182	6
Mar	148	143	-5	106	85	-21
Apr	129	103	-27	72	63	-9
May	144	102	-42	95	79	-17
Jun	168	142	-27	77	69	-8
Jul	188	154	-35	104	72	-32
Aug	175	155	-20	121	91	-30
Sep	153	143	-9	128	103	-25
Oct	137	133	-4	83	75	-8
Nov	180	173	-7	103	83	-20
Dec	192	196	4	165	160	-5
Average Annual Total	1,991	1,836	-155	1,464	1,291	-173
Percent Change from RNAA		-8%			-12%	

OFF-PEAK (MW)	Long-term Average Calendar Years 1922-1990			Dry Period Calendar Years 1929-1934		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	335	335	0	318	309	-9
Feb	311	333	21	320	319	-0
Mar	271	283	13	191	141	-50
Apr	170	116	-54	86	68	-18
May	175	110	-65	99	81	-18
Jun	198	166	-32	84	73	-11
Jul	221	173	-48	108	75	-33
Aug	201	177	-23	134	99	-34
Sep	244	220	-25	205	144	-61
Oct	231	222	-9	110	93	-17
Nov	269	260	-9	183	129	-55
Dec	294	281	-13	253	242	-11
Average Annual Total	2,921	2,677	-244	2,088	1,771	-317
Percent Change from RNAA		-8%			-15%	

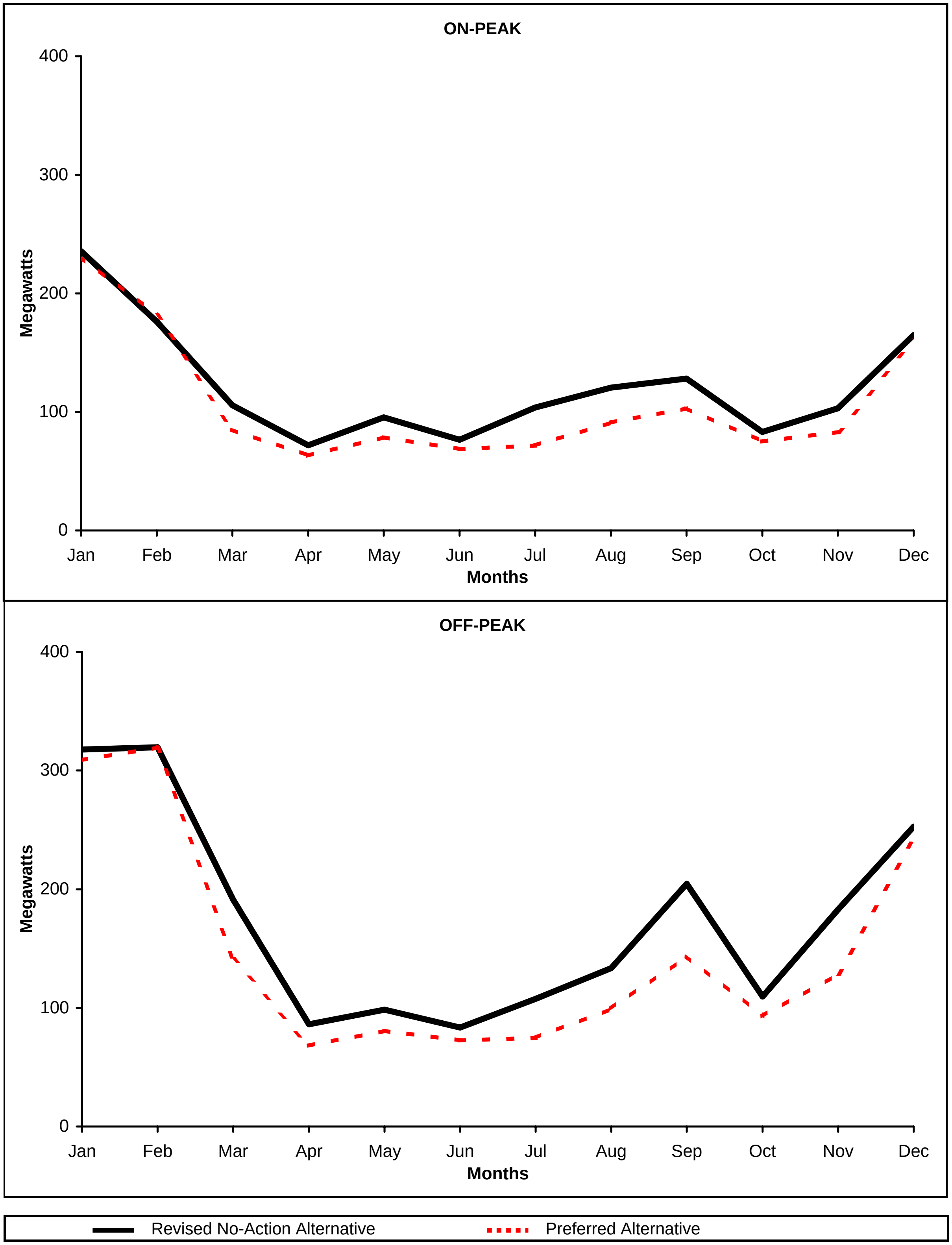


FIGURE IV-107
SIMULATED AVERAGE MONTHLY ON- AND OFF-PEAK
CVP PROJECT USE CAPACITY
DRY PERIOD - CALENDAR YEARS 1929-1934

TABLE IV-89

90 PERCENT EXCEEDENCE SYNTHETIC DRY YEAR MONTHLY CVP GENERATION

	PROSIM CAPACITY (MW)			TOTAL ENERGY (GWh)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	1,551	1,389	-162	123	124	1
Feb	1,454	1,432	-22	110	117	7
Mar	1,524	1,597	73	148	166	18
Apr	1,608	1,450	-158	222	229	7
May	1,488	1,421	-67	409	349	-60
Jun	1,795	1,360	-435	471	473	1
Jul	1,532	1,317	-215	548	417	-131
Aug	1,513	1,456	-57	398	345	-53
Sep	1,366	1,267	-99	234	203	-32
Oct	1,401	1,117	-284	145	144	-1
Nov	1,351	1,361	10	134	124	-10
Dec	1,252	1,368	116	119	124	5
Average Annual Total	17,835	16,535	-1,300	3,062	2,814	-248
Percent Change from RNAA		-7%			-8%	

TABLE IV-90

90 PERCENT EXCEEDENCE SYNTHETIC DRY YEAR ON- AND OFF-PEAK CVP PROJECT USE CAPACITY AND ON- AND OFF-PEAK CVP PROJECT USE ENERGY

CVP PROJECT USE CAPACITY						
	MAXIMUM ON-PEAK (MW)			OFF-PEAK (MW)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	215	212	-3	313	253	-60
Feb	51	67	16	51	98	47
Mar	88	86	-2	163	145	-18
Apr	60	50	-10	66	50	-16
May	70	68	-2	70	68	-2
Jun	184	53	-131	221	55	-166
Jul	109	55	-54	115	55	-60
Aug	106	76	-30	123	76	-47
Sep	109	109	0	153	153	0
Oct	108	125	17	158	215	57
Nov	94	104	10	182	175	-7
Dec	96	91	-5	188	220	32
Average Annual Total	1,290	1,096	-194	1,803	1,563	-240
Percent Change from RNAA		-15%			-13%	

CVP PROJECT USE ENERGY						
	ON-PEAK (GWh)			OFF-PEAK (GWh)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Jan	59	48	-11	89	72	-17
Feb	9	15	6	13	22	9
Mar	28	19	-8	42	29	-13
Apr	12	4	-8	17	6	-11
May	12	11	-0	17	17	-0
Jun	48	7	-41	72	10	-62
Jul	25	5	-20	37	8	-30
Aug	26	14	-12	39	21	-18
Sep	26	25	-1	38	38	-1
Oct	27	35	7	41	52	11
Nov	26	26	-0	39	38	-1
Dec	28	28	0	42	42	0
Average Annual Total	325	236	-88	487	354	-133
Percent Change from RNAA		-27%			-27%	

TABLE IV-91

CVP ENERGY AND CAPACITY AVAILABLE FOR SALE

Alternative	Average Annual Energy (GWh)	90 Percent Exceedence Average Monthly Synthetic Dry Year Cpacity	
		With Energy (MW)	Without Energy (MW)
Revised No-Action	3,779	747	739
Preferred	3,641	689	689

Source:
Western, 1999.

Revised No-Action Alternative. These greater minimum instream flow requirements reduce the amount of water diverted from the Trinity River Basin to the Sacramento River. As a result, less water is available at Carr and Spring Creek for generation. Generation at other CVP facilities remains approximately the same.

Simulated average annual generation at each powerplant for the dry period under the Preferred Alternative is presented in Table IV-83. Generation decreases at Clair Engle Lake, Carr, Spring Creek, and Shasta Lake powerplants. Releases from Clair Engle Lake are reduced in late summer to maintain minimum storage levels. This reduction in releases reduces the amount of water available for generation at Clair Engle powerplant during this period. The Trinity River minimum instream flow requirements are greater under the Preferred Alternative as compared to the Revised No-Action Alternative. These greater minimum instream flow requirements reduce the amount of water diverted from the Trinity River Basin to the Sacramento River. As a result, less water is available at Carr and Spring Creek for generation. Shasta Lake generation is reduced due to lower storage levels during the dry period. Generation at other CVP facilities remains approximately the same.

Simulated average monthly total CVP generation for the long-term average and dry period is shown in Figure IV-101 and presented in Table IV-84. Average annual total CVP generation for the long-term average remains approximately the same. Average annual total CVP generation for the dry period is reduced by 12 percent.

Increased flows in Trinity River and Clear Creek will increase generation at several non-CVP facilities and available power for preference power customers.

Available Capacity. Simulated average monthly available capacity in the Preferred Alternative for the long-term average and dry period is shown in Figure IV-102 and presented in Table IV-85. The average annual available capacity for the long-term average remains approximately the same under the Preferred Alternative as compared to the Revised No-Action Alternative. Storage levels at Clair Engle Lake, Shasta Lake, and Folsom Lake are reduced during the dry period, as compared to the Revised No-Action Alternative, resulting in a reduction in available capacity during the dry period of 8 percent.

CVP Project Use Energy and Project Use Capacity. Simulated average monthly Project Use energy for the long-term average and dry period is shown in Figure IV-103 and Table IV-86. For both the long-term average and dry period, average annual Tracy exports are reduced due to the decreased diversions from the Trinity River Basin and July export restrictions specified in (b)(2) Water Management. As a result, the long-term average and dry period average annual Project Use energy are reduced by 11 percent and 18 percent, respectively. Simulated average monthly on- and off-peak CVP Project Use energy for the long-term average is shown in Figure IV-104 and presented in Table IV-87. Simulated average monthly on- and off-peak CVP Project Use energy for the dry period is shown in Figure IV-105 and presented in Table IV-87. Simulated average monthly on- and off-peak Project Use capacity requirements for the long-term average are shown in Figure IV-106 and presented in Table IV-88. Simulated average monthly on- and off-peak Project Use capacity requirements for the dry period are shown in Figure IV-107 and presented in Table IV-88.

Market Value of Power. PROSIM generation and Project Use values used in the synthetic year for the Preferred Alternative analysis are presented in Tables IV-89 and IV-90. The annual energy available and capacity available for sale, based on the synthetic year, are presented in Table IV-91. The average annual energy available for sale is reduced slightly as compared to the Revised No-Action Alternative. The capacity available for sale decreases, which results in a reduction of the market value of CVP power. Based on the 90 percent exceedence synthetic dry year, the capacity for sale with energy and the capacity for sale without energy decreases by 8 percent and 7 percent, respectively. Table IV-92 presents the change in the average annual market value of CVP power for the Preferred Alternative as compared to the Revised No-Action Alternative. Based on the market value of power analysis, the net decrease in the value of CVP power production is approximately $9,326,000 per year which will make it more difficult to market CVP power in a competitive environment. The allocation of this net decrease in the value of CVP power generation to the counties and regions with preference power customers is presented in Table IV-93. The cost of replacement power and the net effect on an average and on a high allocation Western customer are presented in Table IV-94.

RECREATION

Revised No-Action Alternative

Conditions under the Revised No-Action Alternative are similar to those described under the Draft PEIS No-Action Alternative, especially in rivers. Recreation opportunities at Shasta Lake and Folsom Lake will be less in the Revised No-Action Alternative than under the No-Action Alternative during dry periods.

Preferred Alternative

This section describes changes in recreation opportunities and use at important recreation sites under the Preferred Alternative compared to the Revised No-Action Alternative.

Sacramento River Region - Reservoirs

Shasta Lake. The lake level exceedence frequencies for important recreation opportunities on the main area of the reservoir (Shasta Dam to the Pit River Bridge) and the McCloud River, Pit River, and Sacramento River arms are shown in Table IV-95. On the main area of the lake, during the 69-year study period, boat ramps would be unusable during 2 more peak-season and 5 off-peak season months. Of these, one peak and one off-peak month would be during dry periods. Usable surface area would be constrained during 8 more peak season and 7 more off-peak season months over the 69-year study period. Of these 5 more peak-season and 6 more off-season months would be during the dry periods.

On the McCloud River arm, the last boat ramp would go out of operation during the peak season for 10 more months over the 69-year study period. Of these, 8 months would occur during the dry period. Lake surface area would be limited for boating during 6 more months, 5 of which would occur during the dry period. Lake elevations would be below the point at which

TABLE IV-92

ANNUAL CHANGE IN MARKET VALUE OF CVP POWER COMPARED TO THE NO-ACTION ALTERNATIVE

	Change in Average Annual Energy (Million $)	Change in Average Annual 90 Percent Exceedence Synthetic Dry Year Capacity With Energy (Million $)	Change in Average Annual 90 Percent Exceedence Synthetic Dry Year Capacity Without Energy (Million $)	Total Annual Change (Million $)
Preferred Alternative minus Revised No-Action Alternative	-2,947	-5,453	-925	-9,326

Source:
Western, 1999.

TABLE IV-93

PREFERENCE CUSTOMER BENEFIT/COST ALLOCATION BY COUNTY AND REGION BASED ON CONTRACT RATE OF DELIVERIES (CRD)

	CRD	Preferred Alternative Minus Revised No-Action Alternative ($1,000)
COUNTY		
Alameda	4.08%	-381
Butte	0.78%	-73
Calaveras	0.57%	-54
Contra Costa	0.46%	-43
Fresno	0.53%	-49
Glenn	0.28%	-26
Kern	2.26%	-211
Kings	1.28%	-119
Lassen	0.21%	-19
Mendocino	0.60%	-56
Merced	0.46%	-42
Placer	4.72%	-440
Plumas	1.54%	-143
Sacramento	26.10%	-2,434
San Francisco	0.00%	0
San Joaquin	2.47%	-230
Santa Barbara	0.36%	-33
Santa Clara	35.76%	-3,334
Shasta	8.72%	-813
Solano	2.32%	-216
Sonoma	0.32%	-30
Stanislaus	1.50%	-140
Trinity	1.23%	-115
Tulare	0.27%	-25
Tuolomne	0.60%	-56
Yolo	1.11%	-104
Yuba	1.48%	-138
Total	100.00%	-9,326
REGION		
Bay Area	40.30%	-3,758
Other	4.20%	-392
Sacramento Valley	45.51%	-4,244
San Joaquin Valley	8.76%	-817
Trinity	1.23%	-115
Total	100.00%	-9,326

Source:
Western, 1999.

TABLE IV-94

COST OF REPLACEMENT POWER AND THE EFFECTS ON THE "AVERAGE" AND "HIGH ALLOCATION" WESTERN CUSTOMER

Alternative	Percent CVP Energy Used in Customer Load	Average Replacement Rate ($/MWh)	Change in Customer's Total Cost of Power from RNAA ($/MWh)
"AVERAGE" WESTERN CUSTOMER			
Revised No-Action	14.50%	---	---
Preferred	13.49%	67.56	0.35
"HIGH ALLOCATION" WESTERN CUSTOMER			
Revised No-Action	85.00%	---	---
Preferred	81.90%	67.56	2.10

Notes:
Average Replacement Rate represents the purchase of energy comparable to that lost or gained at market rates.
Source:
Western, 1999.

TABLE IV-95

RESULTS OF RECREATION IMPACT ASSESSMENT FOR SHASTA LAKE

Main Area Peak Season (May - Sept.)		**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])**	
Water Year Type/Alternative	**Number of Months**	**844 ft (1)**	**947 ft (2)**
69-Year Average	**345**		
Revised No-Action Alternative		0 (0%)	22 (6%)
Preferred Alternative		2 (1%)	30 (9%)
Dry-Year Period	**35**		
Revised No-Action Alternative		0 (0%)	12 (34%)
Preferred Alternative		1 (3%)	17 (49%)
Wet-Year Period	**25**		
Revised No-Action Alternative		0 (0%)	0 (0%)
Preferred Alternative		0 (0%)	0 (0%)
Main Area Off Season (Oct. - April)		**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])**	
Water Year Type/Alternative	**Number of Months**	**844 ft (1)**	**947 ft (2)**
69-Year Average	**483**		
Revised No-Action Alternative		0 (0%)	37 (8%)
Preferred Alternative		5 (1%)	44 (9%)
Dry-Year Period	**49**		
Revised No-Action Alternative		0 (0%)	15 (31%)
Preferred Alternative		1 (2%)	21 (43%)
Wet-Year Period	**35**		
Revised No-Action Alternative		0 (0%)	0 (0%)
Preferred Alternative		0 (0%)	0 (0%)

NOTES:
(1) Last boat ramp out of operation.
(2) Limited lake surface area (boating constrained).
LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

TABLE IV-95. CONTINUED

McCloud River Arm Peak Season (May - Sept.) Water Year Type/Alternative	Number of Months	Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months]) 952 ft (1)	960 ft (3)	967 ft (2)
69-Year Average	**345**			
Revised No-Action Alternative		26 (8%)	36 (8%)	38 (10%)
Preferred Alternative		36 (10%)	42 (9%)	46 (12%)
Dry-Year Period	**35**			
Revised No-Action Alternative		13 (34%)	19 (46%)	19 (54%)
Preferred Alternative		21 (40%)	22 (49%)	23 (66%)
Wet-Year Period	**25**			
Revised No-Action Alternative		0 (0%)	0 (0%)	0 (0%)
Preferred Alternative		0 (0%)	0 (0%)	0 (0%)

McCloud River Arm Off Season (Oct. - April) Water Year Type/Alternative	Number of Months	Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months]) 952 ft (1)	967 ft (2)
69-Year Average	**483**		
Revised No-Action Alternative		38 (8%)	50 (10%)
Preferred Alternative		46 (10%)	55 (11%)
Dry-Year Period	**49**		
Revised No-Action Alternative		16 (33%)	22 (45%)
Preferred Alternative		23 (47%)	27 (55%)
Wet-Year Period	**35**		
Revised No-Action Alternative		0 (0%)	0 (0%)
Preferred Alternative		0 (0%)	0 0%

NOTES:
(1) Last boat ramp out of operation.
(2) Limited lake surface area (boating constrained).
(3) Decline in campground use.
LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

TABLE IV-95. CONTINUED

Pit River Arm Peak Season (May - Sept.)		Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])		
Water Year Type/Alternative	**Number of Months**	**907 ft (3)**	**942 ft (1)**	**1,007 ft (2)**
69-Year Average	**345**			
Revised No-Action Alternative		7 (2%)	20 (6%)	100 (29%)
Preferred Alternative		16 (5%)	30 (9%)	111 (32%)
Dry-Year Period	**35**			
Revised No-Action Alternative		4 (11%)	11 (31%)	29 (83%)
Preferred Alternative		10 (29%)	17 (49%)	30 (86%)
Wet-Year Period	**25**			
Revised No-Action Alternative		0 (0%)	0 (0%)	0 (0%)
Preferred Alternative		0 (0%)	0 (0%)	1 (4%)
Pit River Arm Off Season (Oct. - April)		**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])**		
Water Year Type/Alternative	**Number of Months**	**942 ft (1)**		**1,007 ft (2)**
69-Year Average	**483**			
Revised No-Action Alternative		9 (2%)		128 (26%)
Preferred Alternative		25 (5%)		168 (35%)
Dry-Year Period	**49**			
Revised No-Action Alternative		4 (8%)		38 (78%)
Preferred Alternative		14 (29%)		40 (82%)
Wet-Year Period	**35**			
Revised No-Action Alternative		0 (0%)		0 (0%)
Preferred Alternative		0 (0%)		4 (11%)

NOTES:
(1) Last boat ramp out of operation.
(2) Limited lake surface area (boating constrained).
(3) Decline in campground use.
LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

TABLE IV-95. CONTINUED

Sacramento River Arm Peak Season (May - Sept.)		Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [%] of Months])				
Water Year Type/Alternative	**Number of Months**	**937 ft (5)**	**950 ft (1)**	**967 ft (4)**	**1,007 ft (3)**	**1,017 ft (2)**
69-Year Average	**345**					
Revised No-Action Alternative		20 (6%)	25 (7%)	38 (11%)	100 (29%)	128 (37%)
Preferred Alternative		28 (8%)	34 (10%)	46 (13%)	111 (32%)	150 (43%)
Dry-Year Period	**35**					
Revised No-Action Alternative		11 (31%)	12 (34%)	19 (54%)	29 (83%)	30 (86%)
Preferred Alternative		17 (49%)	20 (57%)	23 (66%)	30 (86%)	31 (89%)
Wet-Year Period	**25**					
Revised No-Action Alternative		0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (8%)
Preferred Alternative		0 (0%)	0 (0%)	0 (0%)	1 (4%)	4 (16%)

Sacramento River Arm Off Season (Oct. - April)		Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [%] of Months])	
Water Year Type/Alternative	**Number of Months**	**950 ft (1)**	**1,017 ft (2)**
69-Year Average	**483**		
Revised No-Action Alternative		38 (8%)	191 (40%)
Preferred Alternative		46 (10%)	246 (51%)
Dry-Year Period	**49**		
Revised No-Action Alternative		16 (33%)	41 (84%)
Preferred Alternative		23 (47%)	43 (88%)
Wet-Year Period	**35**		
Revised No-Action Alternative		0 (0%)	7 (20%)
Preferred Alternative		0 (0%)	10 (29%)

NOTES:
(1) Last boat ramp out of operation.
(2) Limited lake surface area (boating constrained).
(3) Lake level requiring marina movement.
(4) Decline in campground use.
(5) Marina closes.
LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

campground use declines during 8 more peak-season months during the 69-year period, 4 of which would occur during the dry period.

On the Pit River arm, the last boat ramp would go out of operation during the peak season for 9 more months over the 69-year study period. Of these, 6 months would occur during the dry period. Lake surface area would be limited for boating during 10 more months, 6 of which would occur during the dry period. Lake elevations would be below the point at which campground use declines during 11 more peak-season months during the 69-year study period, 1 of which would occur during the dry period.

On the Sacramento River arm, the last boat ramp would go out of operation during the peak season for 8 more months over the 69-year study period. Of these, 6 months would occur during the dry period. Lake surface area would be limited for boating during 9 more months, 8 of which would occur during the dry period. Lake elevations would be below the point at which marinas would need to be moved during 8 more months, 4 of which would occur during the dry period. Lake elevations would be below the level at which campground use declines during 11 more peak-season months during the 69-year study period, 1 of which would occur during the dry period. Lake elevations would be above the level at which marinas would need to close during 22 more months over the 69-year study period, 1 of which would occur during the dry period.

Annual use is estimated to decrease by approximately 4 percent during the 69-year hydrologic period, decrease by approximately 2 percent during the wet hydrologic period, and decrease by approximately 15 percent during the dry hydrologic period (Table IV-96).

TABLE IV-96

ANNUAL VISITOR USE FOR RESERVOIRS IN THE SACRAMENTO RIVER REGION

	Annual Visitor Use (1)		
Water Year/Alternative	**Shasta Lake**	**Lake Oroville**	**Folsom Lake**
69-Year Average			
Revised No-Action Alternative	5,682,670	1,843,610	1,371,638
Preferred Alternative	5,441,140	1,866,350	1,322,853
Dry-Year Period			
Revised No-Action Alternative	4,090,290	1,499,980	1,282,374
Preferred Alternative	3,474,380	1,536,650	1,140,650
Wet-Year Period			
Revised No-Action Alternative	6,519,470	1,974,200	1,464,314
Preferred Alternative	6,360,900	2,001,220	1,455,412

NOTE:
(1) Annual visitor use is reported in 12-hour RVDs and is reported to the nearest 10,000 visitor days.

In summary, the surface elevation of Shasta Lake would fall below the levels at which boating becomes constrained on the Sacramento River arm more frequently under the Preferred Alternative than under the Revised No-Action Alternative. This potential impact would occur during both the peak-season and off-season periods.

Lake Oroville. The reservoir level exceedence frequencies for important recreation activities at Lake Oroville under the Preferred Alternative are shown in Table IV-97. The changes in recreation opportunities under the Preferred Alternative, compared to the Revised

TABLE IV-97

RESULTS OF RECREATION IMPACT ASSESSMENT FOR LAKE OROVILLE

Peak Season (April - Sept.)	Number of Months	Frequency with Which Reservoirs Are at or below Elevation Thresholds (Months [% of Months])				
Water Year Type/Alternative		**700 ft (1)**	**710 ft (2)**	**750 ft (3)**	**819 ft (4)**	**840 ft (5)**
69-Year Average	**414**					
Revised No-Action Alternative		28 (7%)	39 (9%)	75 (18%)	179 (43%)	208 (50%)
Preferred Alternative		20 (5%)	25 (6%)	61 (15%)	171 (41%)	207 (50%)
Dry-Year Period	**42**					
Revised No-Action Alternative		14 (33%)	18 (43%)	28 (67%)	35 (83%)	37 (88%)
Preferred Alternative		11 (26%)	13 (31%)	26 (62%)	34 (81%)	36 (86%)
Wet-Year Period	**30**					
Revised No-Action Alternative		0 (0%)	0 (0%)	1 (3%)	5 (17%)	7 (23%)
Preferred Alternative		0 (0%)	0 (0%)	1 (3%)	4 (13%)	7 (23%)

Off Season (Oct. - March)		Frequency with which Reservoirs are at or below Elevation Thresholds (Months [% of Months})	
Water Year Type/Alternative	**Number of Months**	**710 ft (2)**	**750 ft (3)**
69-Year Average	**414**		
Revised No-Action Alternative		54 (13%)	111 (27%)
Preferred Alternative		42 (10%)	96 (23%)
Dry-Year Period	**42**		
Revised No-Action Alternative		22 (52%)	33 (79%)
Preferred Alternative		19 (45%)	30 (71%)
Wet-Year Period	**30**		
Revised No-Action Alternative		0 (0%)	3 (10%)
Preferred Alternative		0 (0%)	1 (3%)

NOTES:
- (1) Decline in campground/picnicking use.
- (2) Limited boat ramp availability, relocation of the marina.
- (3) Limited lake surface area (boating constrained).
- (4) Beach area closed.
- (5) Decline in beach use.

LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

No-Action Alternative, would be nearly the same as the changes discussed under Alternative 1 for the 69-year hydrologic period. During the dry hydrologic period, there would be 2 fewer months when shoreline activities would decrease during the peak season and 3 fewer months when usable surface area would be constrained during the off season. During the wet hydrologic period, change in recreation opportunities under the Preferred Alternative, compared to the Revised No-Action Alternative, would be nearly the same as discussed under Alternative 1 except that beach use would not decline during the peak season and there would be 2 fewer months when usable surface area would decrease.

Annual use is estimated to increase by 1 percent during the 69-year and wet hydrologic periods and decrease by 2 percent during the dry hydrologic period (Table IV-96).

In summary, the surface elevation of Lake Oroville would generally be maintained at higher levels during peak- and off-season periods under the Preferred Alternative than under the Revised No-Action Alternative. Higher surface elevations would benefit recreation opportunities by increasing the availability of boat access and maintaining the lake level above the level at which boating becomes constrained and shoreline activities decrease. Lake levels would remain above recreation opportunity thresholds more frequently under the Preferred Alternative than under the Revised No-Action Alternative.

Folsom Lake. Lake level exceedence frequencies for important recreation opportunities at Folsom Lake under the Preferred Alternative are shown in Table IV-98. During the 69-year study period, usable surface area would be constrained for 18 more months during the peak season, while marinas would be closed for 11 more months, use of campground/ picnicking areas would decline for 43 more months, and there would be 30 fewer months when the beach would be inundated during the peak season. During the off season, there would be 1 less month when boat ramps would be unusable, but usable surface area would be constrained for 30 more months.

During the dry hydrologic period, boat ramps would be unusable for 15 more peak-season months and 2 more off-season months, shoreline activities would decrease for a total of 20 more peak-season months, and usable surface area would be constrained for 6 more off-season months. During the wet hydrologic period, shoreline activities would decrease for 1 more peak-season month, beach area would be inundated for 2 fewer peak-season months, and usable surface area would be reduced for the same number of months during the off season.

Annual use is estimated to decrease by approximately 4 percent during the 69-year study period, by approximately 11 percent during the dry hydrologic period, and by approximately 1 percent during the wet hydrologic period (Table IV-96).

In summary, the surface elevation of Folsom Lake would fall below the levels at which recreation opportunities become constrained more often during peak- and off-season periods under the Preferred Alternative than under the Revised No-Action Alternative. Lower surface elevations would decrease recreation opportunities by limiting the availability of boat access and reducing the reservoir's surface elevation below the level at which boating becomes constrained

TABLE IV-98

RESULTS OF RECREATION IMPACT ASSESSMENT FOR FOLSOM LAKE

Peak Season (April - Sept.)		**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])**									
Water Year Type/Alternative	**Number of Months**	**360 ft**	**(1)**	**400 ft**	**(2)**	**405 ft**	**(3)**	**430 ft**	**(4)**	**450 ft**	**(5)**
69-Year Average	**414**										
Revised No-Action Alternative		8	(2%)	58	(14%)	77	(19%)	171	(41%)	103	(25%)
Preferred Alternative		7	(2%)	76	(18%)	88	(21%)	214	(52%)	79	(19%)
Dry-Year Period	**42**										
Revised No-Action Alternative		0	(0%)	9	(21%)	14	(33%)	27	(64%)	4	(9%)
Preferred Alternative		1	(<1%)	24	(57%)	25	(59%)	36	(86%)	3	(7%)
Wet-Year Period	**30**										
Revised No-Action Alternative		0	(0%)	2	(7%)	2	(7%)	7	(23%)	11	(36%)
Preferred Alternative		0	(0%)	1	(3%)	2	(7%)	6	(20%)	9	(30%)

Off Season (Oct - March)		**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])**			
Water Year Type/Alternative	**Number of Months**	**360 ft**	**(1)**	**400 ft**	**(2)**
69-Year Average	**414**				
Revised No-Action Alternative		13	(3%)	109	(26%)
Preferred Alternative		12	(3%)	139	(34%)
Dry-Year Period	**42**				
Revised No-Action Alternative		0	(0%)	20	(48%)
Preferred Alternative		2	(5%)	26	(62%)
Wet-Year Period	**30**				
Revised No-Action Alternative		0	(0%)	4	(13%)
Preferred Alternative		0	(0%)	4	(13%)

NOTES:
- (1) Limited boat ramp availability.
- (2) Limited lake surface area (constrains boating).
- (3) Marinas close.
- (4) Decline in campground/picnicking use.
- (5) Beach area inundated.

LEGEND:
Thresholds are shown in feet above mean sea level.

more frequently than under the Revised No-Action Alternative. Lake levels would fall below the level at which shoreline activities decrease more frequently than under the Revised No-Action Alternative.

Other Reservoirs. Recreation opportunities at Whiskeytown Lake, Keswick Reservoir, Lake Red Bluff, Englebright Lake, Lake Natoma, and Thermalito Forebay and Afterbay under the Preferred Alternative are not expected to change relative to the Revised No-Action Alternative. Recreation opportunities at New Bullards and Camp Far West reservoirs could change relative to the Revised No-Action Alternative because water would be released for fish flows. These changes are not expected to be substantial because releases from these reservoirs are expected to be made during the off season.

Sacramento River Region Rivers

Sacramento River. The river flow exceedence frequencies for boating on the upper Sacramento River are shown in Table IV-99. The changes in recreation opportunities under the Preferred Alternative compared to the Revised No-Action Alternative would be nearly the same as the changes discussed under Alternative 1. Changes in recreation use associated with increased abundance of anadromous fish are discussed in Attachment A of the Recreation Technical Appendix. Because these estimates of recreation use are based on assumptions regarding anadromous fish abundance, not hydrology or reservoir operations, these estimates are the same under each alternative.

TABLE IV-99

RESULTS OF RECREATION IMPACT ASSESSMENT FOR RIVERS IN THE SACRAMENTO RIVER REGION

Upper Sacramento River Peak Season (May - Sept.)		Frequency with which Rivers are Between Flow Thresholds (Months [% of Months])	
Water Year Type/Alternative	**Number of Months**	**Between 2,500 and 12,000 cfs. (1)**	
69-Year Average	**345**		
Revised No-Action Alternative		210	(61%)
Preferred Alternative		247	(72%)
Dry-Year Period	**35**		
Revised No-Action Alternative		32	(91%)
Preferred Alternative		33	(94%)
Wet-Year Period	**25**		
Revised No-Action Alternative		13	(52%)
Preferred Alternative		13	(52%)

American River Peak Season (May - Sept.)		Frequency with which Rivers are Between or Below Flow Thresholds (Months [% of Months])					
		Between 1,750 and		**Below**		**Below**	
Water Year Type/Alternative	**Number of Months**	**3,000 cfs.**	**(1)**	**1,750 cfs.**	**(2)**	**1,500 cfs.**	**(3)**
69-Year Average							
Revised No-Action Alternative	**345**	89	(26%)	70	(20%)	45	(13%)
Preferred Alternative		95	(28%)	87	(25%)	61	(18%)
Dry-Year Period	**35**						
Revised No-Action Alternative		15	(43%)	14	(40%)	8	(23%)
Preferred Alternative		14	(40%)	16	(46%)	12	(34%)
Wet-Year Period	**25**						
Revised No-Action Alternative		4	(16%)	3	(12%)	2	(8%)
Preferred Alternative		7	(28%)	2	(8%)	1	(4%)

NOTES:
(1) Optimal flow range for all boating.
(2) Below minimum river flows for boating.
(3) Below optimal flow for swimming.
LEGEND:
cfs = cubic feet per second of flow.
SOURCES:
American River: COE, 1991.
Sacramento River: Matzat, pers. comm.

The number of months when upper Sacramento River flows would be within the optimal range for all boating activities during the peak season would be greater under the Preferred Alternative than under the Revised No-Action Alternative. These flows would result in a potential beneficial impact on boating during the peak season.

American River. The river flow exceedence frequencies for boating and swimming on the American River under both the Preferred Alternative and the Revised No-Action Alternative are shown in Table IV-98. During the 69-year hydrologic period, river flows would fall within the optimal range for all boating for 6 more months under the Preferred Alternative than under the Revised No-Action Alternative, but flows would fall below the level for optimal swimming for 16 more months. During the dry hydrologic period, the optimal flow range would be achieved for 1 less month and river levels would fall below minimum flows for boating for 2 more months and below optimal flow for swimming for 4 more months. During the wet hydrologic period, the optimal flow range would be achieved for 3 more months and there would be 1 less month when flows would fall below the minimum for boating and the optimal level for swimming.

Changes in recreation use associated with increased abundance of anadromous fish are discussed in Attachment A of the Recreation Technical Appendix.

The number of months when American River flows would be below the optimal level for swimming during the peak season would be greater under the Preferred Alternative than under the No-Action Alternative. These lower flows would occur during all three hydrologic periods.

Other Rivers. Recreation opportunities on Clear Creek under the Preferred Alternative would be the same as those described under Alternative 1. Although flows would increase on the Feather and Yuba rivers under the Preferred Alternative, recreation opportunities are not expected to change from conditions under the Revised No-Action Alternative because these opportunities occur within a broad range of river flows. Changes in recreation use associated with increased abundance of anadromous fish are discussed in Attachment A of the Recreation Technical Appendix.

Sacramento River Region - Wildlife Refuges and Private Hunting Lands

Wildlife Refuges. Because the water provided to the wildlife refuges under the Preferred Alternative would be Level 4 (the same as that provided under Alternative 2,) the changes in recreation at wildlife refuges in the Sacramento River Region under the Preferred Alternative would be the same as those discussed under Alternative 2.

Water deliveries under the Level 4 and critical period scenarios would potentially benefit recreation opportunities and use at Sacramento River Region wildlife refuges (Table IV-100). Under both water delivery scenarios, wildlife observation, hunting, and fishing opportunities would potentially benefit as a result of enhanced water deliveries and increased wetland acreages. However, changes in use would be greater with full Level 4 deliveries than with critical period delivery. This is reflected in the increase in total recreation use estimated for each scenario.

TABLE IV-100

ANNUAL VISITOR USE FOR WILDLIFE REFUGES IN THE SACRAMENTO RIVER REGION

Water Year Type/Alternative	Annual Visitor Use (1)			
	Hunting	Non- Consumptive	Fishing	Total
69-Year Average				
Revised No-Action Alternative	45,000	49,700	6,500	101,200
Preferred Alternative (Level 4)	59,400	58,600	7,700	125,700
Critical Period				
Revised No-Action Alternative	45,000	37,400	4,800	87,200
Preferred Alternative (Level 4)	52,100	44,000	5,700	101,800

NOTES:
(1) Annual use is reported in 5-hour RVDs.
(2) Critical period = critical dry years when refuges will receive a 25 percent reduction in deliveries.

Private Hunting Lands. Waterfowl hunting opportunities on private lands under the Preferred Alternative are not expected to change from conditions under the Revised No-Action Alternative because water deliveries from CVP or other water sources to duck clubs and other private hunting lands in the Sacramento Valley would not be affected.

San Francisco Bay/Sacramento-San Joaquin Delta Region

Recreation opportunities in the Bay-Delta Region associated with flows and water surface elevations are not expected to change under the Preferred Alternative because the hydrologic characteristics of the Bay-Delta Region are expected to be the same as under the Revised No-Action Alternative. Changes in recreation use associated with increased abundance of anadromous fish are discussed in Attachment A of the Recreation Technical Appendix.

San Joaquin River Region - Reservoirs

San Luis Reservoir. Changes in recreation opportunities at San Luis Reservoir under the Preferred Alternative over the 69-year study period would be nearly the same as under the Revised No-Action Alternative (Table IV-101). During the dry hydrologic period, boating would be constrained and shoreline activities would decline for 2 more peak-season months. During the wet period, boat ramps would be unusable for 1 more peak-season month, and boating would be constrained and shoreline activities would decline for 2 more peak-season months and 1 more off-season month.

Annual use is estimated to decrease by approximately 2 percent during the 69-year study period, by 1 percent during the dry hydrologic period, and by 4 percent during the wet period (Table IV-102).

TABLE IV-101

RESULTS OF RECREATION IMPACT ASSESSMENT FOR SAN LUIS RESERVOIR

Peak Season (May - Sept.) Water Year Type/Alternative	Number of Months	Frequency with which Reservoirs are at or Below Elevation Thresholds(Months [% of Months]) 340 ft (1)		360 ft (2)	
69-Year Average	414				
Revised No-Action Alternative		2	(<1%)	30	(7%)
Preferred Alternative		2	(<1%)	35	(8%)
Dry-Year Period	42				
Revised No-Action Alternative		0	(0%)	2	(5%)
Preferred Alternative		0	(0%)	4	(10%)
Wet-Year Period	30				
Revised No-Action Alternative		0	(0%)	0	(0%)
Preferred Alternative		1	(3%)	2	(7%)
Off Season (Oct. - April) **Water Year Type/Alternative**	**Number of Months**	**Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])** **340 ft (1)**		**360 ft (2)**	
69-Year Average	483				
Revised No-Action Alternative		0	(0%)	16	(8%)
Preferred Alternative		1	(<1%)	14	(3%)
Dry-Year Period	49				
Revised No-Action Alternative		0	(0%)	2	(4%)
Preferred Alternative		0	(0%)	2	(4%)
Wet-Year Period	35				
Revised No-Action Alternative		0	(0%)	0	(0%)
Preferred Alternative		0	(0%)	1	(3%)

NOTES:
(1) Limited boat ramp availability.
(2) Constraints on boating, decline in campground/picnicking use.
LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

TABLE IV-102

ANNUAL VISITOR USE AT RESERVOIRS IN THE SAN JOAQUIN RIVER REGION

Water Year Type/Alternative	Annual Visitor Use (1) San Luis Reservoir	Millerton Lake	New Melones Reservoir	Non-CVP/SWP Reservoirs (2)
69-Year Average				
Revised No-Action Alternative	275,700	1,012,980	1,312,350	1,799,000
Preferred Alternative 1	270,080	1,012,980	1,304,400	1,799,000
Dry-Year Period				
Revised No-Action Alternative	267,020	1,017,030	1,188,680	1,699,000
Preferred Alternative	265,600	1,017,030	1,198,870	1,698,000
Wet-Year Period				
Revised No-Action Alternative	288,550	944,210	1,332,270	1,846,000
Preferred Alternative	277,860	944,210	1,339,000	1,847,000

NOTES:
(1) Annual use is reported in 12-hour RVDs and is reported to the nearest 1,000 visitor days.
(2) Non-CVP/SWP reservoirs are Camanche Reservoir, New Don Pedro Reservoir, New Hogan Lake, and Lake McClure.

Recreation opportunities would decline at San Luis Reservoir under the Preferred Alternative compared to conditions under the No-Action Alternative.

Millerton Lake. The frequency with which reservoir levels at Millerton Lake are below important recreation opportunity thresholds would be the same as under the Revised No-Action Alternative. Annual use during the 69-year, dry, and wet periods would not change from use estimated for the Revised No-Action Alternative (Table IV-102).

No impacts on recreation at Millerton Lake during the 69-year hydrologic period are expected under the Preferred Alternative because recreation opportunities would not change from conditions under the Revised No-Action Alternative.

New Melones Reservoir. Lake level exceedence frequencies for important recreation opportunities at New Melones Reservoir under the Preferred Alternative and the Revised No-Action Alternative are shown in Table IV-103. During the 69-year study period, usable surface area would never decline to a level that would reduce shoreline activity during the peak season; marinas would close for the same number of months (4) as under the Revised No-Action Alternative, and beach use would decline for 5 fewer months. In the off season, reservoir levels would never cause boat ramps to be unusable or limit usable surface area and reduce shoreline activities. During the dry hydrologic period, all categories of recreation opportunity would improve during the peak season.

Annual use is estimated to increase by approximately 1 percent during the 69-year study period and decrease by approximately 1 percent during the dry and wet hydrologic periods (Table IV-102).

In summary, the surface elevations of New Melones Reservoir would remain above the levels at which boating becomes constrained and ramps unusable more frequently under the Preferred Alternative than under the Revised No-Action Alternative. These lower levels would occur in wet and dry periods, and over the 69-year study period.

Surface elevations at New Melones Reservoir would also remain above levels at which shoreline recreation opportunities decline more frequently under the Preferred Alternative than under the Revised No-Action Alternative. These lower levels would occur in wet and dry periods, and over the 69-year study period.

Non-CVP and SWP Reservoirs. The changes in recreation opportunities and use at Camanche Reservoir, New Don Pedro Reservoir, New Hogan Lake, and Lake McClure between the Preferred Alternative and the Revised No-Action Alternative would be similar to the changes discussed under Alternative 2.

Other Reservoirs. Recreation opportunities at Bethany Reservoir and O'Neill Forebay under the Preferred Alternative are not expected to change because lake levels would be similar to conditions under the Revised No-Action Alternative.

TABLE IV-103

RESULTS OF RECREATION IMPACT ASSESSMENT FOR NEW MELONES RESERVOIR

Peak Season (April - Sept.)		Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])							
Water Year Type/Alternative	**Number of Months**	**850 ft**	**(1)**	**860 ft**	**(2)**	**880 ft**	**(3)**	**900 ft**	**(4)**
69-Year Average	**414**								
Revised No-Action Alternative		1	(<1%)	2	(<1%)	4	(1%)	14	(3%)
Preferred Alternative		0	(0%)	0	(0%)	4	(1%)	9	(2%)
Dry-Year Period	**42**								
Revised No-Action Alternative		1	(2%)	2	(5%)	3	(7%)	7	(17%)
Preferred Alternative		0	(0%)	0	(0%)	2	(5%)	5	(12%)
Wet-Year Period	**30**								
Revised No-Action Alternative		0	(0%)	0	(0%)	0	(0%)	0	(0%)
Preferred Alternative		0	(0%)	0	(0%)	0	(0%)	0	(0%)

Off Season (Oct - March)		Frequency with which Reservoirs are at or Below Elevation Thresholds (Months [% of Months])			
Water Year Type/Alternative	**Number of Months**	**850 ft**	**(1)**	**860 ft**	**(2)**
69-Year Average	**414**				
Revised No-Action Alternative		4	(1%)	5	(1%)
Preferred Alternative		0	(0%)	0	(0%)
Dry-Year Period	**42**				
Revised No-Action Alternative		0	(0%)	0	(0%)
Preferred Alternative		0	(0%)	0	(0%)
Wet-Year Period	**30**				
Revised No-Action Alternative		0	(0%)	0	(0%)
Preferred Alternative		0	(0%)	0	(0%)

NOTES:
(1) Limited boat ramp availability.
(2) Limited lake surface area, decline in campground/picnicking use.
(3) Marinas close.
(4) Decline in beach use.

LEGEND:
Thresholds are shown in feet (ft) above mean sea level.

San Joaquin River Region - Rivers

San Joaquin River. The river flow exceedence frequencies for important recreation activities on the San Joaquin River under the Preferred Alternative and Revised No-Action Alternative are shown in Table IV-104. During the peak season over the 69-year study period, river flows would fall below the optimal level for swimming during 2 more months under the Preferred Alternative compared to the Revised No-Action Alternative. During the peak-season over the dry period, optimal flow for all boating activities would occur for 10 fewer months, flows would fall below the minimum for swimming for 10 more months, but would fall within the optimal range for canoeing for 10 more months. During the peak-season wet hydrologic period, flows would not fall below optimal levels for swimming.

TABLE IV-104

RESULTS OF RECREATION IMPACT ASSESSMENT FOR RIVERS IN THE SAN JOAQUIN RIVER REGION

San Joaquin River - Lower Reach Peak Season (May - Sept.)		Frequency with which Rivers are Between or Below Flow Thresholds (Months [%])		
Water Year Type/Alternative	**Number of Months**	**Between 300 and 500 cfs (1)**	**Between 200 and 300 cfs (2)**	**Below 300 cfs (3)**
69-Year Average	**345**			
Revised No-Action Alternative		246 (71%)	15 (4%)	15 (4%)
Preferred Alternative		260 (75%)	18 (5%)	17 (5%)
Dry-Year Period	**35**			
Revised No-Action Alternative		28 (80%)	7 (20%)	7 (20%)
Preferred Alternative		18 (51%)	17 (49%)	17 (49%)
Wet-Year Period	**25**			
Revised No-Action Alternative		18 (72%)	0 (0%)	0 (0%)
Stanislaus River - Upper Reach Peak Season (May - Sept.)		**Frequency with which Rivers are Between or below Flow Thresholds(Months [%])**		
Water Year Type/Alternative	**Number of Months**	**Between 700 and 2,000 cfs (1)**		**Below 700 cfs (4)**
69-Year Average	**345**			
Revised No-Action Alternative		116 (34%)		0 (0%)
Preferred Alternative		122 (35%)		0 (0%)
Dry-Year Period	**35**			
Revised No-Action Alternative		21 (60%)		0 (0%)
Preferred Alternative		21 (84%)	0 (0%)	0 0%
Preferred Alternative		23 (66%)		0 (0%)
Wet-Year Period	**25**			
Revised No-Action Alternative		4 (16%)		0 (0%)
Preferred Alternative		4 (16%)		0 (0%)
Stanislaus River - Lower Reach Peak Season (May - Sept.)		**Frequency with which Rivers are Between or below Flow Thresholds (Months [%])**		
Water Year Type/Alternative	**Number of Months**	**Between 700 and 800 cfs (1)**		**Below 300 cfs (4)**
69-Year Average	**345**			
Revised No-Action Alternative		24 (7%)		126 (36%)
Preferred Alternative		29 (8%)		104 (30%)
Dry-Year Period	**35**			
Revised No-Action Alternative		2 (6%)		14 (40%)
Preferred Alternative		1 (3%)		19 (54%)
Wet-Year Period	**25**			
Revised No-Action Alternative		1 (4%)		5 (20%)
Preferred Alternative		4 (16%)		3 (12%)

NOTES:
- (1) Optimal flow range for all boating activities.
- (2) Optimal range of canoeing flows.
- (3) Below optimal flows for swimming.
- (4) Below minimum flows for all boating activities.

SOURCES:
- San Joaquin River: Koehler and Reep, pers. comms.
- Stanislaus River: Foust, pers. comm.

LEGEND:
- cfs = cubic feet per second of flow

Annual fishing use under the Preferred Alternative is estimated to remain the same during the 69-year study period and the wet period, but to decrease by 1 percent during the dry period (Table IV-105) compared to the Revised No-Action Alternative.

TABLE IV-105

ANNUAL VISITOR USE AT RIVERS IN THE SAN JOAQUIN RIVER REGION

San Joaquin River	Annual Visitor Use (Visitor Days) (1)		
Water Year Type/Alternative	**Fishing**	**Nonconsumptive**	**Total**
69-Year Average			
Revised No-Action Alternative	150,000	370,000	520,000
Preferred Alternative	150,000	370,000	520,000
Dry-Year Period			
Revised No-Action Alternative	154,000	378,000	532,000
Preferred Alternative	152,000	375,000	527,000
Wet-Year Period			
Revised No-Action Alternative	149,000	368,000	517,000
Preferred Alternative	149,000	368,000	517,000
Stanislaus River	**Annual Visitor Use (Visitor Days) (1)**		
Water Year Type/Alternative	**Fishing**	**Nonconsumptive**	**Total**
69-Year Average			
Revised No-Action Alternative	82,000	201,000	283,000
Preferred Alternative	83,000	202,000	285,000
Dry-Year Period			
Revised No-Action Alternative	90,000	216,000	306,000
Preferred Alternative	93,000	222,000	315,000
Wet-Year Period			
Revised No-Action Alternative	85,000	207,000	292,000
Preferred Alternative	84,000	205,000	289,000
69-Year Average			
Revised No-Action Alternative	112,000	278,000	390,000
Preferred Alternative	111,000	277,000	388,000
Dry-Year Period			
Revised No-Action Alternative	100,000	255,000	355,000
Preferred Alternative	99,000	253,000	352,000
Wet-Year Period			
Revised No-Action Alternative	109,000	274,000	383,000
Preferred Alternative	109,000	274,000	383,000

NOTE:
(1) Annual visitor use is reported in 6-hour RVDs and is reported to the nearest 1,000 visitor days.

Recreation opportunities on the San Joaquin River would be affected under the Preferred Alternative because flow levels would limit swimming but improve canoeing, compared to conditions under the Revised No-Action Alternative.

Stanislaus River. The river flow exceedence frequencies for important recreation activities on the Stanislaus River under the Preferred Alternative and the Revised No-Action Alternative are shown in Table IV-104. On the upper reach, river flows would be within the optimal range for all boating during 6 more peak-season months over the 69-year study period, 2 more peak-season months during the dry period, and the same number of peak-season months during the wet hydrologic period. On the lower reach, river flows would be outside the optimal range for boating 5 fewer months and above the minimum flow for 22 fewer months over the 69-year study period, 5 more months during the dry period, and 2 fewer months during the wet period.

Annual fishing use under the Preferred Alternative is estimated to increase by approximately 1 percent during the 69-year study period, increase by approximately 3 percent during the dry hydrologic period, and decrease by 1 percent during the wet hydrologic period (Table IV-105).

River flows on the lower reach of the Stanislaus River under the Preferred Alternative would be maintained at higher levels during the peak-use season than under the No-Action Alternative. These higher flows could result in a potentially beneficial impact on recreation by providing the optimal flows for boating more frequently than the Revised No-Action Alternative.

Non-CVP and SWP Rivers. The changes in recreation opportunities and use on the Tuolumne, Merced, Calaveras, and Mokelumne rivers during the 69-year, dry, and wet periods under the Preferred Alternative, compared to the Revised No-Action Alternative, would be the same as changes discussed under Alternative 2.

Annual fishing-related recreation use on these rivers is expected to decrease by less than one percent over the 69-year study period.

California Aqueduct and Delta-Mendota Canal. Recreation opportunities provided by the California Aqueduct and Delta-Mendota Canal under the Preferred Alternative are not expected to change, compared to the Revised No-Action Alternative, because water levels in the canals would be held at constant levels.

San Joaquin River Region - Wildlife Refuges and Private Hunting Lands

Wildlife Refuges. The changes in recreation use at wildlife refuges in the San Joaquin River Region under the Preferred Alternative compared to the No-Action Alternative would be the same as changes discussed under Alternative 2 (Table IV-106).

Water deliveries under the Level 4 and critical period scenarios would benefit recreation opportunities and use at San Joaquin River Region wildlife refuges. Under both water delivery scenarios, wildlife observation, hunting, and fishing opportunities would potentially benefit as a result of enhanced water deliveries and increased wetland acreages. However, changes in use would be greater with full Level 4 deliveries than with critical period delivery. This is reflected in the increase in total recreation use estimated for each scenario.

TABLE IV-106

ANNUAL VISITOR USE FOR WILDLIFE REFUGES IN THE SAN JOAQUIN RIVER REGION

Water Year Type/Alternative	Annual Visitor Use (1)			
	Hunting	Non-Consumptive	Fishing	Total
69-Year Average				
Revised No-Action Alternative	32,500	35,800	4,600	72,900
Preferred Alternative	48,800	39,300	5,100	93,200
Critical Period (2)				
Revised No-Action Alternative	19,500	27,200	3,400	50,100
Preferred Alternative	25,300	29,600	3,800	58,700

NOTES:
(1) Annual use is reported in 5-hour RVDs.
(2) Critical period = critical dry years when refuges will receive a 25 percent reduction in deliveries.

Private Hunting Lands. Waterfowl hunting opportunities on private lands under the Preferred Alternative are not expected to change from the No-Action Alternative because duck clubs and private hunting lands are expected to receive their historical water deliveries.

Tulare Lake Region - Wildlife Refuges and Private Hunting Lands

Wildlife Refuges. The changes in recreation use at wildlife refuges in the Tulare Lake Region under the Preferred Alternative, compared to the No-Action Alternative, would be the same as changes discussed under Alternative 2 because deliveries to the refuges would be the same as those under Alternative 2 (Table IV-107).

TABLE IV-107

ANNUAL VISITOR USE FOR WILDLIFE REFUGES IN THE TULARE LAKE REGION

Water Year Type/Alternative	Annual Visitor Use (1)		
	Non-Consumptive	Fishing	Total
69-Year Average			
Revised No-Action Alternative	3,900	500	4,400
Preferred Alternative (Level 2)	3,900	500	4,400
Critical Period (2)			
Revised No-Action Alternative	2,700	400	3,100
Preferred Alternative 1 (Level 2)	2,900	400	3,300

NOTES:
(1) Annual use is reported in 5-hour RVDs.
(2) Critical period = critical dry years when refuges will receive a 25 percent reduction in deliveries.

Increased water deliveries to the refuges under the Preferred Alternative (Level 4) would potentially benefit recreation opportunities and use at Tulare Lake Region wildlife refuges, increasing annual visitor use by 27 percent during full-delivery years and by 17 percent during critical periods. Under both water delivery scenarios, wildlife observation, hunting, and fishing opportunities would potentially benefit as a result of enhanced water deliveries and increased wetland acreages. However, changes in use would be greater with full Level 4 deliveries than during reduced deliveries during critical periods.

Private Hunting Lands. Waterfowl hunting opportunities on private lands under the Preferred Alternative are not expected to change from opportunities under the Revised No-Action Alternative because duck clubs and private hunting lands are expected to receive their historical water deliveries.

Pacific Coast Region

Changes in recreation use associated with increased abundance of anadromous fish in the Pacific Coast Region are discussed in Attachment A of the Recreation Technical Appendix.

San Francisco Bay Region

Changes in recreation opportunities at reservoirs in the San Francisco Bay Region under the Preferred Alternative, compared to those under the Revised No-Action Alternative, would be similar to the changes discussed under Alternative 1.

FISH, WILDLIFE, AND RECREATION ECONOMICS

Sacramento River Region

Recreation-Related Spending

Under the Preferred Alternative, spending associated with use of Sacramento River Region reservoirs would be expected to change by about $5,469 (3%) (Table IV-108). This is due to the slight increase in recreational use of these reservoirs expected under the Preferred Alternative.

Spending would increase by an estimated $2.2 million at the region's wildlife refuges (Table IV-108). Spending associated with waterfowl hunting opportunities on private lands is expected to be unchanged compared with spending under the Revised No-Action Alternative.

Potential changes in spending associated with use of affected rivers under three fish harvest improvement scenarios are discussed in Attachment A of the Fish, Wildlife, and Recreation Economics Technical Appendix. The information presented in Attachment A, however, is not specifically related to any of the action alternatives.

TABLE IV-108

ANNUAL RECREATION TRIP-RELATED EXPENDITURES AT KEY RECREATION AREAS IN THE SACRAMENTO RIVER REGION

Recreation Area	Revised No-Action Alternative	Change under Preferred Alternative	Percent Change
Lakes			
Shasta	112,012	4,761	4%
Oroville	29,866	(368)	-1%
Folsom	30,247	1,076	4%
Subtotal	**172,125**	**5,469**	**3%**
Wildlife Refuges	3,434	2,206	25%
Total	**175,559**	**7,675**	**4%**

NOTES:

All values are expressed in thousands of 1992 dollars.

The term “0*” denotes a change of less than 3 percent compared with the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Because of model limitations, wildlife refuge values should be interpreted as indicators of potential changes.

Values associated with changes to sport fishing in rivers of the region are described in Attachment A, “Effects of Improvements in Anadromous Fisheries.”

Total recreation-related spending by visitors to the region is projected to increase by $4,101,000 under the Preferred Alternative (Table IV-109).

TABLE IV-109

ANNUAL REGIONAL RECREATION-RELATED EXPENDITURES OF VISITORS

Region	Revised No-Action Alternative	Change under Preferred Alternative	Percent Change
Sacramento River	133,144	4,101	3%
San Joaquin River	106,104	777	1%
Tulare Lake	34	52	153%

NOTES:

(1) All values are expressed in thousands of 1992 dollars.

(2) Changes in regional recreation-related expenditures by visitors also would occur in other regions as a result of anadromous fishery enhancement. Refer to Attachment A, “Effects of Improvements in Anadromous Fisheries,” for a discussion of regional expenditure impacts associated with the fishery enhancement scenarios.

In summary, total recreation-related spending in the Sacramento River Region under the Preferred Alternative would be expected to increase slightly, compared with spending under the Revised No-Action Alternative, primarily because of improved conditions at the wildlife refuges. Expected enhancements to river fisheries, although not quantified here, are also expected to contribute to increases in recreation-related spending. Overall spending by visitors would be expected to increase slightly.

From a regional perspective, changes in economic activity would be minor. However, businesses serving recreationists near key recreation areas could experience some noticeable change in sales to recreationists. Businesses serving river anglers for anadromous fish, visitors to wildlife refuges, and businesses near affected reservoirs may experience a relatively small increase in sales.

Recreation Benefits

The annual benefits of recreation activity at affected reservoirs and lakes in the Sacramento River Region are expected to increase by $3,005,000 (4%) compared with benefits under the Revised No-Action Alternative (Table IV-110).

TABLE IV-110

ANNUAL RECREATION BENEFITS AT KEY RECREATION AREAS IN THE SACRAMENTO RIVER REGION

Recreation Area	Revised No-Action Alternative	Change under Preferred Alternative	Percent Change
Lakes			
Shasta	54,554	2,319	4%
Oroville	17,699	218	1%
Folsom	13,168	468	4%
Subtotal	**85,421**	**3,005**	**4%**
Wildlife Refuges	2,092	1,386	66%
Total	**87,513**	**4,391**	**5%**

NOTES:
All values are expressed in thousands of 1992 dollars.
Because of model limitations, wildlife refuge values should be interpreted as indicators of potential changes.
Values associated with changes to sport fishing in rivers of the region are described in Attachment A, "Effects of Improvements in Anadromous Fisheries."

The benefits of recreation activity at State and Federal wildlife refuges in the Sacramento River Region are estimated to increase by approximately $1.4 million under the Preferred Alternative, or about 66 percent, compared with benefits under the Revised No-Action Alternative. Recreation benefits associated with waterfowl hunting on private lands are expected to be unchanged compared with such benefits under the Revised No-Action Alternative.

Potential changes in recreation benefits associated with sport fishing on affected rivers in the Sacramento River Region under three fish harvest improvement scenarios are discussed in Attachment A of the Fish, Wildlife, and Recreation Economics Technical Appendix. The information presented in Attachment A of the Technical Appendix, however, is not specifically related to any of the action alternatives.

San Joaquin River Region

Recreation-Related Spending

Overall spending at San Joaquin River Region reservoirs and lakes is not expected to change, compared with spending under the Revised No-Action Alternative (Table IV-111). As described in the Recreation Technical Appendix, a slight decrease in river-related recreation use was estimated; however, because the magnitude of this change is very small (less than 3 percent at all reservoirs) and within the margin of error of the estimation approach, no change in recreation-related spending associated with reservoir visitation is predicted.

TABLE IV-111

ANNUAL RECREATION TRIP-RELATED EXPENDITURES AT KEY RECREATION AREAS IN THE SAN JOAQUIN RIVER REGION

Recreation Area	Revised No-Action Alternative	Change Under Preferred Alternative	Percent Change
Reservoirs and Lakes			
San Luis	7,209	147	0*
Millerton	17,003	0	0*
New Melones	21,260	124	0*
Non-CVP reservoirs (1)	70,431	441	0*
Subtotal	**115,903**	**712**	**0**
Rivers (2)			
San Joaquin	14,729	420	3%
Stanislaus	9,231	(374)	-4%
Non-CVP rivers (3)	10,270	(747)	-7%
Subtotal	**34,230**	**(701)**	**-2%**
Wildlife Refuges	1,891	1,547	82%
Total	**152,024**	**1,558**	**0***

NOTES:

All values are expressed in thousands of 1992 dollars.

The term "0*" denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Because of model limitations, wildlife refuge values should be interpreted as indicators of potential changes.
(1) Includes Lake McClure, New Don Pedro Reservoir, New Hogan Lake, and Camanche Reservoir.
(2) Includes fishing, boating, swimming, and wildlife viewing activities only.
(3) Includes the Merced and Tuolumne rivers.

Wildlife refuge-related spending would increase by $1.5 million. Spending associated with waterfowl hunting opportunities on private lands is expected to be unchanged compared with spending under the Revised No-Action Alternative.

Total recreation-related spending by visitors to the region is projected to increase by $777,000 under the Preferred Alternative (Table IV-109).

In summary, total recreation-related spending in the San Joaquin River Region under the Preferred Alternative would be expected to increase slightly, compared with spending under the Revised No-Action Alternative, primarily because of improved conditions at the wildlife refuges and at reservoirs in the region. This increase could be somewhat offset by minor reductions in river-related spending. Overall spending by visitors would be expected to increase slightly.

From a regional perspective, changes in economic activity would be minor. However, businesses serving recreationists near key recreation areas could experience some noticeable change in sales to recreationists. Businesses serving visitors to wildlife refuges and reservoirs in the region could experience an increase in sales, whereas businesses near affected rivers may experience a relatively small decrease in sales.

Recreation Benefits

The annual benefits of recreation activity at affected reservoirs and lakes in the San Joaquin River Region would not be expected to change, compared with benefits under the Revised No-Action Alternative (Table IV-112). As explained above, the magnitude of change in use (which determines recreation benefits) is very small and within the margin of error of the estimation approach. Consequently, no change in recreation benefits is predicted.

The benefits of recreation activity at State and Federal wildlife refuges in the San Joaquin River Region are estimated to increase by approximately $1.1 million under the Preferred Alternative (72 percent) compared with benefits under the Revised No-Action Alternative. Recreation benefits associated with waterfowl hunting on private lands are expected to be unchanged compared with such benefits under the Revised No-Action Alternative.

Tulare Lake Region

Spending associated with use of Kern and Pixley NWRs would increase by $116,000. Recreation benefits are estimated to increase by $119,000.

Spending and recreation benefits associated with waterfowl hunting opportunities on private lands are expected to be unchanged compared with spending and benefits under the Revised No-Action Alternative.

Total recreation-related spending by visitors to the region is projected to increase by $52,000 (153%) under the Preferred Alternative (Table IV-109).

TABLE IV-112

ANNUAL RECREATION BENEFITS AT KEY RECREATION AREAS IN THE SAN JOAQUIN RIVER REGION

Recreation Area	Revised No-Action Alternative	Change Under Preferred Alternative	Percent Change
Reservoirs and Lakes			
San Luis	4,963	101	0*
Millerton	18,234	0	0
New Melones	23,622	143	0*
Non-CVP reservoirs (1)	72,306	408	0*
Subtotal	**119,125**	**652**	**0***
Rivers (2)			
San Joaquin	10,064	327	3%
Stanislaus	6,204	(445)	-7%
Non-CVP rivers (3)	7,123	(346)	-5%
Subtotal	**23,391**	**(464)**	**0***
Wildlife Refuges	1,507	1,091	72%
Total	**143,607**	**1,279**	**0***

NOTES:

All values are expressed in thousands of 1992 dollars.

The term "0*" denotes a change of less than 3 percent compared to the value associated with the No-Action Alternative. These changes are considered within the margin of error of the models and consequently are treated as zeros.

Because of model limitations, wildlife refuge values should be interpreted as indicators of potential changes.
(1) Includes Lake McClure, New Don Pedro Reservoir, New Hogan Lake, and Camanche Reservoir.
(2) Includes fishing, boating, swimming, and wildlife viewing activities only.
(3) Includes the Merced and Tuolumne rivers.

Local and regional economic effects associated with changes in use of key recreational areas within the region are expected to be minor.

San Francisco Bay/Sacramento-San Joaquin Delta Region

Potential changes in sport-fishing values associated with three fish harvest improvement scenarios are discussed in Attachment A of the Fish, Wildlife, and Recreation Economics Technical Appendix. The information presented in Attachment A of the Technical Appendix, however, is not specifically related to any of the action alternatives.

Pacific Coast Region

Potential changes in sport-fishing and commercial fishing values associated with three fish harvest improvement scenarios are discussed in Attachment A of the Fish, Wildlife, and

Recreation Economics Technical Appendix. The information presented in Attachment A of the Technical Appendix, however, is not specifically related to any of the action alternatives.

Other Economic Values

In addition to recreational and commercial harvesting values associated with enhanced fish and wildlife resources, the CVPIA can also be expected to affect the values of "nonusers" of anadromous fisheries. This type of economic value, which is often referred to as existence value, reflects the public's value of knowing that anadromous fisheries are protected at sustainable levels. Although these values have not been estimated for this analysis, previous research indicates that these values can be significant. Consequently, studies of existence values of other fishery enhancement programs with similar objectives are briefly reviewed in the Fish, Wildlife, and Recreation Economics Methodology/Modeling Technical Appendix.

REGIONAL ECONOMICS

Revised No-Action Alternative

The conditions under the Revised No-Action Alternative are similar to those described under the Draft PEIS No-Action Alternative.

Preferred Alternative

Provisions of CVPIA implemented in the Preferred Alternative include all features of Alternative 1 plus the acquisition of water for instream flow and wildlife refuges. By assumption, (b)(3) water is acquired from willing agricultural sellers who would reduce acreage to provide water for sale, and acquisition is limited to an amount achievable within the limits of the Restoration Fund.

Table IV-113 includes the employment, output, and income effects on all sectors, in each regional economy, of changes initiated in three key sectors: agriculture, recreation, and M&I water use. Table IV-114 shows the impacts of implementation of the Preferred Alternative on individual sectors within each region.

Sacramento River Region

Impacts Due to Changes in Agriculture. Total irrigated land would decline by 400 acres, relative to the Revised No-Action Alternative; 300 acres are rice and 200 are field crops and grains offset by a 100 acre increase in alfalfa. These changes are converted to changes in final demands for crops and for forward-linked sectors, using the procedure described for Alternative 1. The direct impacts are minimal and total regional impacts include a gain of about 10 jobs and losses of $1.2 million in regional output, and $0.4 million in Place-of-Work (POW) income.

TABLE IV-113

REGIONAL ECONOMIC IMPACTS ON ALL SECTORS OF THE PREFERRED ALTERNATIVE

	Impacts on all Sectors					
	Employment (# of jobs)		Output ($MM)		PoW Income ($MM)	
Region and Directly Impact	**Direct**	**Total**	**Direct**	**Total**	**Direct**	**Total**
Sacramento River						
Agriculture						
Reduced Output	0	10	-.6	-1.2	-.1	-.4
Reduced Net Income	20	30	.6	1.6	.3	.9
Increased Income from WS	30	60	1.2	3.0	.6	1.7
Total Agriculture	50	100	1.2	3.4	.8	2.2
Recreation	230	440	7.3	20.8	4.6	12.4
M&I Water Costs	-50	-120	-3.6	-7.8	-1.9	-4.3
TOTAL 1/	220	400	4.9	16.4	3.6	10.3
San Joaquin River						
Agriculture						
Reduced Output	-440	-1,300	-44.3	-94.4	-17.2	-43.3
Reduced Net Income	-50	-90	-1.9	-4.1	-1.0	-2.3
Increased Income from WS	160	280	6.2	13.5	3.4	7.5
Total Agriculture	-330	-1,110	-40	-85.0	-14.8	-38.1
Recreation	50	90	1.7	4.0	1.0	2.3
M&I Water Costs	-80	-160	-5.2	-9.8	-2.7	-5.3
TOTAL 1/	-360	-1,180	-43.5	-90.9	-16.5	-41.1
Tulare Lake						
Agriculture						
Reduced Output	-170	-430	-13.7	-28.3	-6.0	-13.3
Reduced Net Income	-10	-10	-.3	-.5	-.1	-.3
Increased Income from WS	60	100	2.5	5.0	1.3	2.7
Total Agriculture	-120	-340	-11.5	-23.8	-4.8	-10.9
Recreation	0	10	.1	.3	0	.2
M&I Water Costs	0	0	0	0	0	0
TOTAL 1/	-110	-330	-11.3	-23.6	-4.7	-10.8
South & Central Coast						
M&I Water Costs	-300	-690	-22.0	-49.3	-11.8	-27.7
Bay Area						
Agriculture						
Reduced Output	-300	-780	-29.3	-66.0	-9.1	-30.8
Reduced Net Income	0	0	0	0	0	0
Increased Income from WS	0	0	0	0	0	0
Total Agriculture	-300	-780	-29.3	-66.0	-9.1	-30.8
Recreation	0	0	0	0	0	0
M&I Water Costs	-60	-130	-4.7	-10.0	-2.6	-5.7
TOTAL 1/	-370	-920	-34.0	-76.0	-11.7	-36.5
California Total						
Agriculture						
Reduced Output	-910	-2,500	-87.9	-189.9	-32.4	-87.8
Reduced Net Income	-40	-70	-1.6	-3.0	-.8	-1.7
Increased Income from WS	250	440	9.9	21.5	5.3	15.1
Total Agriculture	-700	-2,130	-79.6	-171.4	-27.9	-77.6
Recreation	280	540	9.1	25.1	5.6	14.9
M&I Water Costs	-490	-1,100	-35.5	-76.9	-19.0	-43.0
TOTAL 1/	-920	-2,720	-106.0	-223.4	-41.1	-105.8

Note: (1) May differ from sum of elements because of rounding.

TABLE IV-114

REGIONAL ECONOMIC IMPACTS ON THE PREFERRED ALTERNATIVE, AFFECTED SECTOR

	Employment (# of jobs)		Output ($MM)		PoW Income ($MM)	
Region and Affected Secto	**Direct**	**Total**	**Direct**	**Total**	**Direct**	**Total**
Sacramento River						
Agric., Frst., Fish	0	0	0	.1	0	0
Mining	0	0	0	0	0	0
Construction	0	0	0	.2	0	.1
Manufacturing	0	10	-.7	.2	-.1	.3
TCU	0	10	-.2	.7	-.1	.4
Trade	190	250	5.9	7.8	3.5	4.6
FIRE	-10	20	-.8	2.4	-.5	1.6
Services	40	120	.8	4.3	.9	3.0
Government & Misc.	0	0	-.2	.7	-.1	.3
TOTAL 1/	220	400	4.9	16.4	3.6	10.3
San Joaquin River						
Agric., Frst., Fish	-360	-590	-30.8	-39.1	12.6	-15.5
Mining	0	0	-.1	-.2	0	-.1
Construction	0	-20	0	-1.0	0	-.6
Manufacturing	-70	-100	-12.7	-17.3	-4.2	-5.5
TCU	0	-40	-.3	-4.3	-.2	-1.9
Trade	110	-90	2.7	-4.6	1.8	-2.5
FIRE	0	-110	-1.1	-12.7	-.7	-8.4
Services	-21	-230	-1.0	-10.4	-.5	-6.1
Government & Misc.	0	-10	-.2	-1.3	-.1	-.6
TOTAL 1/	-360	-1,180	-43.5	-90.9	-16.5	-41.1
Tulare Lake						
Agric., Frst., Fish	-170	-250	-13.7	-16.2	-6.0	-6.8
Mining	0	0	0	-.2	0	-.1
Construction	0	0	0	-.3	0	-.2
Manufacturing	10	10	1.1	0	.4	.1
TCU	0	-10	0	-1.0	0	-.5
Trade	50	0	1.2	-.5	.9	-.2
FIRE	0	-20	0	-2.7	0	-1.8
Services	0	-50	0	-2.3	0	-1.3
Government & Misc.	0	0	0	-.3	0	-.1
TOTAL 1/	-110	-330	-11.3	-23.6	-4.7	-10.8
Bay Area						
Agric., Frst., Fish	-300	-350	-29.4	-30.1	-9.2	-9.8
Mining	0	0	0	0	0	0
Construction	0	-10	0	-1.0	0	-.6
Manufacturing	-10	-40	-1.2	-6.8	-.4	-2.4
TCU	0	-30	-.3	-4.1	-.2	-2.2
Trade	-20	-160	-.8	-7.3	-.5	-4.7
FIRE	-10	-100	-1.0	-13.4	-.6	-9.3
Services	-20	-200	-1.2	-11.1	-.7	-7.0
Government & Misc.	0	-10	-.2	-1.3	-.1	-.6
TOTAL 1/	-370	-920	-30.0	-76.0	-11.7	-36.5
South & Central Coast						
Agric., Frst., Fish	0	-10	0	-.4	0	-.2
Mining	0	0	0	-.1	0	0
Construction	0	-10	0	-.7	0	-.4
Manufacturing	-40	-60	-5.6	-9.7	-1.9	-3.4
TCU	-10	-30	-1.5	-4.4	-.8	-2.3
Trade	-100	-200	-3.9	-8.0	-2.3	-4.9
FIRE	-30	-80	-4.7	-11.4	-3.0	-7.5
Services	-120	-270	-5.4	-13.0	-3.3	-8.2
Government & Misc.	-10	-20	-.7	-1.6	-.3	-.7
TOTAL 1/	-300	-690	-22.0	-49.3	-11.8	-27.7
California total						
Agric., Frst., Fish	-830	-1,200	-73.9	-85.8	-27.8	-32.3
Mining	0	0	-.1	-.5	0	-.2
Construction	0	-40	0	-3.3	0	-1.8
Manufacturing	-110	-180	-19.1	-33.6	-6.2	-10.9
TCU	-10	-100	-2.3	-13.1	-1.3	-6.5
Trade	230	-200	5.1	-12.6	3.4	-7.7
FIRE	-50	-290	-7.6	-37.8	-4.8	-25.4
Services	-121	-630	-6.8	-32.5	-3.6	-19.6
Government & Misc.	-10	-40	-1.3	-3.8	-.6	-1.7
TOTAL 1/	-920	-2,720	-106.0	-223.4	-41.1	-105.7

NOTE: (1) May differ from sum of elements because of rounding.

The Preferred Alternative results in lower costs for groundwater pumping, CVP water, and irrigation systems for irrigators. Net farm income increases, leading to direct gains of about 20 jobs, $0.6 million in regional output, and $0.3 million in regional POW income. Total regional impacts include gains of about 30 jobs, $1.6 million in regional output, and $0.9 million in regional POW income.

The Preferred Alternative provides for the sale of water by willing sellers for Level 4 refuge water supplies. Net income of irrigators increases $1.2 million, leading to direct gains of about 30 jobs, $1.2 million in regional output, and $600,000 in POW income. Total regional impacts include gains of about 60 jobs, $3.0 million in output, and $1.7 million in POW income.

Total regional impacts due to the Preferred Alternative changes in agriculture, relative to the Revised No-Action Alternative, include direct gains of about 50 jobs, $1.2 million in output, and $0.8 million in POW income. Total direct, indirect, and induced impacts include a gain of about 100 jobs, $3.4 million in output, and $2.2 million in POW income.

Impacts Due to Changes in Recreation. The Preferred Alternative results in an increase of $7.6 million in recreational spending relative to baseline conditions (Table IV-115), or about a 4 percent increase. The resultant changes in final demands, relative to the Revised No-Action Alternative, cause direct gains in the affected retail and service sectors of about 230 jobs, $7.3 million in output, and $4.6 in POW income. Total impacts include the gain of about 440 jobs, $20.8 million in output, and $12.4 million in POW income. For an analysis of the recreational and other effects of changes in fish harvest, see the commercial fishing scenario included as an attachment to the Fish, Wildlife, and Recreation Technical Appendix.

Impacts Due to Changes in Municipal and Industrial Water Costs. The Preferred Alternative results in reduced personal income of $3.8 million per year because of higher water costs. The resultant decline in consumer spending causes direct losses of about 50 jobs, $3.6 million in output, and $1.9 million in POW income. Total impacts include losses of about 120 jobs, $7.8 million in output and $4.3 million POW income.

Total Impacts. Total direct impacts of the Preferred Alternative, relative to the Revised No-Action Alternative, include a gain of about 220 jobs, $4.9 million in output, and $3.6 million in POW income. Total direct, indirect, and induced impacts include a gain of about 400 jobs, $16.4 million in output, and $10.3 million in POW income. The total direct, indirect, and induced impacts represent 0.03 percent, 0.02 percent, and 0.02 percent of the baseline values of the respective variables. The greatest total regional effects on employment, output, and income are attributable to the direct impacts on recreation.

The largest employment, output and income impacts are in the trade sector. The primary negative impact is caused by higher M&I costs; reduced rice production caused slight reductions in output and income. These are more than offset by increases in output and income.

TABLE IV-115

ANNUAL CHANGES IN REGIONAL RECREATION EXPENDITURES BY SECTOR

	Revised No-Action Alternative	Preferred Alternative
SACRAMENTO RIVER REGION		
Food Stores	30,739	1,138
Service Stations	56,944	2,082
Eating and Drinking Places	33,585	1,409
Hotels and Lodging Places	53,408	1,740
Miscellaneous Retail	32,201	1,192
Total	206,877	7,561
SAN JOAQUIN RIVER REGION		
Food Stores	24,194	2715
Service Stations	38,943	482
Eating and Drinking Places	23,088	454
Hotels and Lodging Places	40,945	247
Miscellaneous Retail	25,054	283
Total	152,204	1,737
TULARE LAKE REGION		
Food Stores	13	21
Service Stations	22	34
Eating and Drinking Places	13	21
Hotels and Lodging Places	23	35
Miscellaneous Retail	14	21
Total	85	132

NOTE:
All values in thousands of dollars.
All values in 1992 dollars

San Joaquin River Region

Impacts Due to Cropping Changes in Agriculture. Total irrigated land declines by 30,600 acres, relative to the revised No-Action Alternative. These changes are converted to changes in final demands for crops and for forward-linked sectors using the procedure described for Alternative 1. Gross revenues from cotton fall $20 million, those for vegetables decline $5.6 million, and those for hay and pasture decline by $1.6 million. Resultant cropping changes cause a direct loss of about 440 jobs to agricultural production and food processing. Total regional impacts include the losses of about 1,300 jobs, $94.4 million in output, and $43.3 million in POW income.

The Preferred Alternative results in higher costs for groundwater pumping, CVP water, and irrigation systems for irrigators. Net farm income declines, leading to direct losses of about 50 jobs, $1.9 million in regional output, and $1.0 million in regional POW income. Total regional impacts include losses of about 90 jobs, $4.1 million in regional output, and $2.3 million in regional POW income.

The Preferred Alternative provides for the sale of water by willing sellers. Net income of irrigators increases $6.4 million, leading to direct gains of about 160 jobs, $6.2 million in output, and $3.4 million in POW income. Total regional impacts include gains of about 280 jobs, $13.5 million in output, and $7.5 million in POW income.

Impacts Due to Changes in Recreation. The Preferred Alternative results in an increase of $1.7 million in recreational spending relative to baseline conditions (Table IV-115), or about a 1 percent increase. The resultant changes in final demands, relative to the Revised No-Action Alternative, cause direct gains in the impacted retail and service sectors of about 50 jobs, $1.7 million in output, and $1 million in POW income. Total impacts include gains of about 90 jobs, $4.0 million in output, and $2.3 million in POW income. For an analysis of the recreational and other effects of changes in fish harvest, see the commercial fishing scenario included as Attachment A to the Fish, Wildlife, and Recreation Technical Appendix.

Impacts Due to Changes in Municipal and Industrial Water Costs. The Preferred Alternative results in reduced personal income of $5.4 million per year because of higher water costs. The resultant decline in consumer spending causes direct losses of about 80 jobs, $5.2 million in output, and $2.7 million in POW income. Total impacts include losses of about 160 jobs, $9.8 million in output and $5.3 million POW income.

Total Impacts. Total direct impacts of the Preferred Alternative, relative to the Revised No-Action Alternative, include losses of about 360 jobs, $43.5 million in output, and $16.5 million in POW income. Total direct, indirect, and induced impacts include losses of about 1,180 jobs, $90.9 million in output, and $41.1 million in POW income. The total direct, indirect, and induced impacts represent 0.1 percent, 0.2 percent, and 0.1 percent of the baseline values of the respective variables.

The largest employment impacts are in agriculture, services, and FIRE. The largest output impacts are in agriculture, manufacturing, and FIRE. The largest income impacts are in FIRE, agriculture, and services.

Tulare Lake Region

Impacts Due to Cropping Changes in Agriculture. Total irrigated land declines, relative to the Revised No-Action Alternative, by 14,000 acres, of which 8,600 are cotton, 2,300 are alfalfa, and 2,300 are grain and other field crops. Gross revenues for cotton decline by about $8 million. Gross revenues for hay and pasture decline by about $1.1 million, and for vegetables about $1.4 million. Resultant cropping changes cause a direct loss of about 170 jobs in agricultural production. Total regional impacts include losses of about 430 jobs, $28.3 million in output, and $13.3 million in POW income.

The Preferred Alternative results in higher costs for groundwater pumping, CVP water, and irrigation systems for irrigators. Net farm income declines, leading to direct losses of about 10 jobs, $300,000 in regional output, and $100,000 in regional POW income. Total regional impacts include losses of about 10 jobs, $500,000 in regional output, and $300,000 in regional POW income.

The Preferred Alternative provides for the sale of water by willing sellers. Net income of irrigators increases by $2.6 million leading to direct gains of 60 jobs, $2.5 million in output, and $1.3 million in POW income. Total regional impacts include gains of about 100 jobs, $50 million in output, and $2.7 million in POW income.

Total regional impacts due to the Preferred Alternative changes in agriculture include direct losses of about 120 jobs, $14.5 million in output, and $4.8 million in POW income. Total direct, indirect, and induced impacts include losses of about 340 jobs, $23.8 million in output, and $10.9 million in POW income.

Impacts Due to Changes in Recreation. The Preferred Alternative causes a 150 percent increase in recreational spending relative to baseline conditions, from $85,000 to $217,000. While the percentage gain is large, the absolute gain is modest compared to the other Central Valley regions. Direct impacts include a small increase in output. Total impacts include a gain of 10 jobs and approximately $300,000 in regional output and $200,000 in POW income. For an analysis of the recreational and other effects of changes in fish harvest, see the commercial fishing scenario included as Attachment A of the Fish, Wildlife, and Recreation Technical Appendix.

Impacts Due to Changes in Municipal and Industrial Water Costs. The Preferred Alternative has no impacts on municipal and industrial water costs in the Tulare Lake Region.

Total Impacts. Total direct impacts of the Preferred Alternative on the Tulare Lake Region, relative to the Revised No-Action Alternative, include direct losses of about 110 jobs, $11.3 million in output, and $4.7 million in POW income. Total direct, indirect, and induced impacts include losses of about 330 jobs, $23.6 million in output, and $10.8 million in POW income. The total direct, indirect, and induced impacts represent 0.07 percent, 0.08 percent, and 0.02 percent of the baseline values of the respective variables.

The largest employment impacts are in agriculture and services. The largest output and income impacts are in agriculture, FIRE, and services. Land fallowing and reduced net farm income cause reduced spending for production inputs and household items, with attendant effects on the trade and services sectors. Other impacts are attributable primarily to those originating in agriculture.

North Coast Region

Regional economic impacts due to the Preferred Alternative for North Coast Region are related to fish, wildlife, and recreational spending. The Preferred Alternative causes no impacts on recreational spending in the North Coast Region relative to the Revised No-Action Alternative.

For an analysis of the recreational and other effects of changes in fish harvest, see the commercial fishing scenario included as Attachment A of the Fish, Wildlife, and Recreation Technical Appendix.

Central and South Coast Region

The Preferred Alternative causes no impacts on recreational spending in the Central Coast Region relative to the Revised No-Action Alternative. For an analysis of the recreational and other effects of changes in fish harvest, see the commercial fishing scenario included as Attachment A of the Fish, Wildlife, and Recreation Technical Appendix.

The Preferred Alternative results in reduced personal income of $22.8 million per year because of higher water costs. The resultant decline in consumer spending causes direct losses of about 300 jobs, $22.0 million in output, and $11.8 million in POW income. Total impacts include losses of about 690 jobs, $49.3 million in output, and $27.7 million POW income.

San Francisco Bay Region

Impacts Due to Cropping Changes. Total irrigated land declines relative to the Revised No-Action Alternative by 8,700 acres of which 4,300 are vegetables, 2,600 are tree and vine crops, and 1,200 acres are field crops. Gross revenues fall by $25.8 million for vegetables, and tree and vine crop gross revenues decrease by approximately $4 million. Resultant cropping changes cause a direct loss of 300 jobs, $29.3 million in output and $9.1 million in POW income. Total regional impacts include losses of 780 jobs, $66 million in output, and 30.8 million in POW income.

Alternative 2 results in higher M&I water costs for the San Francisco Bay Region. The impacts are the same as those for Alternative 1.

Total California Impacts

The total direct impacts of the Preferred Alternative across all affected regions in California, relative to the Revised No-Action Alternative, include losses of about 920 jobs, $106.0 million in output, and $41.1 million in POW income. Total direct, indirect, and induced impacts include losses of about 2,720 jobs, $223.4 million in output, and $105.8 million in POW income. The total direct, indirect, and induced impacts represent 0.02 percent, 0.02 percent, and 0.02 percent of the baseline values of the respective variables.

MUNICIPAL AND INDUSTRIAL WATER USE AND COSTS

The implementation of CVPIA actions, as considered in the PEIS alternatives, could result in changes in municipal water costs due to changes in the availability of CVP and SWP water and, for CVP water service contractors, other costs induced by the CVPIA. The main alternatives considered in the PEIS do not include water transfers from or within the Central Valley as a means to obtain replacement water supplies for municipal and industrial (M&I) use. To evaluate the potential effects of water transfers on municipal water costs, supplemental analyses were conducted. Results of the supplemental analyses are expressed as the difference between the results with transfers and results without transfers. In this manner, the supplemental analysis shows the effect of water transfers on M&I water costs and use for one alternative.

The analysis includes ten groups of M&I providers aggregated into four regions: the Sacramento Valley, the San Joaquin Valley, the San Francisco Bay Area, and the Central and South Coast. The Central and South Coast Region, which includes the Los Angeles and San Diego metropolitan areas, is approximately twice as large in terms of water demand as the other three regions combined. All of the regions, except the Central and South Coast, include M&I users that obtain some CVP contract supplies. All of the regions, except the Sacramento Valley, include M&I users that obtain some SWP supplies, which can also be affected by CVPIA alternatives. All regions obtain some M&I water supplies from other sources that are not expected to be affected by the implementation of CVPIA.

The estimated reductions or increases in M&I water costs are relatively small as compared to the entire M&I water economy of each region. However, some water providers are entirely dependent on CVP contract supplies in all regions except the Central and South Coast Region. Two CVP M&I contractors have been identified with the potential need to implement water meter retrofits under the CVPIA water measurement requirements. Customers of these water providers could experience relatively large cost increases as a result of implementation of CVPIA provisions.

Preferred Alternative

In the Sacramento Valley, M&I water supplies would be reduced by about 5,000 acre-feet on average and 12,000 acre-feet in the dry condition, as compared to the Revised No-Action Alternative. Annual costs of M&I water, due to the imposition of CVPIA provisions, would be $4.2 million in the average condition and an additional $2.8 million annually in the dry condition, as shown in Table IV-116. These increases in costs would result primarily from restoration payments and implementation of metering requirements.

The Bay Area receives M&I water from both CVP and SWP supplies. Under the Preferred Alternative, average CVP supplies and SWP supplies would decrease by 17,000 acre-feet. Some water users in the region are projected to have excess supplies in some years, so some of the supply decrease would have no effect. Annual costs to the Bay Area associated with M&I restoration payments and supply reductions would total approximately $6.0 million in average conditions. These costs would be passed on to customers in the form of higher retail water prices. Under dry conditions, M&I supplies to the Bay Area would decrease by 26,000 acre-feet even with more SWP supplies. Annual dry condition costs over and above the average condition costs are estimated at $37.7 million.

San Joaquin Valley providers also obtain both CVP and SWP supplies, and results reflect a mixture of losses and SWP gains in dry years. The region obtains about 4,000 acre-feet less in average, conditions under the Preferred Alternative. The costs of these supplies are the costs of

TABLE IV-116

SUMMARY OF M&I WATER USE AND ECONOMICS ANALYSIS COMPARISON OF THE PREFERRED ALTERNATIVE

Change from the No-Action Alternative		
Result	**Revised No-Action Alternative**	**Preferred Alternative**
Average Condition Supplies, 1,000 acre-feet (1)		
Sacramento Valley	933	-5
Bay Area	1,025	-17
San Joaquin Valley	708	-4
Central and South Coast	5,929	-31
Average Condition Economic Costs, Million $ (2)		
Sacramento Valley	0.7	4.2
Bay Area	1.5	6.0
San Joaquin Valley	9.1	5.4
Central and South Coast	623.9	25.3
Dry Condition Supplies, 1,000 acre-feet (3)		
Sacramento Valley	992	-12
Bay Area	886	-26
San Joaquin Valley	663	1
Central and South Coast	4,890	72
Annual Additional Cost of Dry Condition, Million $ (4)		
Sacramento Valley	3.1	2.8
Bay Area	177.7	37.7
San Joaquin Valley	8.8	-0.9
Central and South Coast	823.1	-100.1

NOTES:
Water transfers not considered as replacement supplies in this comparison.
(1) After purchase or development of non-transfer replacement supplies to make supply equal demand.
(2) Total costs include replacement supplies, restoration payments and metering. A negative cost means a net gain is estimated.
(3) Before development of any replacement supplies. A positive means the Alternative provides more water supply than the No-Action Alternative.
(4) The annual cost of shortage following the average condition is in addition to average costs.

make-up supplies, primarily groundwater, but CVP contractors would pay more in the form of metering and restoration payments. CVPIA costs amount to $5.4 million annually. During the dry condition, benefits from increased SWP supplies exceed losses from reduced CVP supplies, and net benefits amount to $0.9 million annually.

Municipal water costs in the Central and South Coast Region would be affected only through changes in SWP supplies. Hydrologic analysis (PROSIM) suggests that this region would lose water supply in the average condition. Because this region is projected to be in a substantial average condition supply deficit by the year 2020, the reduction in SWP supplies of 31,000 acre-feet would require an average annual cost of $25.3 million for replacement supplies. During dry conditions a supply increase of 72,000 acre-feet is obtained and annual economic benefits amount to $100 million.

THE DELTA AS A SOURCE OF DRINKING WATER

This section evaluates the Preferred Alternative as compared to the Revised No-Action Alternative with respect to the drinking water quality in the Delta. Water quality results for the Revised Alternative 1 are presented in the Delta as a Source of Drinking Water Technical Appendix. Water quality analyses for the Revised No-Action Alternative and Preferred Alternative were conducted with the DSM2 Delta hydrodynamic and water quality model. DSM2 results are evaluated for average monthly electrical conductivity (EC), bromides, and dissolved organic carbon (DOC) at seven Delta locations critical to drinking water quality.

The DSM2 hydrodynamic model simulates the channel flows, tidal effects, and water quality of the Bay-Delta estuary. DSM2 was used to evaluate the water quality effects of the Preferred Alternative as compared to the Revised No-Action Alternative. For the purposes of the PEIS programmatic analysis, model simulations were conducted for a 15-year historical hydrologic sequence for water years 1976 through 1990. This period was selected to cover a broad range of Delta inflows and exports, and is generally representative of the 69-year historical hydrologic sequence used in the PROSIM and SANJASM water operations planning models. The Delta hydrodynamic simulations were performed with DSM2 using monthly Delta inflow hydrology and exports resulting from the PROSIM and SANJASM water operations models. DSM2 is not intended to provide absolute predictions of future Delta hydrodynamic and water quality conditions; rather, the model is intended to be used as a tool to compare Delta conditions under various alternative conditions.

Simulated average monthly water quality results are presented for the simulation period 1976 through 1990, and for the average of the four critical dry years in that period, as defined by the SWRCB 1995 Water Quality control Plan 40/30/30 index. Figure IV-108 shows the seven locations in the Delta where water quality results are presented.

Revised No-Action Alternative

As in the Draft PEIS No-Action Alternative, water quality conditions in the Revised No-Action Alternative would be governed by the Bay-Delta Plan and Accord and D-1422. In general, water quality conditions would be similar to the recent Delta conditions described under the Draft PEIS No-Action Alternative.

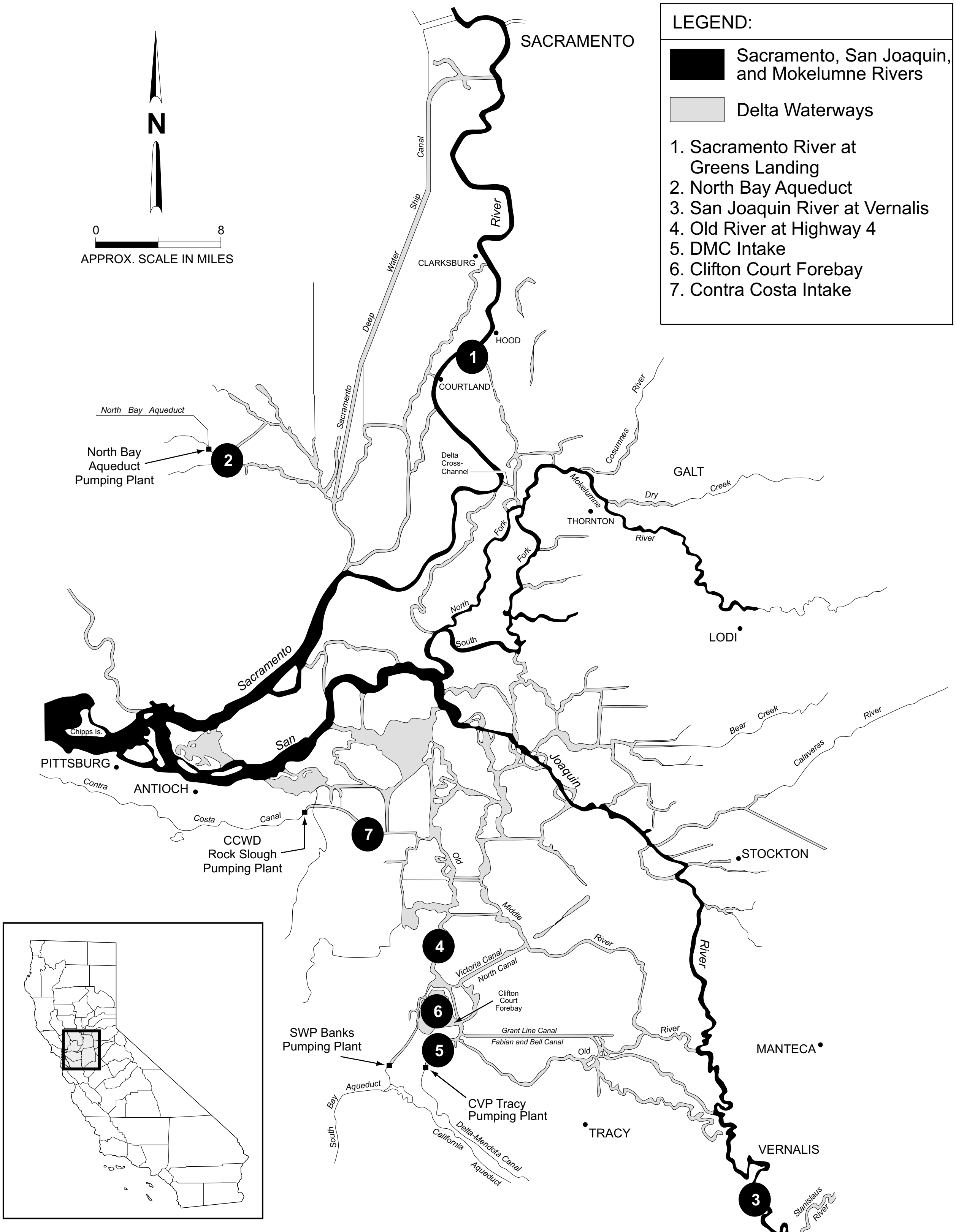


FIGURE IV-108

OUTPUT LOCATIONS FOR SIMULATED AVERAGE MONTHLY WATER QUALITY

Preferred Alternative

Changes in the volume and timing of Delta inflow, outflow, and project exports in the Preferred Alternative affect Delta water quality conditions. As described in the Surface Water Supplies and Facilities Operations section, average annual Delta inflow decreases and average annual Delta outflow increases in the Preferred Alternative as compared to the Revised No-Action Alternative. In general, these increases in outflow occur during April and May when the VAMP export restrictions specified in (b)(2) Water Management are in effect. A discussion of the resulting specific changes in Delta water quality at seven locations critical to drinking water quality is provided below.

The Sacramento River at Greens Landing is used as a baseline for Sacramento River water quality entering the Delta. Table IV-117 shows that for the water quality parameters EC, bromide, and DOC the results of the Preferred Alternative are very similar to the Revised No-Action Alternative and would not change the baseline conditions entering the Delta.

Water quality conditions for the North Bay Aqueduct are shown in Table IV-118. Average monthly EC and bromide levels are very similar to those under the Revised No-Action Alternative for the simulation period and critical dry years. In the Preferred Alternative DOC concentrations generally increase slightly in the fall and decrease during the summer months. The magnitude of the increase is smaller than the relative accuracy of the analytical method for DOC, which is 5 to 10 percent.

EC and bromide concentrations at the Contra Costa Canal Intake at Rock Slough are generally improved in the Preferred Alternative, except in December and January when values increase due to closure of the Cross Channel Gate. Although DSM2 results predict this increase in EC and bromide levels, this increase would not be expected to occur in actual operations. Under proposed b(2) operations, the Cross Channel Gate would be reopened if monitored EC levels at key locations approach target levels as defined in the October 27, 1997 CALFED Operations Group Sacramento River Spring-Run Chinook Salmon Protection Plan. The PROSIM and DSM2 models do not have the ability to incorporate these operational responses triggered by real-time monitoring. Table IV-119 shows the comparison of EC, bromide, and DOC concentrations. Average monthly DOC values generally increase in the months of March through July in the Preferred Alternative, as compared to the Revised No-Action Alternative, and may have a marginal impact on domestic systems served by the supply at Rock Slough.

Water quality values for Old River at Highway 4 are shown in Table IV-120. The general changes in EC, bromides, and DOC in the Preferred Alternative are similar to those described above for the Contra Costa Canal at Rock Slough.

Average monthly EC and bromide levels at the Delta Mendota Canal Intake generally increase from December through July, except in February when values decrease in comparison to the No-Action Alternative. The large increase in December and January would not be expected to occur in actual operations, as described above, since the Cross Channel Gates would be reopened based on EC monitoring. Variations in DOC concentrations due to the Preferred Alternative are smaller

TABLE IV-117

SIMULATED AVERAGE MONTHLY WATER QUALITY SACRAMENTO RIVER AT GREENS LANDING

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	151	151	0	31	31	0	2,121	2,120	-1
Nov	151	151	0	31	31	0	2,304	2,305	1
Dec	151	151	0	30	30	0	2,797	2,797	0
Jan	153	153	0	31	31	0	2,640	2,640	0
Feb	152	152	0	31	31	0	3,591	3,592	1
Mar	151	151	0	31	31	0	2,537	2,536	-1
Apr	151	151	0	30	30	0	2,022	2,022	0
May	151	151	0	31	31	0	2,399	2,399	0
Jun	151	151	0	31	31	0	2,131	2,133	2
Jul	151	151	0	30	31	1	2,506	2,506	0
Aug	151	151	0	30	30	0	2,422	2,422	0
Sep	151	151	0	31	31	0	2,318	2,318	0

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	151	151	0	31	31	0	2,121	2,121	0
Nov	151	151	0	30	30	0	2,299	2,299	0
Dec	151	151	0	30	30	0	2,788	2,788	0
Jan	153	153	0	31	31	0	2,642	2,642	0
Feb	152	151	-1	31	31	0	3,584	3,585	1
Mar	151	151	0	31	31	0	2,551	2,550	-1
Apr	151	151	0	31	31	0	2,035	2,036	1
May	151	151	0	31	31	0	2,397	2,396	-1
Jun	151	151	0	31	31	0	2,141	2,141	0
Jul	151	151	0	31	31	0	2,506	2,509	3
Aug	151	151	0	31	31	0	2,429	2,427	-2
Sep	151	151	0	31	31	0	2,324	2,323	-1

TABLE IV-118

SIMULATED AVERAGE MONTHLY WATER QUALITY NORTH BAY AQUEDUCT

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	190	190	0	65	65	0	4,041	4,048	7
Nov	195	195	0	69	69	0	4,117	4,107	-10
Dec	206	206	0	72	71	-1	4,501	4,464	-37
Jan	248	247	-1	85	84	-1	6,196	6,180	-16
Feb	318	321	3	110	111	1	8,285	8,473	188
Mar	358	360	2	129	129	0	9,086	9,145	59
Apr	354	357	3	135	136	1	8,413	8,511	98
May	283	286	3	109	111	2	6,437	6,560	123
Jun	223	224	1	83	85	2	5,046	5,107	61
Jul	199	199	0	69	70	1	4,513	4,548	35
Aug	193	193	0	63	63	0	4,505	4,526	21
Sep	192	192	0	64	65	1	4,390	4,412	22

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	188	192	4	64	67	3	3,977	4,217	240
Nov	187	191	4	63	67	4	3,755	3,968	213
Dec	190	192	2	61	63	2	3,828	3,966	138
Jan	212	211	-1	65	66	1	4,922	4,919	-3
Feb	253	250	-3	79	78	-1	6,239	6,273	34
Mar	274	273	-1	88	89	1	6,692	6,772	80
Apr	270	269	-1	92	92	0	6,514	6,509	-5
May	243	242	-1	88	88	0	5,736	5,712	-24
Jun	223	218	-5	85	84	-1	5,359	5,222	-137
Jul	211	206	-5	80	78	-2	5,239	5,089	-150
Aug	205	202	-3	74	72	-2	5,280	5,134	-146
Sep	205	202	-3	75	73	-2	5,240	5,097	-143

TABLE IV-119

SIMULATED AVERAGE MONTHLY WATER QUALITY CONTRA COSTA CANAL INTAKE

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	489	474	-15	396	379	-17	3,468	3,456	-12
Nov	522	524	2	420	422	2	3,623	3,622	-1
Dec	463	673	210*	350	605	255*	4,269	4,187	-82
Jan	599	739	140*	457	619	162*	6,422	6,495	73
Feb	656	621	-35	473	429	-44	7,071	6,970	-101
Mar	461	455	-6	266	250	-16	6,537	6,543	6
Apr	336	351	15	167	156	-11	4,955	5,410	455
May	322	352	30	165	155	-10	4,358	5,100	742
Jun	323	327	4	179	158	-21	4,243	4,609	366
Jul	316	314	-2	181	167	-14	4,139	4,405	266
Aug	369	366	-3	256	250	-6	3,921	4,023	102
Sep	456	440	-16	368	349	-19	3,619	3,631	12

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	512	482	-30	425	383	-42	3,386	3,453	67
Nov	539	491	-48	436	375	-61	3,373	3,382	9
Dec	542	708	166*	449	648	199*	3,621	3,603	-18
Jan	798	868	70*	746	825	79*	4,693	4,740	47
Feb	866	722	-144	809	635	-174	4,976	4,947	-29
Mar	597	580	-17	481	423	-58	5,250	5,536	286
Apr	496	462	-34	358	277	-81	4,855	5,412	557
May	460	413	-47	327	239	-88	4,461	5,047	586
Jun	464	423	-41	332	265	-67	4,757	4,925	168
Jul	429	417	-12	305	274	-31	4,541	4,938	397
Aug	521	512	-9	431	418	-13	4,330	4,407	77
Sep	663	603	-60	614	542	-72	3,962	3,918	-44

*NOTE: DSM2 predicted increase would not be expected to occur in actual operations under Sacramento River Spring-Run Chinook Salmon Protection Plan Criteria.

TABLE IV-120

SIMULATED AVERAGE MONTHLY WATER QUALITY OLD RIVER AT HIGHWAY 4

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	466	454	-12	350	334	-16	3,280	3,253	-27
Nov	490	493	3	366	367	1	3,247	3,249	2
Dec	403	601	198*	291	528	237*	3,529	3,528	-1
Jan	479	609	130*	378	530	152*	4,601	4,610	9
Feb	520	497	-23	406	368	-38	5,709	5,697	-12
Mar	364	369	5	223	211	-12	5,319	5,239	-80
Apr	303	330	27	146	144	-2	4,427	4,673	246
May	301	340	39	149	146	-3	3,942	4,232	290
Jun	305	331	26	162	156	-6	3,867	4,175	308
Jul	295	304	9	162	157	-5	3,810	4,076	266
Aug	327	324	-3	217	212	-5	3,615	3,701	86
Sep	420	404	-16	319	303	-16	3,349	3,339	-10

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	491	468	-23	377	342	-35	3,248	3,273	25
Nov	519	481	-38	386	337	-49	3,240	3,219	-21
Dec	496	649	153*	384	567	183*	3,407	3,365	-42
Jan	703	775	72*	649	731	82*	4,143	4,179	36
Feb	797	659	-138	734	578	-156	4,855	4,799	-56
Mar	547	594	47	443	414	-29	4,951	5,069	118
Apr	471	468	-3	322	270	-52	4,514	5,042	528
May	433	410	-23	299	228	-71	4,188	4,723	535
Jun	451	439	-12	309	261	-48	4,425	4,531	106
Jul	400	402	2	273	256	-17	4,214	4,626	412
Aug	457	449	-8	368	357	-11	4,001	4,047	46
Sep	594	540	-54	529	468	-61	3,637	3,564	-73

*NOTE: DSM2 predicted increase would not be expected to occur in actual operations under Sacramento River Spring-Run Chinook Salmon Protection Plan Criteria.

than the relative accuracy of the analytical method for DOC, which is 5 to 10 percent. Water quality values for Delta Mendota Canal Intake are shown in Table IV-121.

Average monthly EC and bromide concentrations at Clifton Court Forebay in the Preferred Alternative increase in April through August and decrease in September through March. Increased values in December and January would not be expected to occur in actual operations since the Cross Channel Gates would be reopened based on EC monitoring, as described above. DOC concentrations increase in April through August but are generally within the accuracy of analytical methods for DOC. Table IV-122 shows a comparison of water quality values for the Preferred Alternative as compared to the Revised No-Action Alternative.

The San Joaquin River at Vernalis is used as a baseline for San Joaquin River water quality entering the Delta. San Joaquin River at Vernalis average monthly EC concentrations for the simulation period and critical dry years increase in November through March and in July through September in the Preferred Alternative. Average monthly bromide concentrations generally decrease in October through May over the simulation period. During critical dry years, bromide values increase in December through March and in July through September. EC and bromide concentrations decrease in April and May under both conditions due to pulse flows associated with VAMP operations. DOC values in the Preferred Alternative are similar to those under the Revised No-Action Alternative. Water quality values for the San Joaquin River at Vernalis are shown in Table IV-123.

MOSQUITOS

Water supplies to the wetlands, including National Wildlife Refuges and Wildlife Management Areas, would be the same under the Revised No-Action Alternative as under the Draft PEIS No-Action Alternative. Water supplies to the wetlands, including National Wildlife Refuges and Wildlife Management Areas, would be the same under the Preferred Alternative as under Alternatives 2, 3, and 4.

As discussed under Alternatives, 2, 3, and 4, the incidence of mosquito breeding habitat is highly dependent on local conditions not considered in the programmatic nature of the PEIS analyses. It is recognized that existing local vector abatement programs are authorized to adapt to changing local mosquito breeding conditions in order to protect public health. Therefore, no changes in public health risks would result from the implementation of the Preferred Alternative. However, because of the potential effect on local conditions, changes in local mosquito breeding conditions will be evaluated as part of site-specific environmental documentation for development of new wetlands and refuge water supplies.

TABLE IV-121

SIMULATED AVERAGE MONTHLY WATER QUALITY DELTA MENDOTA CANAL INTAKE

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	464	447	-17	322	303	-19	3,461	3,420	-41
Nov	479	477	-2	332	325	-7	3,304	3,261	-43
Dec	488	601	113*	268	411	143*	3,625	3,588	-37
Jan	506	595	89*	321	407	86*	4,508	4,515	7
Feb	527	501	-26	318	286	-32	5,549	5,553	4
Mar	411	444	33	212	219	7	4,935	4,909	-26
Apr	449	466	17	181	192	11	4,406	4,424	18
May	424	466	42	187	196	9	3,701	3,560	-141
Jun	428	495	67	195	227	32	4,060	4,233	173
Jul	406	472	66	192	229	37	3,899	4,148	249
Aug	407	416	9	225	233	8	3,788	3,895	107
Sep	413	401	-12	286	273	-13	3,576	3,567	-9

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	481	466	-15	343	317	-26	3,387	3,409	22
Nov	511	478	-33	352	308	-44	3,353	3,333	-20
Dec	599	677	78*	334	448	114*	3,584	3,534	-50
Jan	714	783	69*	505	573	68*	4,341	4,351	10
Feb	874	763	-111	592	485	-107	5,285	5,291	6
Mar	653	772	119	408	437	29	5,106	5,064	-42
Apr	708	731	23	344	344	0	4,500	4,568	68
May	596	643	47	324	305	-19	4,052	3,977	-75
Jun	656	686	30	346	358	12	4,337	4,462	125
Jul	509	563	54	281	313	32	4,310	4,712	402
Aug	496	481	-15	340	335	-5	4,169	4,260	91
Sep	547	501	-46	454	405	-49	3,833	3,754	-79

*NOTE: DSM2 predicted increase would not be expected to occur in actual operations under Sacramento River Spring-Run Chinook Salmon Protection Plan Criteria.

TABLE IV-122

SIMULATED AVERAGE MONTHLY WATER QUALITY CLIFTON COURT FOREBAY

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	451	435	-16	314	297	-17	3,498	3,477	-21
Nov	481	478	-3	339	333	-6	3,382	3,388	6
Dec	406	551	145*	265	441	176*	3,558	3,533	-25
Jan	441	571	130*	320	464	144*	4,584	4,584	0
Feb	497	472	-25	373	335	-38	5,534	5,532	-2
Mar	379	356	-23	230	205	-25	5,226	5,182	-44
Apr	335	357	22	156	161	5	4,588	4,753	165
May	336	378	42	155	160	5	4,109	4,287	178
Jun	328	367	39	161	165	4	4,183	4,364	181
Jul	310	347	37	157	168	11	4,036	4,307	271
Aug	323	331	8	185	189	4	3,918	4,052	134
Sep	395	381	-14	271	258	-13	3,648	3,639	-9

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	466	441	-25	333	301	-32	3,434	3,517	83
Nov	508	476	-32	357	323	-34	3,425	3,555	130
Dec	490	601	111*	342	476	134*	3,488	3,459	-29
Jan	615	719	104*	523	637	114*	4,293	4,320	27
Feb	799	669	-130	696	557	-139	5,052	5,052	0
Mar	624	553	-71	483	402	-81	5,390	5,403	13
Apr	517	564	47	337	323	-14	4,834	5,208	374
May	493	497	4	308	263	-45	4,635	5,131	496
Jun	467	466	-1	296	256	-40	4,737	4,936	199
Jul	419	461	42	261	266	5	4,570	5,012	442
Aug	426	430	4	287	293	6	4,542	4,688	146
Sep	528	483	-45	429	385	-44	4,079	3,933	-146

*NOTE: DSM2 predicted increase would not be expected to occur in actual operations under Sacramento River Spring-Run Chinook Salmon Protection Plan Criteria.

TABLE IV-123

SIMULATED AVERAGE MONTHLY WATER QUALITY SAN JOAQUIN RIVER AT VERNALIS

SIMULATION PERIOD AVERAGE (WATER YEARS 1976-1990)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	735	674	-61	335	294	-41	3,716	3,714	-2
Nov	616	674	58	294	293	-1	2,906	2,907	1
Dec	683	707	24	281	313	32	3,703	3,703	0
Jan	597	608	11	277	260	-17	4,199	4,199	0
Feb	518	524	6	234	218	-16	5,797	5,796	-1
Mar	487	512	25	208	214	6	4,596	4,596	0
Apr	539	477	-62	212	189	-23	4,308	4,306	-2
May	580	488	-92	235	197	-38	3,149	3,136	-13
Jun	634	607	-27	263	262	-1	4,125	4,114	-11
Jul	707	771	64	298	353	55	3,585	3,613	28
Aug	750	828	78	328	382	54	3,550	3,575	25
Sep	783	820	37	348	375	27	4,261	4,265	4

CRITICAL DRY YEAR AVERAGE (WATER YEARS 1976, 1977, 1988, 1990; per 40/30/30 Index)

	Electrical Conductivity (EC) (microsiemens/cm)			Bromides (micrograms/liter)			Dissolved Organic Carbon (DOC) (micrograms/liter)		
	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference	Revised No-Action Alternative	Preferred Alternative	Difference
Oct	811	771	-40	393	346	-47	3,713	3,712	-1
Nov	711	763	52	340	341	1	2,905	2,905	0
Dec	867	856	-11	355	390	35	3,702	3,702	0
Jan	902	908	6	405	417	12	4,200	4,200	0
Feb	865	899	34	402	413	11	5,795	5,795	0
Mar	827	889	62	383	407	24	4,591	4,590	-1
Apr	807	718	-89	369	317	-52	4,315	4,313	-2
May	848	733	-115	377	327	-50	3,173	3,154	-19
Jun	876	854	-22	400	397	-3	4,203	4,193	-10
Jul	1,006	1,056	50	447	511	64	3,740	3,767	27
Aug	1,024	1,119	95	486	541	55	3,658	3,693	35
Sep	1,042	1,060	18	494	505	11	4,298	4,302	4

SOCIAL CONDITIONS

Revised No-Action Alternative

Conditions under the Revised No-Action Alternative will be similar in nature to those discussed under the Draft PEIS No-Action Alternative. However, the extent of unemployment and the need for social services may be greater in the Revised No-Action Alternative than under the Draft PEIS No-Action Alternative due to the reduced reliability in CVP water supplies. The specific conditions are not known at this time because it is difficult to project how individual farming operations and communities will respond to the reduction in CVP water supplies.

Preferred Alternative

In the Sacramento River Region the total number of jobs gained includes approximately 100 jobs in the agricultural sector and 440 jobs in the recreation sector. In the San Joaquin River Region, approximately 1,110 jobs would be lost in the agricultural sector and 90 would be gained in the recreation sector. The Tulare Lake Region would experience losses of 340 jobs in the agricultural sector and a gain of 10 jobs in the recreation sector. These changes in employment represent less than one percent of the total jobs in each region. The projected reduction in agricultural jobs includes not only direct farm labor inputs but also related and secondary declines in manufacturing, service, construction, and retail employment opportunities throughout the region.

In the Sacramento Valley job losses in the agricultural sector would be concentrated on the west side where CVP water service contractors are located. Recreation employment losses would occur at CVP reservoir facilities and could affect sport fishing and river recreation activities.

In the San Joaquin River and Tulare Lake regions agriculture job losses would occur mainly on the west side due to reductions in irrigated agricultural acreage. This would affect the areas near the communities of Mendota, Firebaugh, Huron, and Coalinga the greatest. Because these areas already are experiencing high levels of unemployment and the labor force is primarily farm workers, the social and economic structure of these communities could be affected further when compared to Revised No-Action Alternative. Examples may include higher demand for social services, loss of community-specific fire and police protection services in favor of less expensive area-wide services merged with one or more other communities, increased crime such as shoplifting, and loss of local small businesses such that customers may have to travel further to purchase supplies.

In the San Francisco Bay Region there will be a loss of 780 jobs from the agriculture sector and a total of 920 jobs in the region. Given the size of the employment base for the region, employment losses would not create an increase the need for social services.

In the South Coast and Central Coast regions, jobs would decrease by 690 jobs. While this would be a negative impact on the regions, the changes would be very small, given the size and large population of the affected areas.

The responses to the loss of agricultural jobs would be similar to those described under Alternative 1.

Changes in recreation or commercial fishing employment and the projected need for social services would be similar to those described under Alternative 1.

The Hoopa Valley and Yurok tribes would benefit from the provision of increased flows in the Trinity River similar to the effects described under Alternative 1.

CULTURAL RESOURCES

Impact Mechanisms Related to Reservoir Operations

Sacramento River Region

Shasta Lake. Under the Preferred Alternative, the high water level would be the same as under the Revised No-Action Alternative and the low water level would be 51 feet lower than under the Revised No-Action Alternative. This could expose portions of the old town of Shasta , inundated when the lake was first filled, and exposed only briefly since that time. Cultural resources could be exposed to vandalism and erosion during periods when the reservoir is drawn down to these levels.

Under the Preferred Alternative, the annual visitor use days for Shasta Lake would decrease by 4 percent from the annual use estimated for the Revised No-Action Alternative. This amount of change would not likely have an impact on cultural resources.

Lake Oroville. Under the Preferred Alternative, the high water level would remain constant and the low water level would be 3 feet higher than under the Revised No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under the Preferred Alternative, annual visitor use days at Lake Oroville would increase by 1 percent. This increase in recreational use would not have an impact on cultural resources.

Folsom Lake. Under the Preferred Alternative, the high water and low water levels at Folsom Lake would be the same as under the Revised No-Action Alternative. Since there is no change, there would not be an impact on cultural resources.

Under the Preferred Alternative, annual visitor use days at Folsom Lake would decrease 4 percent from the annual use estimated for the Revised No-Action Alternative. This amount of change would not have an impact on cultural resources.

San Joaquin River Region

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne and the Merced. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. For more information, see the discussion under Analysis Methodologies.

Millerton Lake. Under the Preferred Alternative, the high and low water levels at Millerton Lake would remain the same as under the Revised No-Action Alternative. No impact on cultural resources would occur.

Under the Preferred Alternative, annual visitor use days at Millerton Lake would remain the same as estimated for the Revised No-Action Alternative. No impact on cultural resources would occur.

New Melones Reservoir. Under the Preferred Alternative, New Melones Reservoir's high water level would remain the same as under the Revised No-Action Alternative. The low water level would be 58 feet higher than under the Revised No-Action Alternative. No impacts on cultural resources would occur.

Under the Preferred Alternative, annual visitor use days at New Melones Reservoir are expected to decrease 1 percent from the annual use estimated for the Revised No-Action Alternative. This small change would not have an impact on cultural resources.

San Luis Reservoir. Under the Preferred Alternative, the high and low water levels at San Luis Reservoir would remain the same as under the Revised No-Action Alternative. No impact on cultural resources would occur.

Under the Preferred Alternative, annual visitor use days at San Luis Reservoir are expected to decrease 2 percent from the annual use estimated for the Revised No-Action Alternative. This amount of change in recreational use would not have an impact on cultural resources.

Non-CVP and Non-SWP Reservoirs. Under the Preferred Alternative, the high and low water levels would remain the same as levels under the Revised No-Action Alternative.

Impact Mechanisms Related to Streamflow Changes

Sacramento River Region

The conditions under the Preferred Alternative are similar to those described under Alternative 1.

Sacramento-San Joaquin Delta Region

The conditions under the Preferred Alternative are similar to those described under Alternative 1.

San Joaquin River Region

San Joaquin River. Under the Preferred Alternative, the annual number of visitors to the San Joaquin River will increase by 3 percent compared with the Revised No-Action Alternative. This amount of change will not have an impact on cultural resources.

Stanislaus River. Under the Preferred Alternative, the annual number of visitors to the Stanislaus River will decrease by 7 percent compared with the Revised No-Action Alternative. This amount of change could result in a beneficial impact on cultural resources from a decreased potential for vandalism.

Impact Mechanisms Related to Land Use Changes

Sacramento River Region

Under the Preferred Alternative, conditions would be similar to those described under Alternative 1.

Sacramento-San Joaquin Delta Region

Under the Preferred Alternative, approximately 100 acres of agricultural land would be fallowed as compared to the Revised No-Action Alternative. No land in this region would be retired. This amount of change could result in a very minimal benefit to cultural resources.

San Joaquin River Region

Under the Preferred Alternative, approximately 30,600 acres of agricultural land would be fallowed and an additional 14,400 acres would be retired in the San Joaquin River Region. Orchard acreage would be reduced by 200 acres and rice production would be reduced by 100 acres. The fallowing of 30,600 acres could provide a substantial benefit to cultural resources because resources located on these acres would be relieved from the impacts that result from ongoing agricultural practices. Minimal benefits would also occur from the reduction in orchards and rice under production because cultivation of these crops has a high potential to disturb cultural resources.

Tulare Lake Region

Under the Preferred Alternative, approximately 13,900 acres of agricultural land would be fallowed and an additional 15,600 acres would be retired in the Tulare Lake Region. Land in production for orchards would decrease by 200 acres and no rice would be produced. The fallowing of 13,900 acres could provide a benefit to cultural resources because resources located on these acres would be relieved from the impact that results from ongoing agricultural practices.

Impact Mechanisms Related to Terrestrial Habitat Restoration

Sacramento River Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento River Region under the Preferred Alternative and no land would be retired. No impacts on cultural resources would occur.

Sacramento-San Joaquin Delta Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento-San Joaquin Delta Region under the Preferred Alternative and no land would be retired. No impacts on cultural resources would occur.

San Joaquin River Region

Under the Preferred Alternative, approximately 18,800 acres of the land fallowed in the San Joaquin River Region would be restored, and all 14,400 acres proposed for retirement would be reseeded as annual grasslands.

Conservation easements would be acquired on 15 percent of the fallowed lands, and the management of these lands would include vegetation and wildlife objectives. This type of restoration would involve little or no land reshaping and thus would have no more impacts on cultural resources than current farming practices.

Tulare Lake Region

Under the Preferred Alternative, none of the land fallowed in the Tulare Lake Region would be restored, but approximately 15,600 acres of retired land would be reseeded as annual grasslands. As described for the San Joaquin River Region, this restoration would have a very low probability of affecting cultural resources.

Impact Mechanisms Related to Increased Water Deliveries to Refuges

Under the Preferred Alternative, all refuges would receive Level 4 water resulting in the delivery of more water than under the Revised No-Action Alternative. Deliveries to the Sacramento River Region refuges would increase 40 percent, deliveries to the San Joaquin River refuges would increase 120 percent, and deliveries to the Tulare Lake Region refuges would increase 113 percent. Reduced deliveries to refuges would occur during dry years. Deliveries to refuges would be reduced by the same percentage as reductions for other users receiving water from the same sources.

Cultural resources in the areas receiving additional water could be flooded or subjected to increased erosion. Under the Preferred Alternative, Level 4 water would be supplied to the refuges and recreational use would increase over the Revised No-Action Alternative.

Recreational use in the Sacramento River Region would increase by an estimated 63 percent, by an estimated 66 percent in the San Joaquin River Region, and by an estimated 150 percent in the Tulare Lake Region. This additional visitation would increase the potential for sites to be vandalized.

Impact Mechanisms Related to Anadromous Fisheries Habitat Restoration

Some of the projects currently proposed to improve anadromous fisheries habitat under the Preferred Alternative include considerable ground disturbance and are likely to affect cultural resources. Many of the projects are proposed to occur in areas that have a high probability of containing cultural resources. These projects would occur in all study regions except the Tulare Lake Region. Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities. Tables III-2, III-3, and III-4 in the Draft PEIS Fisheries Technical Appendix show the fisheries restoration activities that would occur under the Preferred Alternative.

INDIAN TRUST ASSETS

There would be no change to conditions under the Revised No-Action Alternative as compared to the Draft PEIS No-Action Alternative. Implementation of the Preferred Alternative would be the same as described under Alternatives 1, 2, 3, and 4, and would not result in adverse impacts to Indian Trust Assets. Increased flows associated with the Preferred Alternative would be within the normal floodplain of affected rivers, and would not negatively affect Indian Trust Assets located adjacent to rivers. Increases in fishery resources in Central Valley rivers and in the Trinity River could be beneficial to ITAs associated with fishing rights.

AIR QUALITY

As described under the Agricultural Economics and Land Use impact assessment, agricultural land use conditions would not change in the Revised No-Action Alternative as compared to the Draft PEIS No-Action Alternative and in the Preferred Alternative as compared to the Revised No-Action Alternative. As presented in the description of impacts associated with Agricultural Economics and Land Use, the total changes in land use under Preferred Alternative would be small in each region in the Central Valley as compared to the Revised No-Action Alternative.

It is assumed that current policies and practices of regulatory agencies would continue at the present level of intensity. This would include the continuation of air quality monitoring and air quality compliance programs. Because the cultivated and fallowed acreage patterns for the entire Sacramento and San Joaquin valleys would be similar to historical patterns, it is anticipated that air quality under the Revised No-Action Alternative would be similar to recent conditions described in the Affected Environment.

Changes to agricultural land uses resulting from the reduction of water supplies due to changes in CVP operations would be made consistent with existing land management practices. Lands fallowed due to the acquisition of water would be planted with a cover crop and irrigated during the first year of fallowed conditions to establish wind erosion controls, and would not result in increased potential for elevated PM_{10} concentrations. Specific actions to reduce air quality impacts due to land fallowing associated with the acquisition of water from willing sellers will be addressed in site-specific environmental documentation.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and application of pesticides and fertilizers. However, because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under the Preferred Alternative as compared to the Revised No-Action Alternative.

SOILS

Revised No-Action Alternative

Conditions under the Revised No-Action Alternative would be similar to those described under the Draft PEIS No-Action Alternative.

Preferred Alternative

Erosion Potential Due to Changes in Cropping Patterns

It is assumed that the lands to be retired or fallowed will have a cover crop planted in the last year of cultivation. Given these cultivation measures and the relatively minor changes in land use, it is anticipated that the level of erosion potential will not increase under the Preferred Alternative as compared to the Revised No-Action Alternative.

Erosion Potential Due to Changes in Streamflows

Under the Preferred Alternative, increased river releases would be in accordance with target flows which include flow ramping limitations to protect aquatic species and prevent siltation due to bank erosion. In addition, the flow pattern will not result in release oscillations on a month-to-month basis, so potential for sloughing will not be increased. Continued application of streamflow considerations in reservoir operations will apply under the Preferred Alternative and will not result in additional streambed erosion relative to the Revised No-Action Alternative.

This increase in flow under the Preferred Alternative could increase erosion potential if the habitat restoration activities identified in the Preferred Alternative were not implemented. However, with full implementation of the Preferred Alternative, including the habitat restoration activities and increased flows, erosion potential would not increase as compared to the Revised No-Action Alternative. Land subsidence, due to groundwater level declines, will occur along the west side of the San Joaquin Valley as described under the Groundwater impact assessment.

VISUAL RESOURCES

Revised No-Action Alternative

Conditions under the Revised No-Action Alternative would be similar to those described under the Draft PEIS No-Action Alternative.

Preferred Alternative

Under the Preferred Alternative, irrigated acreage would be reduced by a small amount in the Central Valley as compared to the Revised No-Action Alternative. Therefore, it is anticipated that the general cultivated and fallowed acreage patterns would be similar to historical patterns, and that agricultural viewsheds under the Preferred Alternative would be similar to those under the Revised No-Action Alternative.

The Preferred Alternative would reduce the end-of-month storage volumes in September in several CVP reservoirs in dry years. This would increase the occurrence of the “bathtub ring” effect at those lakes, particularly during the summer months when they experience substantial use. However, the lower levels would expose more of the natural canyons for viewing. Therefore, it is difficult to determine whether this effect is an adverse or beneficial impact.

CHAPTER V

CUMULATIVE EFFECTS

Chapter V

CUMULATIVE EFFECTS

Cumulative effects are defined as the incremental impact upon the environment from this program when added to other past, present, and reasonably foreseeable future actions undertaken by the same or other agencies or persons. The PEIS alternatives, including the No-Action Alternative, are limited to those actions clearly addressed by the CVPIA and the environmental consequences of closely related actions. However, it is recognized that the provisions of the CVPIA may be implemented in an interactive manner with other concurrent and subsequent projects. The non-CVPIA actions implemented concurrently with CVPIA may affect the overall conditions in the study area and the results of implementation of the CVPIA, and may have impacts different from those associated with implementation of CVPIA in isolation, as summarized in Table V-1.

Other actions that may contribute to cumulative effects include the following, which are described below:

- implementation of the Bay-Delta Plan Accord,
- Conformed Place of Use EIR for CVP Water Supplies,
- recommendations for increased instream flows in the Trinity River,
- implementation of the Sacramento and San Joaquin River Basins Comprehensive Study,
- implementation of the Sacramento Area Water Forum Proposal (American River),
- changes in non-CVPIA water transfer actions,
- changes in federal farm programs,
- changes in demand for agricultural products,
- changes to the commercial and recreational harvest actions for commercial fishing,
- implementation of Yield Increase Plan,
- creation of additional wetlands, and
- additional listings of special-status species.

In addition, this cumulative analysis addresses potential impacts from CVPIA projects that may occur during preparation of or following the completion of the PEIS. These actions include early implementation of CVPIA provisions, Least-Cost Yield Increase Plan, development of additional wetlands, and contract renewals.

A summary of the potential effects of these actions and how they may influence the effects of implementing the alternatives considered in the PEIS is presented in Table V-1.

TABLE V-1

SUMMARY OF CUMULATIVE EFFECTS

Action	Potential Results	Effects of Cumulative Actions on Results of Impacts of PEIS Alternatives
Implementation of the Bay-Delta Plan Acord	Changes in Delta inflow and associated instream releases.	Changes in instream and Delta flows may influence methodology for reoperation, (b)(2) water, or water acquisition for instream or Delta flows.
	Restoration of habitat in streams and actions to improve water quality.	Programs that could lead to partnerships with CVPIA actions or eliminate need for specific AFRP actions to be implemented under CVPIA.
	Development of new storage and/or Delta conveyance facilities.	Water delivery shortages may not be as severe as identified in PEIS.
	Unknown cumulative effects on CPVIA water requirements.	May lead to partnerships with CVPIA actions or eliminate the need for specific AFRP actions to be implemented under CVPIA.
Place of Use EIR for CVP Water Supplies	Permitting or cessation of CVP water service areas currently served with CVP water but outside of authorized Place of Use.	No anticipated change.
Trinity River Studies	Changes in instream flow requirements for Trinity River.	Could change (b)(2) water management and CVP water reliability.
Sacramento and San Joaquin River Basins Comprehensive Study	Develop a program to provide offstream storage, channel modifications, and other actions to reduce flood potential and improve habitat.	Could change channel cross-sections; instream flows; and offstream storage. Habitat improvements could be integrated with CVPIA actions.
Sacramento Water Forum Proposal	Changes in water demands and flow requirements on American River.	Could change (b)(2) and (b)(3) water management and CVP water reliability.
Changes in Water Transfer Actions	More extensive non-CVPIA water transfers than assumed in Base Transfer Scenario for alternatives with CVPIA transfers.	Competition for water from water rights holders would reduce available water supplies for transfers under CVPIA water acquisition programs or increase cost of water beyond assumptions for PEIS. Both of these impacts could reduce the amount of water acquired by Interior or increase the price of water purchased by Interior.
Changes in Federal Farm Programs	If lands fallowed or retired due to CVPIA actions continue to accumulate support payments, the net revenue to farmers may increase and the revenue to the Federal Treasury may not increase.	Farmers may decide to increase participation in water transfer programs, including water acquisition programs by Interior. The price of water also may be reduced, which could lead to an opportunity for higher purchases by Interior.

TABLE V-1. CONTINUED.

Action	Potential Results	Effects of Cumulative Actions on Results of Impacts of PEIS Alternatives
Changes in Demand for Agricultural Products	If changes in demand increase crop value, the price of water would increase and/or farmers would be less willing to sell water. If changes in demand decrease crop value, the price of water could decrease and/or farmers would be more willing to sell water. Changes in demand may cause farmers to change cropping patterns.	Increases in price or reduction in willing sellers would improve the ability of Interior to acquire water. Decreases in price or an increase in willing sellers would improve the ability of Interior to acquire water. Changes in cropping patterns could change the impacts of water shortages, especially if the ratio of permanent to annual crops changes.
Changes in Future Use of Hatcheries	Changes in use of hatcheries could occur based upon future studies. Changes in harvest limitations could occur in the future.	Whether changes in hatchery operations increase fish populations may depend upon habitat, hatchery practices, and other factors such as predation. Use of hatcheries also could reduce natural stock and the overall population through competition or reduction in genetic diversity. Changes in harvest limitations may increase fish population. However, the impact of domestic harvest may not be noticeable if larger numbers of fish are lost to international harvest, ocean conditions, or predation.
Yield Increase Plan	Development of facilities and programs to increase CVP water supplies could reduce impact of shortages from CVPIA actions.	Associated programs may increase the amount of water available for use by Interior for fish and wildlife purposes or may result in adverse impacts to fish and wildlife habitat due to new storage or conveyance facilities. The programs also may compete for the same sources of water that the PEIS identified as sources for the water acquisition program.
Additional Wetlands	Improve reliability of water supplies to private wetlands and develop new wetlands. A portion of the new wetlands proposal is considered in the PEIS alternatives.	For the new wetlands, water supplies would probably be obtained with the land. Water obtained from other sources could be acquired for multiple purposes or water available for transfers may be reduced.
Future Listings under ESA of Special-Status Species	Initiation of consultation with the Service and NMFS.	Possible additional measures (flow and non-flow) to avoid a jeopardy determination. However, measures being taken under the AFRP, (b)(1) “other” program, and the Conservation Program may suffice to avoid substantial additional requirements.

IMPLEMENTATION OF BAY-DELTA PLAN ACCORD

As a follow-up to adoption of the 1995 Water Quality Control Plan for the San Francisco/ Sacramento-San Joaquin Delta Estuary, the State Water Resources Control Board (SWRCB) is evaluating alternatives for implementing that plan. As described below, the evaluation is proceeding along three separate but complementary tracks: (1) the SWRCB water rights process, (2) the CalFed EIR/EIS process, and (3) Category III funding.

SWRCB WATER RIGHTS PROCESS

The purpose of the SWRCB water rights process for Delta water quality and quantity is to develop a methodology to provide adequate flows to meet the Bay-Delta Plan Accord. The SWRCB process is evaluating several alternatives that would require different agencies, including the CVP and SWP, to release water in a manner to protect Delta quality.

This process may increase the amount of water provided by other water rights holders to meet Bay-Delta water quality standards, but it is anticipated that the impacts to the CVP water supply would not be more severe than the impacts presented in the PEIS. Consequently, operations of upstream projects may change. Because the outcome is not complete, a conservative assumption was used in modeling for the EIR being prepared by the SWRCB for the project. It was assumed that the Bay-Delta Accord criteria would be the long-term plan for the Delta. If instream flows provided by the other water rights holders increase, some portion of the CalFed Ecosystem Restoration Program environmental flows could be satisfied by this water rights process, which may reduce the amount of water that the program needs to acquire from willing sellers. It may also reduce the amount of water that the program needs to develop or may allow for the developed water to be used more effectively in meeting program objectives. Any additional demand on water right holders could decrease the amount of water available for transfer.

The SWRCB water rights process is being developed to improve the ecosystem and water quality and possibly implement many of the same programs identified by the AFRP under CVPIA. Therefore, actions implemented under CVPIA could serve as all or part of the Federal share of any state actions. It also is possible that under the SWRCB process, water rights holders may release water in a new pattern that would partially or fully meet the target flows suggested by the AFRP. Therefore, the CVPIA water acquisitions may not need to be as extensive as estimated in this PEIS.

CALFED EIS/EIR PROCESS

The CalFed Bay-Delta Program (Program) is a cooperative effort of 15 State and Federal agencies with regulatory and management responsibilities in the San Francisco Bay/San Joaquin River Bay-Delta to develop a long-term plan to restore ecosystem health and improve water management for beneficial users of the Bay-Delta system. The objective of this collaborative planning process is to identify comprehensive solutions to the problems of ecosystem quality, water supply reliability, water quality, and Delta levee and channel integrity. Implementation of the long-term plan will follow the approval of a Final Programmatic EIS/EIR, and subsequent environmental review for project-specific aspects of the Program will be required.

The CalFed Program issued a Draft Programmatic EIS/EIR in March 1998. Following identification of a CalFed Preferred Program Alternative, CalFed decided to prepare a new Draft Programmatic EIS/EIR.

The CalFed Preferred Program Alternative consists of a set of broadly described programmatic actions that set the long-term, overall direction of the Program. For example, the CalFed Program is evaluating several water storage options that include groundwater banking, offstream surface water storage, and conjunctive use. However, detail at a greater level of specificity than is available in the programmatic description of the CalFed Preferred Program Alternative is important to understanding how this large, complex program may be implemented, funded, and governed in the future. Accordingly, the CalFed agencies have described proposed actions for the first years following a Record of Decision/Certification of the Final EIS/EIR, as well as setting out a long-term implementation strategy.

The potential near-term actions and the long-term implementation strategy share two characteristics: they are designed to achieve multiple benefits by emphasizing actions that serve several purposes, and they will be implemented in ways that increase knowledge so that CalFed can adapt subsequent actions to increase their effectiveness. As appropriate, the near- and long-term actions will be subject to subsequent alternative analysis, environmental review, and permitting decisions before these actions are implemented. Together, the description of the CalFed Preferred Program Alternative, the near-term actions, and the long-term implementation strategy make up the CalFed Program Decision.

The Program currently consists of multiple actions that are diverse, geographically dispersed, and generally described. These actions will be carried out over the course of many years. In addition, there is some uncertainty regarding the eventual outcome of Program actions. Consequently, the Program will be implemented in stages, using the information gained by adaptive management to modify and refine Program actions over time, within the framework of the CalFed Preferred Program Alternative.

The CalFed Preferred Program Alternative will not, in itself, enact any changes in law, regulation, or policy, or allow project construction. Instead, the Preferred Program Alternative describes programmatic actions that set the long-term, overall direction of the Program. Any subsequent actions or facility construction stemming from the programmatic actions in the Preferred Program Alternative must be developed in compliance with NEPA, CEQA, and other applicable laws and regulatory processes.

The CalFed Bay-Delta Program is being developed to improve the ecosystem and water quality and possibly implement many of the same programs identified by the AFRP under CVPIA. Therefore, actions implemented under CVPIA could serve as all or part of the Federal share of CalFed actions. It is also possible that, under the CalFed process, water rights holders may release water in a new pattern that would partially or fully meet instream flows evaluated in the

PEIS. Therefore, the CVPIA water acquisitions may not need to be as extensive as estimated in this PEIS.

CalFed also could develop more reliable water supplies, and thereby reduce the impacts of CVPIA actions on CVP contractors through the construction of new storage and conveyance facilities.

CATEGORY III

The Bay-Delta Plan Accord included a commitment to develop and fund nonflow-related restoration activities to improve the health of the Bay-Delta ecosystem. This funding source and commitment is commonly referred to as "Category III." The Category III Steering Committee was formed to administer previous rounds of Category III funding. In 1996, the administration function for Category III funds was shifted to CalFed's Restoration Coordination Program.

Actions funded under the CalFed Restoration Coordination Program are selected for their benefits to the long-term program, regardless of the final configuration of the CalFed Preferred Program Alternative. These actions must be consistent with any alternative configuration and provide early implementation benefits. This implementation also provides valuable information that can be used to adaptively manage the system. Actions funded through the CalFed Restoration Coordination Program must have appropriate environmental documentation, result in no potentially significant cumulative impacts, and must not limit the choice of a reasonable range of alternatives. As the CalFed long-term program becomes more developed, the priorities and project selection process have been revised to ensure consistency with the Strategic Plan for Ecosystem Restoration (Strategic Plan), and the Ecosystem Restoration Program objectives.

To date, the CalFed Restoration Coordination Program has received more than 800 proposals and has funded 195 projects, for a total of approximately $228 million. Types of projects funded have included fish screens, fish ladders, land acquisition, habitat restoration, and focused research and monitoring that are designed to provide information to improve future restoration efforts. Funding sources include contributions from the California Urban Water Agencies, Proposition 204 State bond funds and funding from the Federal Bay-Delta Act, and Federal EPA watershed funds. The CalFed Restoration Coordination Program also has the responsibility of improving coordination among fish and wildlife restoration programs in the Central Valley to ensure that Category III programs and projects are well integrated with other restoration programs, and are consistent with the long-term CalFed Ecosystem Restoration Program and the Strategic Plan. These programs will be integrated with CVPIA actions through evaluation of site-specific programs at the local level.

CONFORMED PLACE OF USE EIR FOR CVP WATER SUPPLIES

Some existing CVP service areas that may be out of the SWRCB Authorized Place of Use have been served with CVP water. This process considered the impacts of expanding the SWRCB designated place of use for CVP water to include these areas. The SWRCB is preparing the EIR as part of the approval process. The modeling for the PEIS assumes that the process will be completed by 2025, to include lands currently receiving CVP water. If it is not completed and approved, water would need to be used within the existing Authorized Place of Use. This may marginally increase the reliability of CVP deliveries and thereby marginally increase the overall reliability of the program.

TRINITY RIVER STUDIES

In October 1984, the U.S. Fish and Wildlife Service (USFWS) began a 12-year study to describe the effectiveness of increased flows and other habitat restoration activities to restore fishery populations in the Trinity River. An EIS/EIR is being prepared under a concurrent program to evaluate alternatives to restore and maintain natural production of anadromous fish in the Trinity River mainstem downstream of Lewiston Dam. Historically, an average annual quantity of approximately 1.3 million acre feet of water have been diverted from the Trinity River to the Sacramento River system (1964-1992). A change in the Trinity River flow requirements and a corresponding change in the amount of water diverted to the Sacramento River system could affect future flows to the Delta. Changes also could affect overall water supply reliability and carryover storage in Shasta Reservoir, and water quality and temperature in the Sacramento River.

The analysis in Chapter IV assumed for the No-Action Alternative a Trinity River minimum flow requirement of 340,000 acre-feet/year, and assumed for the PEIS alternatives minimum flow requirements of 390,000 acre-feet/year in critical dry years to 750,000 acre-feet/year in extremely wet years, which represented an initial flow recommendation in the draft Trinity River Flow Evaluation. That initial Trinity River flow recommendation has since been refined in the Trinity Flow Evaluation to 362,000 acre-feet/year in critical dry years to 815,000 acre-feet/year in extremely wet years. However, a Record of Decision has not yet been signed establishing the flow requirements for the Trinity River, so this PEIS must make assumptions about Trinity River flows for the purposes of analysis. To provide a broad range to the analysis in this PEIS, the Cumulative Effects Analysis assumed the final flow in the Flow Evaluation (which is also the Preferred Alternative in the Trinity River Flow draft EIR/EIS). This allows for comparison of the effects of Preferred Alternative assuming Trinity River flows of 390,000 - 750,000 acre-feet/year as presented in Chapter IV, and the Preferred Alternative assuming Trinity River flows of 362,000 - 815,000 acre-feet/year as presented in the Cumulative Effects Analysis.

SACRAMENTO AND SAN JOAQUIN RIVER BASINS COMPREHENSIVE STUDY

In response to extensive flooding and damages in 1997, the U.S. Congress authorized the U.S. Army Corps of Engineers (Corps) to provide a comprehensive analysis of the Sacramento River and San Joaquin River basin flood management systems, and to partner with the State of California to develop master plans for flood management into the next century. The Corps and the California Reclamation Board are leading a Comprehensive Study to improve flood management by combining traditional engineering flood damage reduction measures with measures that include a broader set of floodplain management concepts. The Comprehensive Study is examining policy issues that affect flood management and is seeking opportunities to integrate environmental restoration with flood damage reduction measures.

The Comprehensive Study will develop and begin to implement master plans within a watershed framework that will increase flood protection and improve the ecosystem or major rivers and tributaries in the Central Valley. Because this study is the first system-wide evaluation of the flood management systems in the Central Valley, it represents a change in how projects are identified, selected, and implemented.

SACRAMENTO AREA WATER FORUM PROPOSAL

The Sacramento Area Water Forum (Water Forum), a diverse group of water managers, business and agricultural leaders, environmentalists, citizen groups, and local governments, was formed in September 1993 to evaluate water resources and future water supply needs of the Sacramento metropolitan region. During its early activities, the Water Forum defined its goals and mission, which are embodied in coequal objectives: (1) to provide a reliable and safe water supply for the region's economic health and planned development through the year 2030; and (2) to preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River.

The Water Forum has formulated a Water Forum Proposal (WFP) for the effective long-term management of water resources in the Sacramento area, including parts of Sacramento, Placer, and El Dorado counties.

Many aspects of the WFP will reduce the overall amounts of new diversions from the Lower American River, especially in drier years. Purveyors signing the Water Forum Agreement would agree to reduce their diversions on the Lower American River in drier years to specified levels, and to institute programs including water conservation measures and increased conjunctive use. In addition, because these reductions will not eliminate increased diversions to supply future needs, the WFP includes funding commitments for an interagency Habitat Management Program to provide habitat restoration and other benefits to the Lower American River ecosystem. All this was developed in order to avoid adverse environmental impacts.

Implementation of the WFP will require the involvement and approval of not only the Water Forum stakeholders, but also numerous State and Federal agencies. These agencies will be subject to various regulatory standards including requirements of environmental review. It is anticipated that the Water Forum Successor Effort, funded pursuant to the Water Forum Agreement, will participate with Reclamation and other agencies in environmental documentation for any activities it may take associated with the Water Forum. The Successor Effort will also monitor and coordinate implementation of the Water Forum Agreement by stakeholders and regulatory agencies.

NON-CVPIA WATER TRANSFERS

The use of water transfers to allow water trades between willing sellers and buyers is expected by many experts to be used increasingly in the future. Transfers provide an opportunity to increase or replace water supplies to support future demands. The success of the 1991 Drought Water Bank demonstrated the potential for transfers to ameliorate severe localized shortages. Currently, the DWR is proposing a Supplemental Water Purchase Program to allow water transfers by SWP contractors over a 6-year program. The Draft EIR for the Supplemental Water Purchase Program indicated that there was approximately 200,000 acre-feet of water available for a short-term water transfer program. The report also identified several potential adverse impacts associated with water transfers, including reduced Delta inflow during certain time periods, entrainment losses of some fish due to diversions at new locations, losses of fish due to changes in flow patterns that may raise temperatures or dewater or flood spawning areas, reduced reservoir levels and associated recreation actions, and reduced irrigated acreage and wetlands due to changes in use of water. These same types of issues could occur under long-term transfers.

The PEIS evaluated transfers with respect to use of water for fish and wildlife purposes under the Water Acquisition Program and the opportunities for water transfers to agricultural and municipal users. Each of the transfer analyses assumes a well-functioning water transfer market. Future conditions could potentially increase demands for transfers beyond what has been assumed in the PEIS. This could lead to greater competition for the water, which would increase the cost of water to all purchasers including Interior.

CHANGES IN FEDERAL FARM PROGRAMS

The 1996 Farm Bill revised the way commodity payments are determined, and decoupled the size of the payment from the actual production level. There remains, however, some uncertainty about how the U.S. Department of Agriculture (USDA) will handle lands that are part of a grower's base acreage, yet are retired or fallowed as CVPIA is implemented. For purposes of the PEIS analysis, it was assumed that USDA would remove such lands from the grower's base acreage and reduce the deficiency payment accordingly. The estimates of changes in farm commodity payments are based on that assumption.

If, instead, growers who retire or fallow their land as part of CVPIA implementation continue to receive program payments associated with that land, then no savings would accrue to the Federal treasury. However, net revenues to the farmers would increase. This may lead to greater participation in the water transfer market, which may lead to a lower cost for water. Either or both of these impacts could increase the amount of water purchased by Interior for water acquisitions. Because the 1996 Farm Bill extends for only a limited number of years, great uncertainty remains about interactions between CVPIA and Federal commodity programs.

CHANGING DEMAND FOR AGRICULTURAL PRODUCTS

The PEIS analysis used real 1992 prices and costs, and did not attempt to estimate differential increases in prices and costs in the future. However, some evidence exists that demands for farm produce, especially fruits and vegetables grown in California, will increase in the future and cause their price to increase faster than the overall inflation rate. If this occurs, then the cost associated with acreage reductions estimated in this study are understated. Higher value for crops would increase the cost of water or reduce the willingness of sellers to participate in the transfer market. This would decrease the opportunities for Interior to acquire water for fish and wildlife purposes.

Another view is that increasing competition from expanding production regions, especially in Central and South America, will hold future price increases to below the level of inflation. Lower value for crops would decrease the cost of water or increase the willingness of sellers to participate in the transfer market. This would increase the opportunities for Interior to acquire water for fish and wildlife purposes.

Changes in demand could change the ratio of permanent to annual crops. If more permanent crops were planted, the effects of changes in water availability on an annual basis could become more significant.

FISHERIES ISSUES

Although artificial production of many species of game fish, including West Coast anadromous fish, has become an essential tool in fishery management, the CVPIA by necessity focused on the natural production of anadromous fish in the Central Valley rivers and streams. Therefore, the PEIS does not attempt to evaluate in detail either the positive or negative benefits of hatchery production of fish. The analysis recognizes that there are numerous Federal, State, and local fish hatcheries and rearing facilities that appear to be making successful and substantial contributions to the management of anadromous fish species. Most of these programs are well founded and funded annually by their respective agencies. Associated with the physical facilities that contribute to sustaining fish populations, the Coleman National Fish Hatchery is undergoing a major rehabilitation to improve water quality and production facilities. The CVPIA evaluated the alternatives that would provide the most acceptable and balanced method to sustain on a long-term basis the anadromous fish populations using natural production methods. At a future time, it may be possible to evaluate the impact of artificially produced anadromous fish and how to accomplish the balance of resource use and doubling of native populations, as discussed in the CVPIA.

The same holds true for an accurate analysis of the impacts on salmon that spend over two-thirds of their life cycle in the ocean. During this stage of their lives, they are not available for intensive scientific study. Certainly, both sport and commercial harvests play a major role in resolving year-class success. However, until the physical loss to harvest can be adequately equated with natural phenomena of the sea (such as temperature changes, upwelling, current changes and food availability), there is no exact method to assign negative or positive benefits. The NMFS has made good advances in resolving some of these issues and will continue to address these concerns.

YIELD INCREASE PLAN

As part of the CVPIA, the Least-Cost Yield Increase Plan was completed to describe possible actions to increase CVP yield. The yield increase options considered in the plan ranged from purchase of water supplies, land fallowing, conjunctive use, water conservation, urban wastewater reuse, to offstream storage. New facilities, water reuse, and conjunctive use methods could reduce the shortages that are projected under the PEIS alternatives. The PEIS identified land fallowing and water conservation as measures to provide additional water supplies for fish and wildlife purposes. Implementation of water purchases for both purposes could cause conflicts, or could be implemented in a way that would benefit both programs. For example, if acquired water purchased to increase instream flows were diverted downstream of the critical reaches and stored in an offstream storage facility, both purposes would benefit. In addition, the cost to both users would be less.

ADDITIONAL WETLANDS

Another section of CVPIA, Section 3406(d)(6), requires investigations addressing water needs and supplies. Part A addresses alternative means of improving the reliability and quality of water supplies currently available to privately owned wetlands in the Central Valley and the need, if any, for additional supplies; part B of this Section requires investigations of water supply and delivery requirements necessary for full habitat development of water dependent wildlife on 120,000 acres of new wetlands. To date, about 50,000 acres have been protected and much has been restored toward the goal, including additions to existing refuges and San Joaquin Basin Action Plan lands. It is likely that future wetland development would occur by fee acquisition or easement with willing landowners, in areas where water is currently available through water rights or contract. Water supply to those areas would likely result from converting one type of land use to wetland and associated habitat. If additional water purchase is necessary for these lands, future studies may determine that available water be transferred from other users.

ADDITIONAL LISTINGS OF SPECIAL-STATUS SPECIES

There is a high probability that new special-status species will be listed, and possibly de-listed. As the listings occur, Reclamation and the Service will follow the requirements under the Endangered Species Act and conduct consultation as required. Additional conservation actions are anticipated under the Conservation Program, AFRP, and the (b)(1) "other" program which will aid in ecosystem restoration and improve the status of special-status species, so the need for future listings may be reduced.

CONTRACT RENEWALS

The Draft PEIS No-Action Alternative and other alternatives assume that all renewable CVP contracts would be renewed. It is further assumed that the contract renewal process would include the completion of a needs analysis to identify and quantify beneficial uses/demands and a biological assessment of lands that would receive CVP water. Either of these analyses could limit the amount of water that could be delivered. In addition, the lack of diversion facilities could limit the amount of water that could be delivered. It was not feasible to complete more detailed analyses during the preparation of this PEIS. Therefore, for the purposes of the PEIS, the maximum amount of water delivered under the contracts was assumed to be limited by the maximum historical delivery amount up to the maximum contract amount, the maximum amount that had been considered in a previous environmental document up to the maximum contract amount, or the maximum amount that could be diverted with existing facilities, as described in Chapter II and summarized in Table V-2.

It is recognized that as beneficial use needs analyses and biological assessments are completed, the contract amounts may be modified. If these analyses lead to renewal of contracts at the existing contract amounts, the amounts to be delivered by the CVP would be different from those analyzed in the PEIS alternatives. To evaluate this condition on deliveries by the CVP, a Cumulative Effects Analysis was completed based upon the Preferred Alternative. The analysis includes the full contract amounts for all existing CVP contractors and proposed contract amounts for new contracts provided for under Section 206 of PL101-514 per 3404(b) of CVPIA. This information will be used in the subsequent long-term contract renewal process.

IMPACT ASSESSMENT

The conditions for the Cumulative Effects Analysis were evaluated for surface water operations, groundwater resources, and agricultural economics.

Surface Water Operations

In the Cumulative Effects Analysis, the operations of the CVP and SWP are in accordance with all operational criteria described in the Preferred Alternative, plus:

- Utilization of CVP contracts at the full CVP contract allocation; and

- Increased Trinity River instream fishery flows as developed by the Service for the Trinity River Mainstem Fishery Restoration EIS/EIR (Trinity River EIS/R) Flow Evaluation Study Alternative. As explained above in the "Trinity River Flow Studies," the flow recommendation assumed in this Cumulative Effects Analysis differs from the flow recommendation assumed in other PEIS alternatives. The annual instream fishery flow releases specified in the Flow Evaluation Study Alternative range from 362,000 acre-feet in critical dry years to 815,000 acre-feet in extremely wet years. The water year type index for these flow requirements is based on the annual inflow to Clair Engle Lake.

Table V-2 shows a comparison of CVP contract amounts between the No-Action Alternative, Preferred Alternative, and the Cumulative Effects Analysis. As shown in the table, the increase to full CVP contract amounts only affects contractors located north of the Delta.

TABLE V-2

CVP CONTRACT AMOUNTS IN THE REVISED-NO ACTION ALTERNATIVE, THE PREFERRED ALTERNATIVE, AND THE CUMULATIVE EFFECTS ANALYSIS

	Total Contract Amounts (in 1,000 acre-feet)			
CVP Water Users	Revised No-Action Alternative (RNA)	Preferred Alternative (PA)	Cumulative Effects Analysis (CEA)	Calculated Change in Contract Amounts (CEA - PA)
North of the Delta				
Agricultural Water Service Contractors	420	420	510	90
Sacramento Water Rights Contractors	2,070	2,070	2,300	130
Municipal River Water Rights	550	550	570	20
Municipal Water Service Contractors	270	270	540	270
Refuge Water Supplies	90	190	190	0
South of the Delta				
Agricultural Water Service Contractors	1,980	1,980	1,980	0
San Joaquin River Exchange Contractors	880	880	880	0
Municipal Water Service Contractors	140	140	140	0
Refuge Water Supplies	160	290	290	0
CVP Contracts on the Stanislaus River	160	160	160	0
Friant Division				
Madera Canal Contractors	490	490	490	0
Friant-Kern Canal Contractors	1,450	1,450	1,450	0

CVP Operations and Deliveries

CVP Operations. The integrated operations of CVP facilities are balanced in response to meeting full contract amounts and assuming increased Trinity River instream fishery flows consistent with the recommendations of the Flow Evaluation Study and the Preferred Alternative in the Trinity River Draft EIR/EIS. For the discussion of CVP operations, the dry period is defined as 1929 through 1934, the wet period as 1967 through 1971, and the long-term average period as 1922 through 1990.

The major change specific to Trinity River Division operations in the Cumulative Effects Analysis is the incorporation of the Flow Evaluation Study minimum fishery flows developed by the Service for the Trinity River EIR/EIS of 362,000 acre-feet/year in critical dry years to 815,000 acre-feet/year in extremely wet years. As explained above in “Trinity River Studies,” the flow recommendation assumed in this Cumulative Effects Analysis differs from the flow recommendation assumed in the analysis in Chapter IV. The long-term average annual minimum Trinity River fishery flow in the Cumulative Effects Analysis is 600,000 acre-feet, which is about 60,000 acre-feet or 18 percent greater than in the Preferred Alternative. The increase in Trinity River instream fishery flows reduce average annual end-of-water year storage in Clair Engle Lake by 80,000 acre-feet or 6 percent during the long-term period, 50,000 acre-feet or 8 percent during the dry period, and 50,000 acre-feet or 3 percent during the wet period. A comparison of end-of-water year Clair Engle Lake storage is presented in the frequency distributions shown in Figure V-1. Long-term average annual diversions from the Trinity River Basin to the Sacramento River are reduced by approximately the same amount that the instream flows are increased, as compared to the Preferred Alternative.

In comparison to the Preferred Alternative, end-of-water year storage in Shasta Lake decreases in some years in the Cumulative Effects Analysis. The reduction in average annual diversions from the Trinity River Basin and the increase to full CVP contract amounts often necessitate increased releases from Shasta Lake to meet 1995 Winter-Run Biological Opinion temperature requirements, downstream water rights and water service contracts, minimum navigational flow requirements, Delta water quality requirements, and implementation of CVPIA. These additional releases from Shasta Lake often reduce storage in following years, unless the lake refills or subsequent releases are reduced.

A comparison of Shasta Lake end-of-water year storage is shown in the frequency distributions for the Cumulative Effects Analysis and the Preferred Alternative in Figure V-1. The average reduction in Shasta Lake end-of-water year storage is about 70,000 acre-feet or 3 percent during the long-term average period and 100,000 acre-feet or 3 percent during the wet period. During the dry period, it is not possible to maintain the same minimum storage in Shasta Lake while still meeting the minimum instream flows, Delta water quality requirements, and minimum CVP delivery requirements. The minimum dry period storage is approximately 460,000 acre-feet, which is 80,000 acre-feet less than the minimum storage in the Preferred Alternative of 540,000 acre-feet. Storage levels appreciably less than the historical minimum of about 560,000 acre-feet experienced in 1977 may result in infeasible operations.

These Shasta Lake storage reductions reduce the ability of the CVP to maintain a cold water pool for releases to comply with 1995 Winter-Run Biological Opinion temperature requirements. The 1995 Winter-Run Biological Opinion requires a minimum end-of-water year storage of 1.9 million acre-feet in Shasta Lake to maintain a cold water pool for Sacramento River temperature control, except in the 10 percent driest years when Reclamation would reconsult with NMFS to determine appropriate operations criteria. In the Cumulative Effects Analysis, end-of-water year

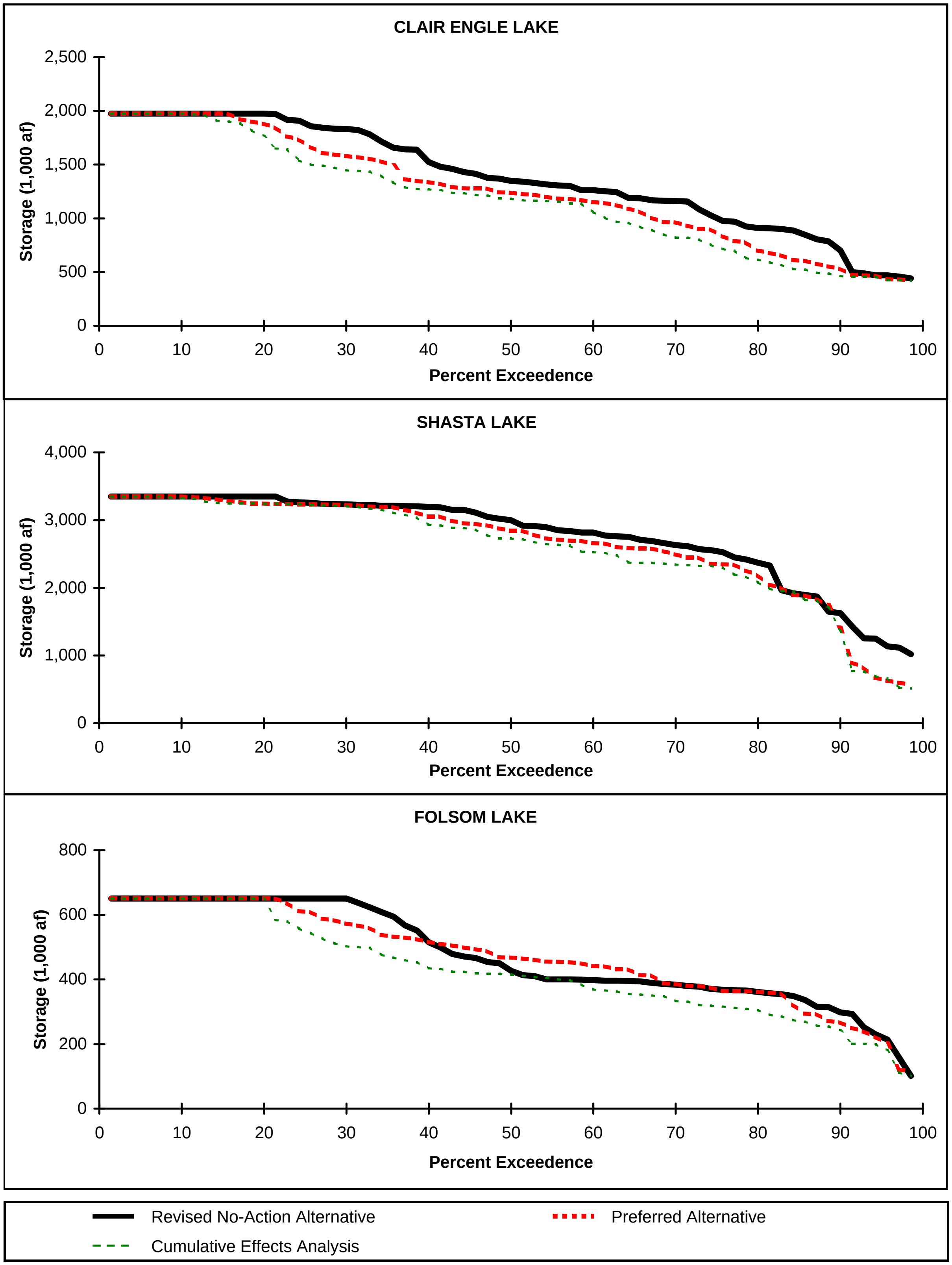


FIGURE V-1
TRINITY, SHASTA, AND AMERICAN RIVER DIVISIONS
SIMULATED FREQUENCY OF END-OF-WATER YEAR STORAGE
WATER YEARS 1922-1990

storage in Shasta Lake is below 1.9 million acre-feet in 10 years or 14 percent of the years in the simulation period, as compared to the Preferred Alternative where storage is below 1.9 million acre-feet in 9 years or 13 percent of the time. Storage levels in these 10 percent driest years are considerably lower than in the Preferred Alternative, which further reduces the CVP's ability to meet the temperature requirements in the Cumulative Effects Analysis.

The percentage of months in compliance with the 1995 Winter-Run Biological Opinion temperature requirements in the Cumulative Effects Analysis and the Preferred Alternative are presented in Table V-3. The models do not account for all operational variables that affect temperature operations and therefore may underrepresent temperature impacts. Overall, the frequency of temperature compliance is similar in the Cumulative Effects Analysis to conditions in the Preferred Alternative. River water temperatures are generally warmer during non-compliance periods in the Cumulative Effects Analysis.

TABLE V-3

COMPARISON OF SIMULATED MONTHS MEETING THE 1995 WINTER-RUN BIOLOGICAL OPINION IN THE REVISED NO-ACTION ALTERNATIVE, THE PREFERRED ALTERNATIVE, AND THE CUMULATIVE EFFECTS ANALYSIS, 1922 - 1990

	Percent of Months Meeting Temperature Requirements						
Simulation	Apr	May	Jun	Jul	Aug	Sep	Oct
Revised No-Action Alternative	93	87	87	78	81	71	91
Preferred Alternative	99	78	81	68	75	71	94
Cumulative Effects Analysis	99	80	77	70	75	67	94

NOTES:
1995 Winter-Run Biological Opinion temperature requirements in effect April through October. Based on Sacramento River Index, target locations are between Bend Bridge and Jelly's Ferry.

In the Cumulative Effects Analysis, Folsom Lake and American River operations are directly affected by changes in operations due to the increase to full CVP contract amounts on the American River and the changes to Trinity, Shasta, and Sacramento River Division operations described above.

Average reductions in end-of-water year storage in Folsom Lake are about 40,000 acre-feet or 9 percent during the long-term average period and similar during the dry and wet periods. End-of-water year storage differences in Folsom Lake are presented in the frequency distributions shown in Figure V-1. In three extremely critical dry years, it is not possible to meet all of the minimum instream flow, delivery, and reservoir storage requirements on the American River in the Cumulative Effects Analysis. Therefore, additional delivery reductions were imposed on CVP contract deliveries to agricultural and M&I water service contractors, and reductions of up to 25 percent are imposed on American River water rights holders to maintain a minimum Folsom Lake storage of 90,000 acre-feet.

Comparisons of simulated average monthly flows in the American River below Nimbus during the dry, wet, and long-term average periods are presented in Figure V-2. In comparison to the Preferred Alternative, simulated average monthly flows during the summer months are reduced in all three periods due to the full contract amounts above Nimbus Dam.

In the Delta Division, Delta inflows and outflows decrease due to reductions in diversions from the Trinity River Basin and the increase to full CVP contract amounts. In comparison to the Preferred Alternative, average annual Delta inflow decreases by approximately 160,000 acre-feet or 1 percent during the long-term average period, 250,000 acre-feet or 1 percent during the wet period, and is similar during the dry period. Average annual exports through Tracy Pumping Plant are reduced slightly during the long-term average, dry, and wet periods. Average annual Delta outflow decreases by approximately 140,000 acre-feet during the long-term average period, 230,000 acre-feet during the wet period, and is similar during the dry period.

Operations in the Eastside and West San Joaquin Divisions are similar to those in the Preferred Alternative. The frequency distribution for New Melones Reservoir storage is shown in Figure V-3.

CVP Water Contract Deliveries. The increase to full CVP contract amounts affects contract amounts for contractors located north of the Delta as shown in Table V-2. The increase in contract amounts and reduction in diversions from the Trinity River Basin result in additional and more frequent reductions in deliveries to agricultural water service contractors in drier years as compared to the Preferred Alternative. Overall though, total CVP average annual deliveries increase due to greater deliveries to Sacramento water rights and M&I water service contractors. Frequency distributions of the simulated annual deliveries to CVP agricultural water service and M&I water service contractors north and south of the Delta are presented in Figures V-4 and V-5. Average annual deliveries to CVP contractors in the Cumulative Effects Analysis, as compared to the Revised No-Action Alternative and the Preferred Alternative are provided in Table V-4.

CVP Water Deliveries North of the Delta. In comparison to the Preferred Alternative, simulated annual deliveries to CVP agricultural water service contractors north of the Delta are greater in wetter years due to the increase to full contract amounts and less in drier years due to the increase to full contract amounts for other contractors that are subject to smaller deficiencies. However, full annual deliveries occur with a similar frequency of 55 percent in both simulations. In both the Preferred Alternative and the Cumulative Effects Analysis, the minimum annual delivery in the driest years is zero acre-feet. This minimum level occurs more frequently in the Cumulative Effects Analysis as shown Figure V-4, where zero deliveries occur in 10 percent of the years as compared to about 8 percent in the Preferred Alternative.

In comparison to the Preferred Alternative, simulated annual deliveries to CVP M&I water service contractors north of the Delta are greater due to the increase to full contract amounts. The frequency of full contract deliveries is reduced to about 65 percent of the years in the

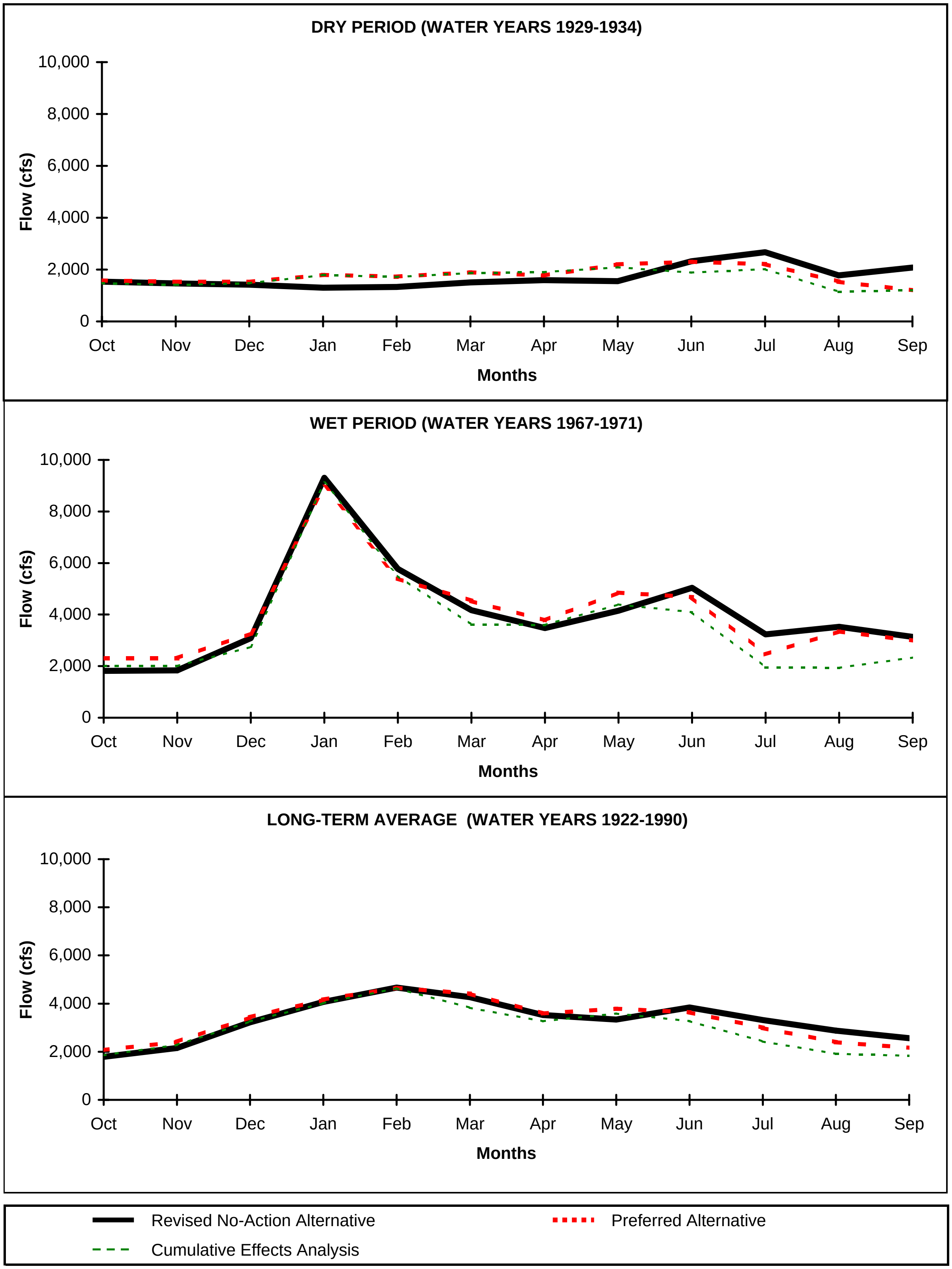
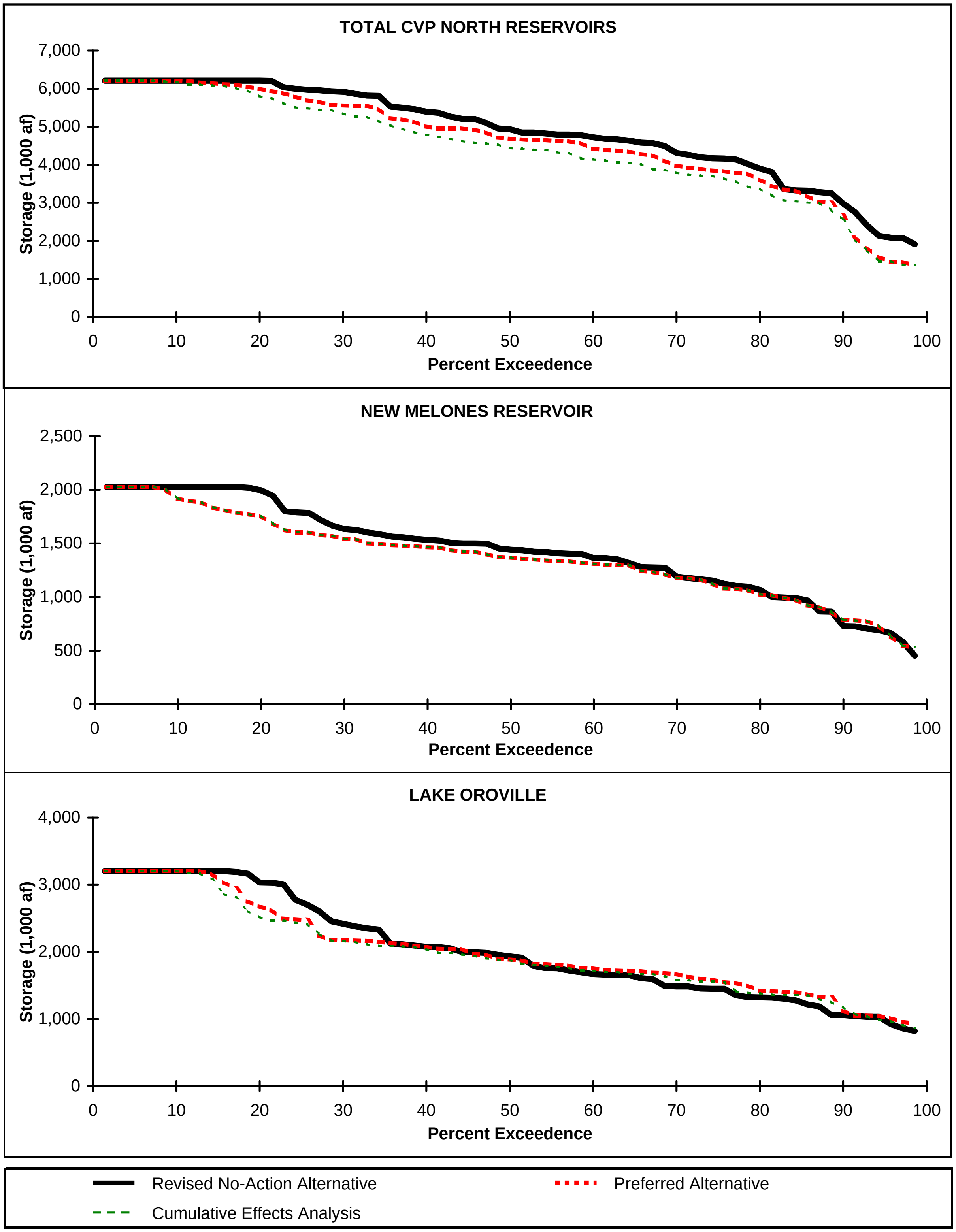
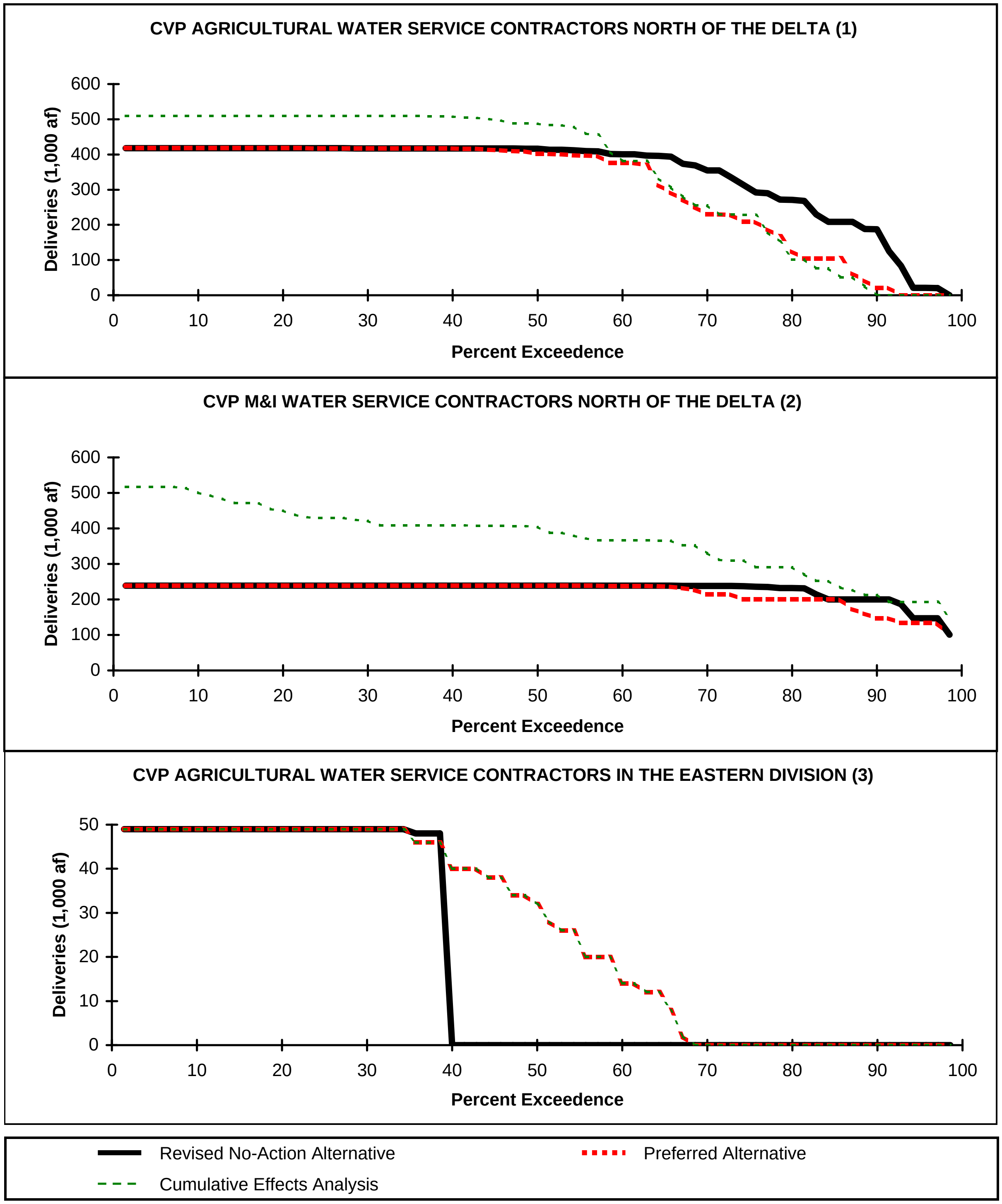


FIGURE V-2
AMERICAN RIVER BELOW NIMBUS
SIMULATED AVERAGE MONTHLY FLOWS



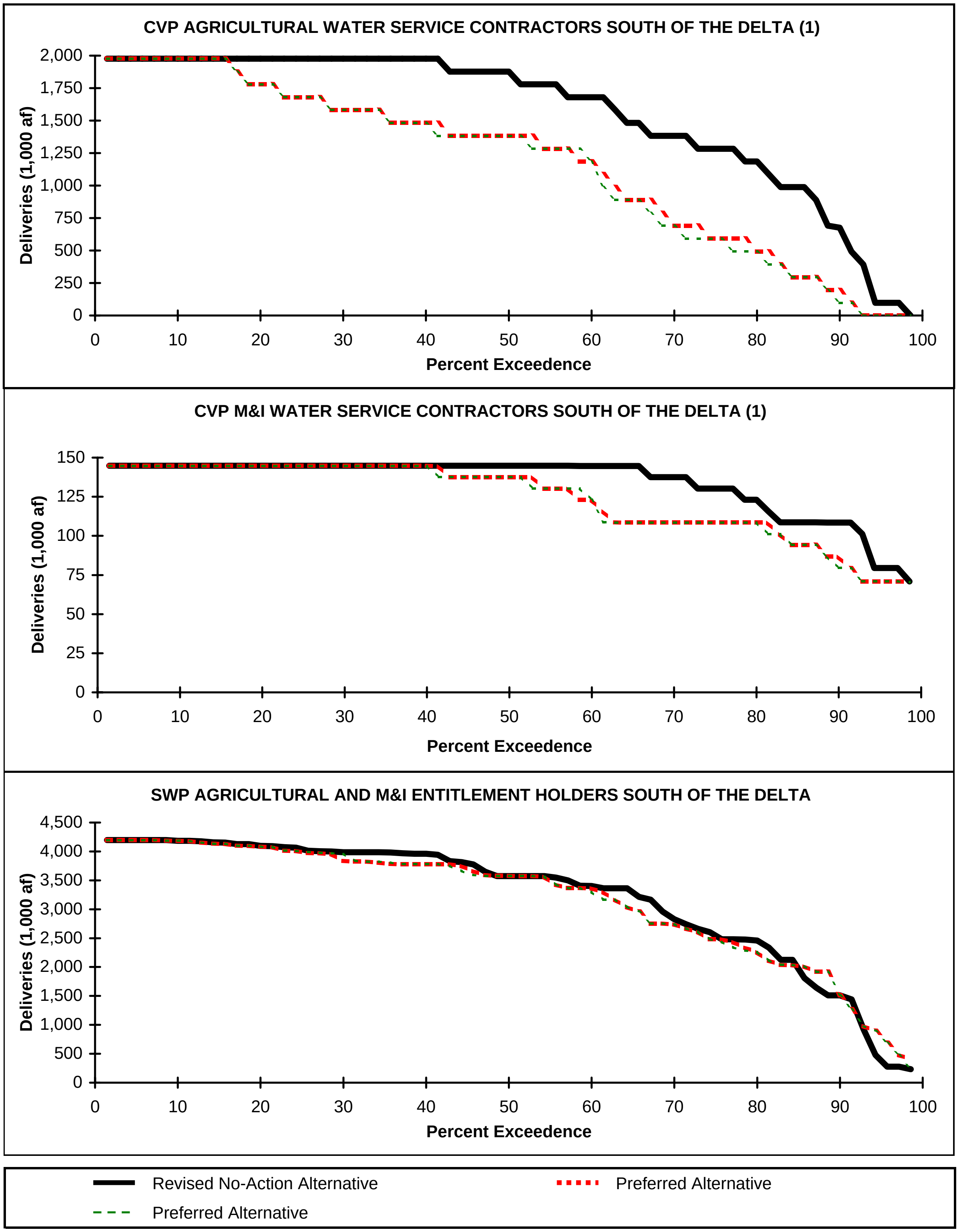
NOTE: Total CVP North Reservoirs include Clair Engle Lake, Whiskeytown Reservoir, Shatsa Lake, and Folsom Lake.

FIGURE V-3
TOTAL CVP NORTH, EASTSIDE DIVISION, AND STATE
SIMULATED FREQUENCY OF END-OF-WATER YEAR STORAGE
WATER YEARS 1922-1990



NOTE: (1) Includes Sacramento River and American River Divisions.
(2) Includes Sacramento River and American River Divisions plus Contra Costa exports.
(3) Firm contract deliveries to Central San Joaquin Irrigation District from the Stanislaus River. Deliveries under Cumulative Effects Analysis are identical to Preferred Alternative.

FIGURE V-4
SIMULATED FREQUENCY OF ANNUAL CVP DELIVERIES NORTH OF THE DELTA AND IN THE EASTSIDE DIVISION CONTRACT YEARS 1922-1990



NOTE: (1) Includes Delta (DMC only), West San Joaquin, and San Felipe Divisions.

FIGURE V-5
SIMULATED FREQUENCY OF ANNUAL CVP AND SWP DELIVERIES SOUTH OF THE DELTA CONTRACT YEARS 1922-1990

Cumulative Effects Analysis as compared to 80 percent in the Preferred Alternative. Annual deliveries below 75 percent of the contract amount are made in about 15 percent of the years in the Preferred Alternative and 20 percent of the years in the Cumulative Analysis.

TABLE V-4

COMPARISON OF CVP DELIVERIES IN THE REVISED NO-ACTION ALTERNATIVE, THE PREFERRED ALTERNATIVE, AND THE CUMULATIVE EFFECTS ANALYSIS

		Simulated Average Annual CVP Deliveries (1,000 acre-feet)		
Contract Years	Type of Period	Revised No-Action Alternative	Preferred Alternative	Cumulative Effects Analysis
1922 - 1990	Simulation Period	5,690	5,130	5,460
1928 - 1934	Dry Period	4,260	3,720	3,870
1967 - 1971	Wet Period	6,200	5,830	6,270

NOTES:
CVP deliveries include deliveries to Agricultural and M&I Water Service Contractors, Sacramento River water rights contractors, other water rights contractors, San Joaquin River Exchange Contractors. CVP deliveries do not include refuge water supplies.

CVP Water Deliveries South of the Delta. Simulated deliveries to agricultural and M&I water service contractors south of the Delta are a function of available CVP water supply and the amount of water that can be exported through Tracy Pumping Plant. Due to increased CVP water service contract amounts to users located north of the Delta and lower Trinity River diversions in the Cumulative Effects Analysis than Preferred Alternative analysis, there is a resulting decrease in CVP water service contractor deliveries south of the Delta.

South of the Delta, simulated annual deliveries to CVP agricultural water service contractors in the Cumulative Effects Analysis are less in some years as shown in Figure V-5. Full annual deliveries occur with a similar frequency of about 15 percent of the years in both simulations. In both the Preferred Alternative and the Cumulative Effects Analysis the minimum annual delivery in the driest years is zero acre-feet, and occurs with a similar frequency in about 8 percent of the years.

Simulated annual deliveries to CVP M&I water service contractors south of the Delta are less in many years in the Cumulative Effects Analysis due to the reduced available water supply, as shown in Figure V-5. Full annual deliveries occur with a similar frequency of 40 percent of the years in both the Cumulative Analysis and Preferred Alternative. Annual deliveries below 75 percent of the contract amount are also made with a similar frequency in both simulations of about 20 percent of the years. The minimum delivery of 50 percent of the contract amount occurs in about 8 percent of the years.

SWP Operations and Deliveries

SWP Operations. SWP operations are affected by the changes in seasonal releases from upstream CVP reservoirs for full CVP contract amounts and increased Trinity River instream fishery flows. These changes to CVP operations shift the timing of flow entering the Delta and affect the SWP responsibility to help meet in-basin water rights and Delta water quality requirements under the COA. However, the effects of these changes are less noticeable because of the incidental benefit associated with having available capacity at Banks Pumping Plant to export water released from upstream CVP reservoirs for implementation of CVPIA that is in excess of the capacity at Tracy Pumping Plant. In comparison to the Preferred Alternative, simulated end-of-water year storage in Lake Oroville Reservoir in the Cumulative Effects Analysis is similar and is presented in the frequency distributions in Figure V-3.

Average annual exports through Banks Pumping Plant and SWP storage in San Luis Reservoir are similar to those of the Preferred Alternative.

SWP Entitlement Water Deliveries. Simulated deliveries to SWP entitlement holders south of the Delta are a function of the available SWP water supply and the amount of water that may be exported through Banks Pumping Plant. Frequency distributions of the simulated annual deliveries to SWP entitlement holders south of the Delta are presented in Figure V-5. Average annual deliveries to SWP entitlement holders are presented in Table V-5. In comparison to the Preferred Alternative, average annual deliveries in the Cumulative Effects Analysis are similar.

GROUNDWATER IMPACT ASSESSMENT

A summary of groundwater resources under the conditions of the Cumulative Effects Analysis is presented below. Changes to groundwater conditions are reported in comparison to the Revised No-Action Alternative.

SACRAMENTO RIVER REGION

Under the Cumulative Effects Analysis, average groundwater pumping would decrease by 22,000 acre-feet/year compared to the Revised No-Action Alternative within the Sacramento River Region West (see Table V-6). This net difference in groundwater pumping is a function of increased CVP deliveries to Sacramento River Water Rights Contractors and M&I Service Contractors, and reduced CVP deliveries to Agricultural Water Service Contractors.

Groundwater levels along most of the west side of the region would be similar to the Revised No-Action Alternative (see Figure V-6). However, in areas with Agricultural Water Service Contractors, groundwater levels would be lower under the Cumulative Effects Analysis as compared to the Revised No-Action Alternative by up to 5 feet. This change is a result of decreased CVP deliveries to Agricultural Water Service Contractors in this area.

TABLE V-5

COMPARISON OF SWP DELIVERIES IN THE REVISED NO-ACTION ALTERNATIVE, THE PREFERRED ALTERNATIVE, AND THE CUMULATIVE EFFECTS ANALYSIS

Contract Years	Type of Period	Simulated Average Annual SWP Deliveries (1,000 acre-feet)		
		Revised No-Action Alternative	Preferred Alternative	Cumulative Effects Analysis
1922 - 1990	Simulation Period	3,220	3,150	3,150
1928 - 1934	Dry Period	1,810	1,910	1,910
1967 - 1971	Wet Period	4,000	3,940	3,940

NOTES:
SWP deliveries include deliveries south of the Delta to entitlement holders. SWP deliveries do not include refuge water supplies.

In the Sacramento River Region (East), average groundwater pumping would decrease by 137,000 acre-feet/year under the Cumulative Effects Analysis as compared to the Revised No-Action Alternative. This decrease in groundwater pumping is in response to increased CVP deliveries to Sacramento River Water Rights Contractors and M&I Water Service Contractors.

Groundwater levels in the northern portion of the Sacramento River Region (East) would be similar to those under the Revised No-Action Alternative. However, groundwater levels in the southern half of this area would increase by as much as 65 feet (see Figure V-6). This change is a result of increased CVP deliveries to Sacramento River Water Rights Contractors and M&I Water Service Contractors in this area.

Under the Cumulative Effects Analysis, groundwater elevations do not decline in areas of poor groundwater quality or areas of potential land subsidence. No additional changes in groundwater quality or land subsidence would occur in comparison to the Revised No-Action Alternative.

SAN JOAQUIN RIVER AND TULARE LAKE REGIONS

As shown in Table V-6, groundwater conditions in the San Joaquin River and Tulare Lake regions under the Cumulative Effects Analysis would be similar to those under the Preferred Alternative.

TABLE V-6

AVERAGE ANNUAL CENTRAL VALLEY GROUNDWATER CONDITIONS 1922-1990 FOR REVISED NO-ACTION ALTERNATIVE, PREFERRED ALTERNATIVE AND CUMULATIVE EFFECTS ANALYSIS

Region	Revised No-Action Alternative (RNAA)	Preferred Alternative (PA))	Cumulative Effects Analysis (CEA)	Differences		
				PA-RNAA	CEA-RNAA	CEA-PA
Sacramento River Region (West)						
Total Recharge	2,034	2,094	2,011	60	-23	-82
Total Discharge	2,041	2,104	2,019	63	-22	-85
Change in GW Storage	-7	-10	-7	-3	0	3
Sacramento River Region (East)						
Total Recharge	1,726	1,732	1,614	6	-112	-118
Total Discharge	1,787	1,791	1,650	5	-137	-141
Change in GW Storage	-61	-59	-36	2	24	23
San Joaquin River Region						
Total Recharge	1,864	1,947	1,950	83	86	4
Total Discharge	1,889	1,982	1,986	93	97	4
Change in GW Storage	-26	-35	-36	-10	-10	-1
Tulare Lake Region (North)						
Total Recharge	3,815	3,847	3,851	32	36	4
Total Discharge	4,068	4,165	4,173	98	106	8
Change in GW Storage	-252	-318	-322	-66	-70	-4
Tulare Lake Region (South)						
Total Recharge	1,572	1,565	1,566	-8	-6	2
Total Discharge	1,483	1,474	1,477	-10	-7	3
Change in GW Storage	89	91	89	2	0	-1

NOTES:

All values presented in 1,000 acre-feet. For the purpose of presenting model results, data presented here have been rounded to the nearest 1,000 acre-feet. This may introduce small rounding error into the reported values.

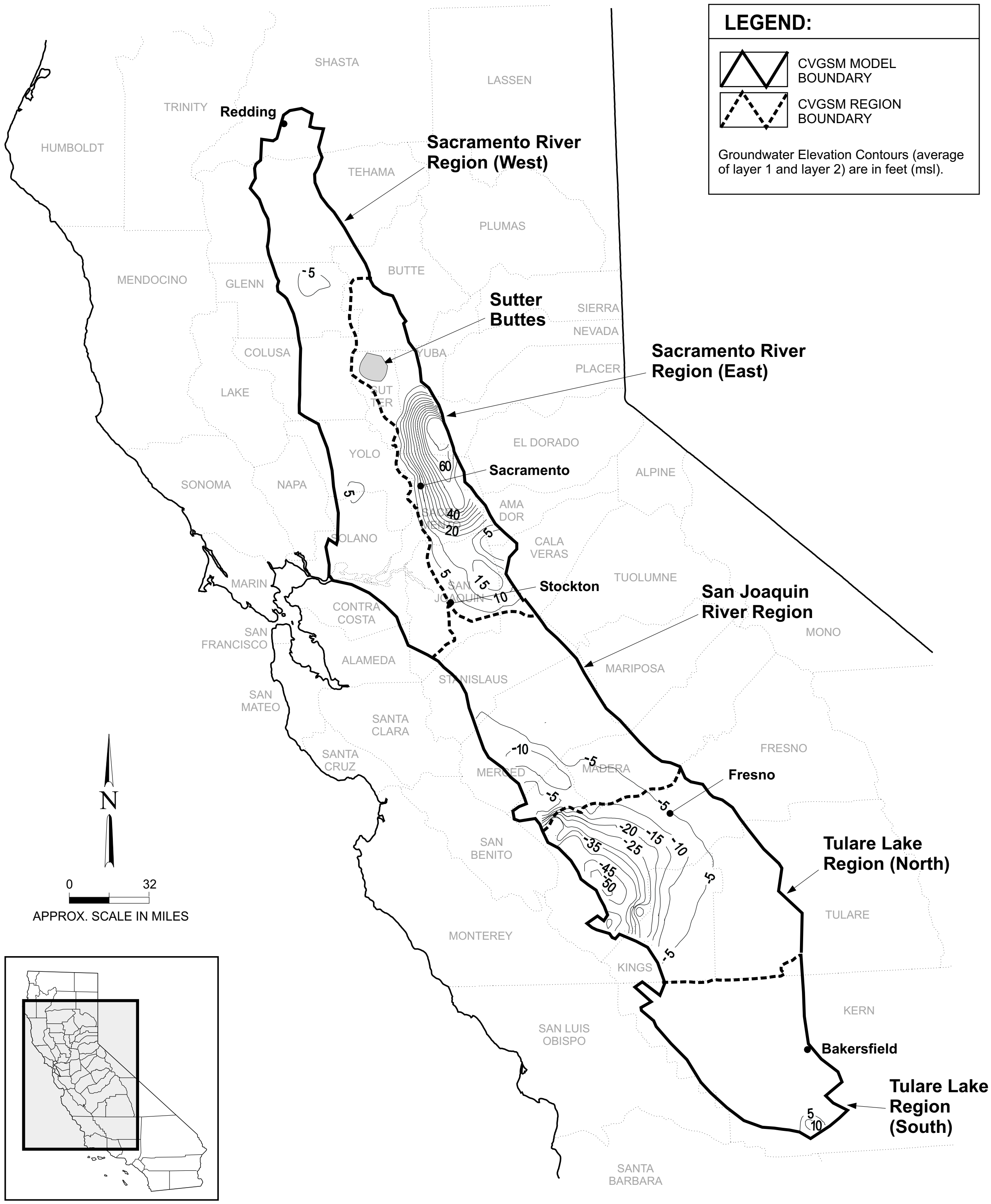


FIGURE V-6
DIFFERENCES IN END OF SIMULATION GROUNDWATER ELEVATIONS FOR THE CUMULATIVE EFFECTS ANALYSIS AS COMPARED TO THE REVISED NO-ACTION ALTERNATIVE

AGRICULTURAL IMPACT ASSESSMENT

DELIVERY OF FULL CONTRACT QUANTITIES

The results of the analysis assuming full contract quantities are delivered when possible are presented for average year conditions in Table V-7. The table shows the Preferred Alternative and Cumulative Impacts relative to the Revised No-Action Alternative.

Total expected reduction in CVP agricultural water deliveries is about 344,000 af. A net increase to the Sacramento River Region (110,000 af) is largely due to increased delivery to Sacramento River Water Rights Contractors and to American River contractors. The San Joaquin River and Tulare Lake regions are estimated to lose about 436,000 af. The Tehama-Colusa, Delta-Mendota, San Luis, and Cross Valley Canal service areas would be among the areas most affected. The changes in delivery are estimated to be partly offset in each region by changes in groundwater use. Groundwater use declines in the Sacramento River Region and increases in the other two Central Valley regions. A small increase in irrigated acreage is estimated in the Sacramento River Region. Net revenue increases in the Sacramento River Region due to increased delivery of low-cost water rights settlement contract delivery. Net revenue declines in the San Joaquin River, Tulare Lake, and San Felipe regions, due to a combination of: reduced agricultural production, higher groundwater pumping costs, higher irrigation costs, and higher CVP water costs.

OTHER ISSUE AREAS

Other factors considered in the PEIS analysis also would change as compared to the conditions described under Preferred Alternative. The primary differences would occur to fisheries and wildlife habitat in and along the Sacramento and American rivers due to reduced flows and recreational opportunities. These conditions also could increase the potential for vandalism of cultural resources as more soils are exposed.

TABLE V-7

SUMMARY OF AGRICULTURAL ECONOMIC IMPACTS: CUMULATIVE IMPACTS WITH FULL CVP CONTRACT DELIVERIES

Item/ Region	Revised No-Action Alternative	Preferred Alternative Impacts	Cumulative Impacts
Surface Water Use (1,000 af)			
Sacramento River	4,522	-58	110
San Joaquin River	4,436	-345	-357
Tulare Lake	2,673	-75	-79
San Felipe	68	-17	-18
Total	11,699	-495	-344
Groundwater Use (1,000 af)			
Sacramento River	2,573	48	-104
San Joaquin River	3,439	167	166
Tulare Lake	3,361	8	9
San Felipe	na	na	na
Total	9,373	223	71
Irrigated Acreage (1,000 acres)			
Sacramento River	2,016	-0.4	0.6
San Joaquin River	2,558	-30.6	-31.3
Tulare Lake	2,008	-14.0	-14.1
San Felipe	24	-8.7	-9.1
Total	6,606	-53.7	-53.9
Gross Revenue ($ Million)			
Sacramento River	1,826	0.5	1.1
San Joaquin River	4,437	-31.0	-31.2
Tulare Lake	3,890	-12.7	-12.9
San Felipe	84	-30.4	-31.6
Total	10,237	-73.6	-74.6
Net Revenue ($ Million)			
Sacramento River	268	0.3	3.1
San Joaquin River	557	-13.8	-14.2
Tulare Lake	512	-17.3	-17.8
San Felipe	8	-2.8	-2.9
Total	1,345	-33.6	-31.8

NOTE: Non-CVP supplies not estimated for San Felipe Unit.

CHAPTER VI

CONSULTATION AND COORDINATION

Chapter VI

CONSULTATION AND COORDINATION

During the preparation of the PEIS, input was actively solicited and incorporated from a broad range of cooperating and consulting agencies and the public. The PEIS also was prepared in consultation and coordination with other Federal and state agencies in accordance with applicable requirements. While Reclamation was originally the lead agency, and primarily responsible for preparing the PEIS, the Fish and Wildlife Service was integrally involved with its preparation. In August 1999 the Service officially became a co-lead and with Reclamation will jointly implement the CVPIA.

This chapter summarizes the public involvement program and key issues raised by the public and interest groups. This chapter also addresses the manner in which Federal statutes, implementing regulations, and executive orders potentially applicable to implementation of the CVPIA have been addressed. The conclusions of compliance are based on the Environmental Consequences presented in Chapter IV. The compliance summaries apply only to the alternatives discussed in the PEIS and not the development of concurrent CVPIA implementation programs.

PUBLIC INVOLVEMENT

During the development of the PEIS, detailed information was prepared and presented to inform the public about the activities, assumptions, and decision making needs of the PEIS process. Through a variety of public involvement activities such as public meetings, workshops, and informational materials, Reclamation solicited public input about the activities and assumptions. The public involvement approach developed for the PEIS was a two-way process. This approach maximized the exchange of information between Reclamation, other agencies, and the public. Public interest was high and participants were well informed. This led to very active public participation on a wide range of issues, which played a significant role in guiding the PEIS process.

The process was divided into the Scoping, Project Development, Alternatives Refinement and Impact Analysis, and Preparation of the PEIS phases. Issues raised during these phases are summarized below. A more detailed discussion of the public involvement program is presented in the Public Involvement Technical Appendix.

SCOPING PHASE

Reclamation started the preparation of the PEIS during the Scoping Phase. Scoping served as a fact-finding process to identify public concerns and recommendations about the CVPIA, the PEIS process, issues that would be addressed in the PEIS, and the scope and level of detail for analyses. Scoping activities began in January 1993 after a Notice of Intent to prepare the PEIS was filed in the Federal Register. The scoping period formally ended in April 1993 with the release of the Scoping Report and the Public Involvement Plan. Scoping continued, however, on an informal basis during the technical analysis to ensure that new issues and concerns were considered throughout the PEIS process. Public input collected during this phase helped guide several important initial PEIS preparation activities and set a course for the remainder of the process.

Public involvement activities began with a series of discussions with interest groups and individuals to educate the public concerning the process and to identify important public issues and concerns to be addressed in the PEIS. The results of these discussions formed the basis of the Public Involvement Plan, which was the framework for public involvement activities through the four PEIS phases.

At public scoping meetings held around the state in March 1993, Reclamation and the Service provided information about the Draft PEIS process and solicited public comments, questions, and concerns. Participants commented about key issues that should be discussed in the PEIS, potential environmental impacts, public involvement activities, the PEIS preparation process, and alternatives development. At these early meetings, participants had numerous comments and questions about how important issues would be considered, analyzed, and addressed in the PEIS, including water contract renewals, the AFRP, tiered water pricing, the Endangered Species Act, and alternatives development. In addition, comments were received on the geographic scope of the PEIS and the level of detail of the analysis. Based on public comments, the geographic scope of the analysis was expanded to include an assessment of potential environmental impacts on areas throughout the state.

Reclamation received numerous comments about issues to be considered in the PEIS and methodologies for analyzing impacts. Although these comments would be addressed more specifically in the next two phases -- Project Development and Alternatives Refinement and Impact Analysis -- they helped expand the scope of analysis and refine the Plan of Action for preparing the PEIS.

During this phase, Reclamation established cooperative agreements with the public agencies who would assist in preparing the PEIS. Cooperating agencies were involved in substantial research, data collection, participation in development and evaluation of alternatives, and preparation of the Draft PEIS. The following Cooperating Agencies participated in the process.

- California Department of Fish and Game
- California Department of Water Resources
- California State Water Resources Control Board
- Hoopa Valley Tribe
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- National Marine Fisheries Service
- Western Area Power Administration

Consulting Agencies were involved in the development of analytical tools and background information. The following Consulting Agencies participated in the process.

- U.S. Geological Survey
- Natural Resource Conservation Service
- Bureau of Indian Affairs

The Cooperating and Consulting agencies met at Interagency Group Meetings (IAG) to provide input and direction into the PEIS. The first IAG meeting was held in April 1993 to discuss scoping issues with the public agencies.

Interest Group Meetings (IGM) and public workshops were held with the public to obtain input and comments on the Draft PEIS. The IGMs were used to discuss technical issues in a smaller forum than the public workshops. The public workshops provided opportunities for the public throughout the study area to learn about the PEIS process.

PROJECT DEVELOPMENT PHASE

Program activities of the Project Development phase consisted of the following goals.

- Prepare a Purpose and Need Statement
- Define Existing Conditions
- Prepare the Existing Conditions Technical Appendices
- Develop the No-Action Alternative
- Identify projects for the cumulative impacts analysis
- Develop the PEIS alternatives
- Screen and identify the preliminary analytical tools

Developing a set of alternatives that reflected the full range of feasible options was a significant challenge. To meet this challenge, Reclamation worked closely with the public and agencies to develop the PEIS alternatives. The second phase, beginning in May 1993 and continuing to January 1995, resulted in the largest number of comments.

Public information efforts for this phase focused on explaining the process for developing the No-Action Alternative and preliminary PEIS alternatives and providing accurate information to support informed participation. Table VI-1 lists the public involvement activities that occurred during the Project Development phase.

During the first 18 months of the development of the Draft PEIS, each of the Cooperating Agencies provided technical experts to serve on designated work groups to define, outline, and initially develop the criteria and process for the alternative analysis. These experts served on one or more workgroup committees, including development of the purpose and need, level of detail, development of the No-Action Alternative and other alternatives, and selection of analytical tools. The results of the process were shared with the public and other agencies.

TABLE VI-1

PROJECT DEVELOPMENT PHASE PUBLIC INVOLVEMENT ACTIVITIES

Date	Public Involvement Activity
May 1993	IAG
June 1993	IAG; Public Meetings and Information Packet
July 1993	IAG; IGM
August 1993	Outflow Newsletter
September 1993	IAG; IGM; Congressional Briefing and Information Packet; Draft Response to Comments Report
October 1993	Media Packet; Public Meetings
November 1993	IAG; IGM; Public Meetings; Management Briefing and Materials; Elected Officials Newsletter
December 1993	Outflow Newsletter
January 1994	IAG; Small Group Meeting
February 1994	IGM; Media Packet; Draft Response to Comments Report
March 1994	Public Meetings and Information Packet; Small Group Meeting
April 1994	Stakeholder Meetings; Alternatives Briefings
May 1994	Alternatives Briefings; Small Group
June 1994	IAG; IGM; Small Group Meetings; Outflow Newsletter
July 1994	Stakeholder Meetings; Alternatives A to Z Report; Draft Response to Comments Report
August 1994	Public Meetings and Information Packet; Congressional Briefing and Information Packet; Management Briefing and Materials; Elected Officials Memo
September 1994	Public Meetings and Information Packet; Stakeholder Meetings
November 1994	Stakeholder Meetings
December 1994	IGM Meeting; Media Packet
January 1995	Small Group Meeting; Analytical Tools Workshop

ALTERNATIVES REFINEMENT AND IMPACT ANALYSIS PHASE

Program activities of the Alternatives Refinement and Impact Analysis phase consisted of the following goals.

- Select and refine analytical tools
- Develop criteria and refine assumptions for the No-Action Alternative and Draft PEIS alternatives
- Conduct preliminary impact analysis for the No-Action Alternative and Draft PEIS alternatives

In January 1995, Reclamation initiated the Alternatives Refinement and Impact Analysis phase. During this phase, the primary goal was to analyze the effects of the PEIS Alternatives and the No-Action Alternative and refine the alternatives. The analysis allowed Reclamation to assess the impacts and benefits of each alternative, and to compare these impacts to future conditions under a No-Action Alternative.

During this phase, Reclamation considered and discussed three substantial issues: refining the No-Action Alternative to incorporate new Bay-Delta Plan Accord water quality standards, refining the Dedicated Water Methodology, and incorporating the results of the Anadromous Fish Restoration Program activities and associated flow goals. As Reclamation discussed these issues and began preliminary impact analysis of the preliminary Draft PEIS alternatives, it became apparent that refinements to the alternatives would be necessary. During this phase, interagency and public comments helped to identify specific issues that warranted additional analyses. During the final screening phase of the alternatives in late 1996, it was determined that three of the five preliminary alternatives were eliminated from further analysis because they would have resulted in less balance of competing needs. Two additional alternatives were developed through discussions with the interagencies and the public.

Table VI-2 lists the public activities that occurred during the Alternatives Refinement and Impact Analysis phase.

TABLE VI-2

ALTERNATIVES REFINEMENT AND IMPACT ANALYSIS PUBLIC INVOLVEMENT ACTIVITIES

Date	Public Involvement Activities
February 1995	Outflow Newsletter; Draft Response to Comments Report
March 1995	Progress Report Newsletter
April 1995	Small Group Meeting; Progress Report Newsletter
May 1995	Progress Report Newsletter
June 1995	IAG; IGM
July 1995	Small Group Meeting
August 1995	Public Meetings; Congressional Briefing and Information Packet
October 1995	IAG; IGM; Small Group Meeting; Progress Report Newsletter
November 1995	Small Group Meeting
December 1995	Progress Report Newsletter
January 1996	Small Group Meeting
February 1996	Combined IAG/IGM Meeting; Small Group Meeting; Progress Report Newsletter
April 1996	Combined IAG/IGM Meeting; Draft Response to Comments Report
May 1996	Small Group Meeting
June 1996	Combined IAG/IGM Meeting
July 1996	Progress Report Newsletter
September 1996	IGM; Small Group Meeting
November 1996	Combined IAG/IGM Meeting
January 1997	Combined IAG/IGM Meeting
April 1997	Combined IAG/IGM Meeting

PREPARATION OF THE DRAFT AND FINAL PEIS PHASE

Program activities of the Preparation of the Draft and Final PEIS phase include the following goals.

- Prepare the Draft PEIS
- Circulate the Draft PEIS for public review
- Prepare Supplement to the Draft PEIS
- Circulate Supplement to the Draft PEIS
- Prepare the Final PEIS
- File Record of Decision for preferred actions or range of actions

In the fourth and final phase, Reclamation compiled the results and conclusions into the Draft PEIS for public review and comment. The Draft PEIS was distributed to a wide range of agencies and interest groups, as summarized in Attachment B of the Draft PEIS. The public review period of the Draft PEIS started in November 1997 and closed in April 1998. A series of public information forums were held around the state during the review period to gather verbal comments as shown in Table VI-3. Written comments also were solicited.

As described in Chapter II, a Supplement to the Draft PEIS was prepared and circulated following circulation of the Draft PEIS. The public review period of the Supplement to the Draft PEIS started in July 1999 and closed in September 1999. A series of public information forums and public hearings were held around the state during the review period to gather verbal comments, as shown in Table VI-3. Written comments were also solicited.

TABLE VI-3

PREPARATION OF DRAFT AND FINAL PEIS PUBLIC INVOLVEMENT ACTIVITIES

Date	Public Involvement Activities
July 1997	IAG
January 1998	Public Information Forum
March 1998	Public Hearings
June 1998	IAG; IGM
April 1999	IAG; IGM
July 1999	Public Information Forums on Supplement to the Draft PEIS
August 1999	Public Hearings on Supplement to the Draft PEIS
October 1999	IAG

Public input will be used by the Secretary as a guide in making the final decision about how the CVPIA will be implemented. A Record of Decision (ROD) will be prepared and the public will be formally notified of the decision.

CONSULTATION AND COORDINATION WITH OTHER AGENCIES

The PEIS was prepared in accordance with the policies and regulations for the following issues. Brief discussions of these issues and how compliance was addressed in the PEIS is discussed in the remaining sections of this chapter. Work is continuing on each of these requirements. As individual projects are implemented, compliance requirements will be considered.

- National Environmental Policy Act
- California Environmental Quality Act
- Endangered Species Act
- Fish and Wildlife Coordination Act
- National Historic Preservation Act
- Indian Trust Assets
- Indian Sacred Sites on Federal Land
- Environmental Justice
- State, Area-wide, and Local Plan and Program Consistency
- Floodplain Management
- Wetlands Protection
- Wild and Scenic Rivers Act
- Farmland Protection Policy Act and Farmland Preservation
- Clean Air Act
- Safe Drinking Water Act
- Clean Water Act

NATIONAL ENVIRONMENTAL POLICY ACT

This PEIS was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4321 *et seq.*). NEPA provides a commitment 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. The PEIS provides detailed information regarding the No-Action Alternative and alternatives, the environmental impacts of the alternatives, potential mitigation measures, and adverse environmental impacts that cannot be avoided. As projects are implemented at the local level, additional NEPA reviews may be required. Actions implemented in compliance with other environmental laws, such as the ones listed below, would be addressed in subsequent NEPA documents.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

Implementation, funding and permitting actions carried out by State and local agencies must comply with the California Environmental Quality Act (CEQA). The CEQA requirements are similar to NEPA requirements and include provisions for the preparation of programmatic and site-specific environmental documents.

As CVPIA actions are implemented, there may be some associated State actions involved which require compliance with CEQA. The environmental documents prepared under CEQA are similar to the federal NEPA documents. The Council on Environmental Quality regulations encourage the preparation of joint environmental documents to reduce duplication of analysis and paperwork. Joint preparation of NEPA and CEQA documents will be considered and carried out, as appropriate, in implementing the CVPIA actions.

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)(2) of the ESA requires Federal agencies to consult with the Service and/or NMFS on any activities that may affect any species listed as threatened or endangered. The PEIS analyzes various alternative courses of action at the programmatic level, and the subsequent Record of Decision will identify general policy decisions. Implementation of these policies may affect listed species. These potential effects require initiation of the Section 7 consultation process. Reclamation initiated formal consultation with the Service in 1998. The Service became a co-lead on the PEIS in August 1999, and, as a result, is developing a Biological Opinion to address implementation of CVPIA by both Reclamation and the Service. While specific details are being developed, a conceptual approach with two basic elements has been identified: (1) a conservation program to address the needs of species that have been and continue to be impacted by the CVP; and (2) an agreement to consult on specific activities/programs that are initiated as part of the CVPIA or the CVP. The intent is to develop a conservation plan that addresses the needs of the species in such a way that potential impacts that could be identified in subsequent consultations on specific programs would, to a large extent (and perhaps entirely in specific cases) have been addressed through the Conservation Program. This approach will be refined through a public process that will include interaction with interested parties. Reclamation and the Service have jointly initiated formal consultation with NMFS. Formal consultation will be concluded prior to the signing of the Record of Decision.

Under the No-Action Alternative, it is assumed that compliance with ESA will be addressed through consultation on discretionary actions such as contract renewals, operational changes, and other new activities that would be initiated. In addition, Reclamation has committed to consult on the overall effects of the CVP, specifically throughout the water service areas.

Under the PEIS alternatives, it is assumed that all compliance actions under the No-Action Alternative would occur. However, due to the CVPIA authorizing language and funding, the approach to compliance with ESA would be broader in nature and would, to a large extent, focus on the needs of species rather than on discrete impacts attributed to CVP operations. The level of protection would be similar to that under the No-Action Alternative, but conservation activities would be expanded to identify, prioritize, and assist in the implementation of actions to address the needs of listed species. In addition, individual actions would be consulted on as they are initiated to ensure that the needs of the species would be addressed with the implementation of

CVPIA. The scope of subsequent consultations is expected to be minimal in most cases as a result of the implementation of both the (b)(1) "other" and the Conservation Program.

In addition to these considerations, Reclamation requested and received from the Service a listing of special status species to be considered in the impact assessment of the PEIS. Consideration of these species is discussed in detail in the Fisheries and Vegetation and Wildlife technical appendices.

FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (FWCA) requires consultation with the Service and consideration of their views and recommendations when any water body is impounded, diverted, controlled, or modified for any purpose. The Service and state agencies charged with administering fish and wildlife resources are to conduct surveys and investigations to determine the potential damage to fish and 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. Because the Service is a co-lead agency in the preparation of this PEIS, and appropriate State agencies have participated as cooperating agencies in its preparation, the Department of the Interior's compliance under (2)(b) of the Fish and Wildlife Coordination Act has been met. Appropriate recommendations for the mitigation and conservation of fish and wildlife species have been adequately included in planning and alternative selection processes of this document.

NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act (NHPA) requires that Federal agencies evaluate the effects of Federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking. The first step in the process is to identify cultural resources included on (or eligible for inclusion on) the National Register of Historic Places that are located in or near the project area. The second step is to identify the possible effects of proposed actions. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

During preparation of the PEIS, programmatic consultation was investigated. It was determined by the State Historic Preservation Office that compliance with Section 106 should be coordinated on a project-specific basis.

INDIAN TRUST ASSETS

The United States Government's trust responsibility for Indian resources requires Reclamation and other agencies to 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 Indian tribes or individuals. Indian reservations, rancherias, and allotments are common ITAs.

During preparation of the PEIS, Reclamation coordinated with Bureau of Indian Affairs to locate and review survey records of ITAs within the Central Valley and the Trinity River Basin. Notices of Scoping Workshops were sent to all tribes associated with ITAs in the Central Valley and Trinity River basin. Separate meetings were held with the Hoopa Valley Tribe (a Cooperating Agency) and the Yurok Tribe. Based upon this analysis, the Draft PEIS includes consideration of ITAs in the impact assessment of alternatives.

INDIAN SACRED SITES ON FEDERAL LAND

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 Indian sacred sites by Indian religious practioners, and avoid adversely affecting the physical integrity of such sacred sites. No sacred sites were identified during the scoping or planning process, and therefore were not included in the impact assessment of the PEIS. If sites are identified in future scoping efforts for project-specific environmental documentation, efforts will be completed to identify and protect the sacred sites.

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.

Reclamation has evaluated the environmental, social, and economic impacts on minority and low-income populations in the impact assessment of alternatives. During preparation of the PEIS, meetings were held in the west side of the Sacramento and San Joaquin Valleys where low-income and minority populations live. Potential impacts to these areas were discussed in these meetings. Participants received meeting notices and newsletters throughout preparation of the PEIS.

STATE, AREA-WIDE, AND LOCAL PLAN AND PROGRAM CONSISTENCY

Agencies must consider the consistency of a proposed action with approved state and local plans and laws. Given the extremely large number of state and local jurisdictions within the study area, the lead agencies were not able to review all of the individual plans and laws that may be applicable. In accordance with Executive Order 12372, the PEIS has been prepared with input from the Cooperating Agencies and Consulting Agencies. During the review period, the Draft PEIS was circulated to the appropriate state agencies and to the state clearing house to satisfy review and consultation requirements.

FLOODPLAIN MANAGEMENT

If a Federal agency program will affect a floodplain, the agency must consider alternatives to avoid adverse effects in the flood plain or to minimize potential harm. Executive Order 11988 requires Federal agencies to evaluate the potential effects of any actions they might take in a floodplain and to ensure that planning, programs, and budget requests reflect consideration of flood hazards and floodplain management. Several of the PEIS alternatives, but not the Preferred Alternative, would impact the floodplains by increasing instream flows and Delta flows, as described in the impact assessment.

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. In the PEIS alternatives, several actions would provide for increased wetland habitat at refuge and non-refuge lands. Impacts on wetlands were analyzed as part of the alternatives.

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 PEIS alternatives would affect flows in wild and scenic portions of rivers.

FARMLAND PROTECTION POLICY ACT AND FARMLAND PRESERVATION

Two policies require federal agencies to include assessments of the potential effects of a proposed project on prime and unique farmland. These policies are the Farmland Protection Policy Act of 1981 and the Memoranda on Farmland Preservation, dated August 30, 1976, and August 11, 1980, respectively, from the U.S. Council on Environmental Quality. Under requirements set forth in these policies, federal agencies must determine these effects before taking any action that could result in converting designated prime or unique farmland for nonagricultural purposes. If implementing a project would adversely affect farmland preservation, the agencies must consider alternatives to lessen those effects. Federal agencies also must ensure that their programs, to the extent practicable, are compatible with state, local, and private programs to protect farmland. The SCS is the federal agency responsible for ensuring that these laws and polices are followed. No specific consultation was conducted during preparation of the PEIS due to the programmatic nature of the document and the inability to identify impacts to specific parcels.

The only CVPIA provisions that would result in conversion of farmland to nonagricultural purposes would be land retirement from willing sellers for the purpose of reducing agricultural drainage problems. The retired land would be used either for non-irrigated agriculture (which would not result in a conversion of farmland) or for restored native habitat (which would support increased vegetation and wildlife habitats). Due to the presence of agricultural drainage problems on the retired lands, it is assumed that the retired land would not be prime farmland.

The PEIS alternatives include "fallowing" of irrigated acreage due to the reduced reliability in water supplies, increased price of CVP water, and acquisition of water from willing sellers. However, the fallowed land can still be used for non-irrigated agricultural practices, such as "winter wheat" crops. In addition, some of the fallowed lands are assumed to remain in irrigation during wet water years when CVP water supplies have higher reliability. The agricultural economic impact analysis indicated that most of the fallowed crops would be limited to irrigated pasture and cotton which are not generally grown on prime or unique farmlands. Therefore, the impacts to prime or unique farmlands are anticipated to be minimal.

The PEIS alternatives do not result in changes in municipal and industrial lands uses as compared to the No-Action Alternative. Therefore, there would be no conversion of agricultural lands to municipal uses in the PEIS alternatives as compared to the No-Action Alternative.

CLEAN AIR ACT

The Federal Clean Air Act (CAA) was enacted to protect and enhance the nation's air quality in order to promote public health and welfare and the productive capacity of the nation's population. The CAA requires an evaluation of any federal action to determine its potential impact on air quality in the project region. Coordination is required with the appropriate local air quality management district as well as with the EPA. This coordination would determine whether the project conforms to the Federal Implementation Plan and the State Implementation Plan (SIP).

Section 176 of the CAA (42 U.S.C. Section 7506(c)) prohibits federal agencies from engaging in or supporting in any way an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and in attaining those standards expeditiously. EPA promulgated conformity regulations (codified in 40 CFR Section 93.150 et seq.).

The PEIS alternatives assume that current practices to control dust and soil erosion on lands that are seasonally fallowed would be used on lands fallowed under the PEIS alternatives. These practices include provisions for a cover crop and minimal cultivation to prevent disturbance of the soil. Therefore, it assumed that no air quality impacts would occur due to the PEIS alternatives.

The PEIS alternatives include construction of many site-specific projects. It is assumed in the PEIS analysis that all construction and operation activities would be conducted in accordance with requirements of local air quality management district requirements. Site-specific technical and environmental documents for these projects will address the potential for impacts to air quality and coordination/consultation will be implemented with EPA and the local air quality management districts.

SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA) (PL 99-339) became law in 1974 and was reauthorized in 1986 and again in August 1996. Through the SDWA, Congress gave the EPA the authority to set standards for contaminants in drinking water supplies. Amendments to the SDWA provide more flexibility, more state responsibility, and more problem prevention approaches. The law changes the standard-setting procedure for drinking water and establishes a State Revolving Loan Fund to help public water systems improve their facilities and to ensure compliance with drinking water regulations and to support state drinking water program activities.

Under the SDWA provisions, the California Department of Health Services has the primary enforcement responsibility. The California Health and Safety Code establishes this authority and stipulates drinking water quality and monitoring standards. To maintain primacy, a state's drinking water regulations cannot be less stringent than the federal standards.

The analysis of the PEIS alternatives as compared to the SDWA requirements indicated that there were no changes in compliance as compared to the No-Action Alternative.

CLEAN WATER ACT

The Clean Water Act (CWA) gave the EPA the authority to develop a program to make all waters of the United States "fishable and swimmable." This program has included identifying existing and proposed beneficial uses and methods to protect and/or restore those beneficial uses. The CWA contains many provisions, including provisions that regulate the discharge of pollutants into the water bodies. The discharges may be direct flows from point sources, such as an effluent from a wastewater treatment plant, or a non-point source, such as eroded soil particles from a construction site. There are numerous provisions that could effect implementation of parts of the PEIS alternatives. The following discussion focuses on the main provisions that will be evaluated as part of technical and environmental evaluations for site-specific projects under CVPIA.

Many of the PEIS alternatives include actions that would involve potential impacts on wetlands and waters of the United States. Therefore, the actions will require Corps of Engineers permits under Section 404 of the CWA or Section 10 of the Rivers and Harbors Act (Section 404 permits). The actions potentially range from construction of a fish passage facility to creation of new wetlands habitat that would involve contouring land and changing local hydrology. The need for a Section 404 permit will need to be determined on a site-specific basis. It has been proposed through the CalFed process that a programmatic Section 404 permit be provided for similar projects located in a similar geographical area. If this occurs, expansion of the programmatic Section 404 permit should be considered.

Under Section 401 of the CWA, the SWRCB, acting for EPA, certifies that federally licensed or funded projects are consistent with maintenance or attainment of water quality standards. The need for a Section 401 certification is required for Section 404 permits and will need to be determined on a site-specific basis.

Section 303(d) of the CWA requires all states to conduct triennial reviews to evaluate and, where necessary, to protect the designated uses for the state's waters and to revise water quality standards. As part of this requirement, states develop a list of water bodies; with impaired water quality. The Section 303(d) list identifies impaired water bodies and sources of contamination, such as mine drainage, agricultural drainage, urban and industrial runoff, and municipal and industrial wastewater discharges. In California, the SWRCB is responsible for the triennial review process and for developing the Section 303(d) list. In late 1998, the EPA partially approved a new Section 303(d) list submitted by the SWRCB that includes 472 polluted water bodies. This list will be considered in the development of future site-specific projects under CVPIA to improve water quality as well as habitat under the fish and wildlife restoration programs.

The EPA also has developed National Guidance on Water Quality Criteria under Section 304(a) of the CWA for pollutants to protect human health and aquatic life. Relevant pollutants are identified under Section 307 of the CWA. These criteria will be considered in the development of future site-specific projects under CVPIA to improve water quality as well as habitat under the fish and wildlife restoration programs.

ATTACHMENT A

CENTRAL VALLEY PROJECT IMPROVEMENT ACT

TITLE 34

(of Public Law 102-575)

SEC. 3401. SHORT TITLE.

This title may be cited as the "Central Valley Project Improvement Act."

SEC. 3402. PURPOSES.

The purposes of this title shall be:

(a) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;

(b) to address impacts of the Central Valley Project on fish, wildlife and associated habitats;

(c) to improve the operational flexibility of the Central Valley Project;

(d) to increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation;

(e) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary;

(f) to achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors.

SEC. 3403. DEFINITIONS.

As used in this title:

(a) the term "anadromous fish" means those stocks of salmon (including steelhead), striped bass, sturgeon, and American shad that ascend the Sacramento and San Joaquin rivers and their tributaries and the Sacramento-San Joaquin Delta to reproduce after maturing in San Francisco Bay or the Pacific Ocean;

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* Text of Bill downloaded from Westlaw Congressional Record Database 10-5-92 and formatted by the Department of Water Resources, October 23, 1992.(b)the terms "artificial propagation" and "artificial production" mean spawning, incubating, hatching, and rearing fish in a hatchery or other facility constructed for fish production;

(c) the term "Central Valley Habitat Joint Venture" means the association of Federal and State agencies and private parties established for the purpose of developing and implementing the North American Waterfowl Management Plan as it pertains to the Central Valley of California;

(d) the terms "Central Valley Project" or "project" mean all Federal reclamation projects located within or diverting water from or to the watershed of the Sacramento and San Joaquin rivers and their tributaries as authorized by the Act of August 26, 1937 (50 Stat. 850) and all Acts amendatory or supplemental thereto, including but not limited to the Act of October 17, 1940 (54 Stat. 1198, 1199), Act of December 22, 1944 (58 Stat. 887), Act of October 14, 1949 (63 Stat. 852), Act of September 26, 1950 (64 Stat. 1036), Act of August 27, 1954 (68 Stat. 879), Act of August 12, 1955 (69 Stat. 719), Act of June 3, 1960 (74 Stat. 156), Act of October 23, 1962 (76 Stat. 1173), Act of September 2, 1965 (79 Stat. 615), Act of August 19, 1967 (81 Stat. 167), Act of August 27, 1967 (81 Stat. 173), Act of October 23, 1970 (84 Stat. 1097), Act of September 28, 1976 (90 Stat. 1324) and Act of October 27, 1986 (100 Stat. 3050);

(e) the term "Central Valley Project service area" means that area of the Central Valley and San Francisco Bay Area where water service has been expressly authorized pursuant to the various feasibility studies and consequent congressional authorizations for the Central Valley Project;

(f) the term "Central Valley Project water" means all water that is developed, diverted, stored, or delivered by the Secretary in accordance with the statutes authorizing the Central Valley Project and in accordance with the terms and conditions of water rights acquired pursuant to California law;

(g) the term "full cost" has the meaning given such term in paragraph (3) of section 202 of the Reclamation Reform Act of 1982;

(h) the term "natural production" means fish produced to adulthood without direct human intervention in the spawning, rearing, or migration processes;

(i) the term "Reclamation laws" means the Act of June 17, 1902 (82 Stat. 388) and all acts amendatory thereof or supplemental thereto;

(j) the term "Refuge Water Supply Report" means the report issued by the Mid-Pacific Region of the Bureau of Reclamation of the U.S. Department of the Interior entitled Report on Refuge Water Supply Investigations, Central Valley Hydrologic Basin, California (March 1989);

(k) the terms "repayment contract" and "water service contract" have the same meaning as provided in sections 9(d) and 9(e) of the Reclamation Project Act of 1939 (53 Stat. 1187, 1195), as amended;

(l) the terms "Restoration Fund" and "Fund" mean the Central Valley Project Restoration Fund established by this title; and,

(m) the term "Secretary" means the Secretary of the Interior.

SEC. 3404. LIMITATION ON CONTRACTING AND CONTRACT REFORM.

(a) NEW CONTRACTS. - Except as provided in subsection (b) of this section, the Secretary shall not enter into any new short-term, temporary, or long-term contracts or agreements for water supply from the Central Valley Project for any purpose other than fish and wildlife before:

(1) the provisions of subsections 3406(b)-(d) of this title are met;

(2) the California State Water Resources Control Board concludes the review ordered by the California Court of Appeals in U.S. v. State Water Resources Control Board, 182 Cal. App. 3rd 82 (1986) and determines the means of implementing its decision, including the obligations of the Central Valley Project, if any, and the Administrator of the Environmental Protection Agency shall have approved such decision pursuant to existing authorities; and,

(3) at least one hundred and twenty days shall have passed after the Secretary provides a report to the Committee on Energy and Natural Resources of the Senate and the Committee on Interior and Insular Affairs and the Committee on Merchant Marine and Fisheries of the House of Representatives explaining the obligations, if any, of the Central Valley Project system, including its component facilities and contracts, with regard to achieving its responsibilities for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary as finally established and approved by relevant State and Federal authorities, and the impact of such obligations on Central Valley Project operations, supplies, and commitments.

(b) EXCEPTIONS TO LIMIT ON NEW CONTRACTS. - The prohibition on execution of new contracts under subsection (a) of this section shall not apply to contracts executed pursuant to section 305 of Pub. L. 102-250 or section 206 of Pub. L. 101-514 or to one-year contracts for delivery of surplus flood flows or contracts not to exceed two years in length for delivery of class II water in the Friant Unit. Notwithstanding the prohibition in the Energy and Water Development Appropriations Act of 1990, the Secretary is authorized, pursuant to section 203 of the Flood Control Act of 1962, to enter into a long-term contract in accordance with the Reclamation laws with the Tuolumne Regional Water District, California, for the delivery of water from the New Melones project to the county's water distribution system and a contract with the Secretary of Veteran Affairs to provide for the delivery in perpetuity of water from the project in quantities sufficient, but not to exceed 850 acre-feet per year, to meet the needs of the San Joaquin Valley National Cemetery, California.

(c) RENEWAL OF EXISTING LONG-TERM CONTRACTS. - Notwithstanding the provisions of the Act of July 2, 1956 (70 Stat. 483), the Secretary shall, upon request, renew any existing long-term repayment or water service contract for the delivery of water from the Central Valley Project for a period of 25 years and may renew such contracts for successive periods of up to 25 years each.

(1) No such renewals shall be authorized until appropriate environmental review, including the preparation of the environmental impact statement required in section 3409 of this title, has been completed. Contracts which expire prior to the completion of the environmental impact statement required by section 3409 may be renewed for an interim period not to exceed three years in length, and for successive interim periods of not more than two years in length, until the environmental impact statement required by section 3409 has been finally completed, at which time such interim renewal contracts shall be eligible for long-term renewal as provided above. Such interim renewal contracts shall be modified to comply with existing law, including provisions of this title. With respect to all contracts renewed by the Secretary since January 1, 1988, the Secretary shall incorporate in said contracts a provision requiring payment of the charge mandated in subsection 3406(c) and subsection 3407(b) of this title and all other modifications needed to comply with existing law, including provisions of this title. This title shall be deemed "applicable law" as that term is used in Article 14(c) of contracts renewed by the Secretary since January 1, 1988.

(2) Upon renewal of any long-term repayment or water service contract providing for the delivery of water from the Central Valley Project, the Secretary shall incorporate all requirements imposed by existing law, including provisions of this title, within such renewed contracts. The Secretary shall also administer all existing, new, and renewed contracts in conformance with the requirements and goals of this title.

(3) In order to encourage early renewal of project water contracts and facilitate timely implementation of this title, the Secretary shall impose on existing contractors an additional mitigation and restoration payment of one and one-half times the annual mitigation and restoration payment calculated under subsection 3407(d) of this title for every year starting October 1, 1997 or January 1 of the year following the year in which the environmental impact statement required under section 3409 is completed, whichever is sooner, and ending on the effective date of the renewed contract payable prior to the

renewal of such contract, to be covered to the Restoration Fund; Provided, however, That this paragraph shall not apply to contracts renewed after January 1, 1988, and prior to the date of enactment of this title or, in the event the environmental impact statement required by section 3409 is not completed by October 1, 1997, to any holder of a contract in existence on the date of enactment of this title who enters into a binding agreement with the Secretary prior to October 1, 1997, to renew its contract immediately upon completion of that environmental impact statement, if such contract has not expired prior to such date.

SEC. 3405. WATER TRANSFERS, IMPROVED WATER MANAGEMENT AND CONSERVATION.

(a) WATER TRANSFERS. - In order to assist California urban areas, agricultural water users, and others in meeting their future water needs, subject to the conditions and requirements of this subsection, all individuals or districts who receive Central Valley Project water under water service or repayment contracts, water rights settlement contracts or exchange contracts entered into prior to or after the date of enactment of this title are authorized to transfer all or a portion of the water subject to such contract to any other California water user or water agency, State or Federal agency, Indian Tribe, or private non-profit organization for project purposes or any purpose recognized as beneficial under applicable State law. Except as provided herein, the terms of such transfers shall be set by mutual agreement between the transferee and the transferor.

(1) CONDITIONS FOR TRANSFERS. - All transfers to Central Valley Project water authorized by this subsection shall be subject to review and approval by the Secretary under the conditions specified in this subsection. Transfers involving more than 20 percent of the Central Valley Project water subject to long-term contract within any contracting district or agency shall also be subject to review and approval by such district or agency under the conditions specified in this subsection:

(A) No transfer to combination of transfers authorized by this subsection shall exceed, in any year, the average annual quantity of water under contract actually delivered to the contracting district or agency during the last three years of normal water delivery prior to the date of enactment of this title.

(B) All water under the contract which is transferred under authority of this subsection to any district or agency which is not a Central Valley Project contractor at the time of enactment of this title shall, if used for irrigation purposes, be repaid at the greater of the full-cost or cost of service rates, or, if the water is used for municipal and industrial purposes, at the greater of the cost of service or municipal and industrial rates.

(C) No transfers authorized by this subsection shall be approved unless the transfer is between a willing buyer and a willing seller under such terms and conditions as may be mutually agreed upon.

(D) No transfer authorized by this subsection shall be approved unless the transfer is consistent with State law, including but not limited to provisions of the California Environmental Quality Act.

(E) All transfers authorized by this subsection shall be deemed a beneficial use of water by the transferor for the purposes of section 8 of the Act of June 17, 1902, 32 Stat. 390, 43 U.S.C. 372.

(F) All transfers entered into pursuant to this subsection for uses outside the Central Valley Project service area shall be subject to a right of first refusal on the same terms and conditions by entities within the Central Valley Project service area. The right of first refusal must be exercised within ninety days from the date that notice is provided of the proposed transfer. Should an entity exercise the right of first refusal, it must compensate the transferee who had negotiated the agreement upon which the right of first refusal is being exercised for that entity's total costs associated with the development and negotiation of the transfer.

(G) No transfer authorized by this subsection shall be considered by the Secretary as conferring supplemental or additional benefits on Central Valley Project water contractors as provided in section 203 of Public Law 97-293 (43 U.S.C. 390(cc)).

(H) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary has determined, consistent with paragraph 3405(a)(2) of this title, that the transfer will not violate the provisions of this title or other Federal law and will have no significant adverse effect on the Secretary's ability to deliver water pursuant to the Secretary's Central Valley Project contractual obligations or fish and wildlife obligations under this title because of limitations in conveyance or pumping capacity.

(I) The water subject to any transfer undertaken pursuant to this subsection shall be limited to water that would have been consumptively used or irretrievably lost to beneficial use during the year or years of the transfer.

(J) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary determines, consistent with paragraph 3405(a)(2) of this title, that such transfer will have no significant long-term adverse impact on groundwater conditions in the transferor's service area.

(K) The Secretary shall not approve a transfer unless the Secretary determines, consistent with paragraph 3405(a)(2) of this title, that such transfer will have no unreasonable impact on the water supply, operations, or financial conditions of the transferor's contracting district or agency or its water users.

(L) The Secretary shall not approve a transfer if the Secretary determines, consistent with paragraph 3405(a)(2) of this title, that such transfer would result in a significant reduction in the quantity or decrease in the quality of water supplies currentlyused for fish and wildlife purposes, unless the Secretary determines pursuant to finding setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer. In the event of such a determination, the Secretary shall develop and implement alternative measures and mitigation activities as integral and concurrent elements of any such transfer to provide fish and wildlife benefits substantially equivalent to those lost as a consequence of such transfer.

(M) Transfers between Central Valley Project contractors within countries, watersheds, or other areas of origin, as those terms are utilized under California law, shall be deemed to meet the conditions set forth in subparagraphs (A) and (I) of this paragraph.

(2) REVIEW AND APPROVAL OF TRANSFERS. - All transfers subject to review and approval under this subsection shall be reviewed and approved in a manner consistent with the following:

(A) Decisions on water transfers subject to review by a contracting district or agency or by the Secretary shall be rendered within ninety days of receiving a written transfer proposal from the transferee or transferor. Such written proposal should provide all information reasonably necessary to determine whether the transfer complies with the terms and conditions of this subsection.

(B) All transfers subject to review by a contracting district or agency shall be reviewed in a public process similar to that provided for in section 226 of Pub. L. 97-293.

(C) The contracting district or agency or the Secretary shall approve all transfers subject to review and approval by such entity if such transfers are consistent with the terms and conditions of this subsection. To disapprove a transfer, the contracting district or agency or the Secretary shall inform the transferee and transferor, in writing, why the transfer does not comply with the terms and conditions of this subsection and what alternatives, if any, could be included so that the transfer would reasonably comply with the requirements of this subsection.

(D) If the contracting district or agency or the Secretary fails to approve or disapprove a proposed transfer within ninety days of receiving a complete written proposal from the transferee or transferor, then the transfer shall be deemed approved.

(3) Transfers executed after September 30, 1999 shall only be governed by the provisions of subparagraphs 3405(a)(1)(A)-(C), (E), (G), (H), (I), (L), and (M) of this title, and by State law.

(b) METERING OF WATER USE REQUIRED. - All Central Valley Project water service or repayment contracts for agricultural, municipal, or industrial purposes that are entered into, renewed, or amended under any provision of Federal Reclamation law after the date of enactment of this title, shall provide that the contracting district or agency shall ensure that all surface water delivery systems within its boundaries are equipped with water measuring devices or water measuring methods of comparable effectiveness acceptable to the Secretary within five years of the date of contract execution, amendment, or renewal, and that any new surface water delivery systems installed within its boundaries on or after the date of contract renewal are so equipped. The contracting district or agency shall inform the Secretary and the State of California annually as to the monthly volume of surface water delivered within its boundaries.

(c) STATE AND FEDERAL WATER QUALITY STANDARDS. - All Central Valley Project water service or repayment contracts for agricultural, municipal, or industrial purposes that are entered into, renewed, or amended under any provision of Federal Reclamation law after the date of enactment of this title, shall provide that the contracting district or agency shall be responsible for compliance with all applicable State and Federal water quality standards applicable to surface and subsurface agricultural drainage discharges generated within its boundaries. This subsection shall not affect or alter any legal obligation of the Secretary to provide drainage services.

(d) WATER PRICING REFORM. - All Central Valley Project water service or repayment contracts for a term longer than three years for agricultural, municipal, or industrial purposes that are entered into, renewed, or amended under any provision of Federal Reclamation law after the date of enactment of this title shall provide that all project water subject to contract shall be made available to districts, agencies, and other contracting entities pursuant to a system of tiered water pricing. Such a system shall specify rates for each district, agency or entity based on an inverted block rate structure with the following provisions:

(1) the first rate tier shall apply to a quantity of water up to 80 percent of the contract total and shall not be less than the applicable contract rate;

(2) the second rate tier shall apply to that quantity of water over 80 percent and under 90 percent of the contract total and shall be at a level halfway between the rates established under paragraphs (1) and (3) of this subsection;

(3) the third rate tier shall apply to that quantity of water over 90 percent of the contract total and shall not be less than the full cost rate; and

(4) the Secretary shall charge contractors only for water actually delivered. The Secretary shall waive application of this subsection as it relates to any project water delivered to produce a crop which the Secretary determines will provide significant and quantifiable habitat values for water fowl in fields where the water is used and the crops are produced; Provided, That such waiver shall apply only if such habitat values can be assured consistent with the goals and objectives of this title through binding agreements executed with or approved by the Secretary.

(e) WATER CONSERVATION STANDARDS. - The Secretary shall establish and administer an office on Central Valley Project water conservation best management practices that shall, in consultation with the Secretary of Agriculture, the California Department of Water Resources, California academic institutions, and Central Valley Project water users, develop criteria for evaluating the adequacy of all water conservation plans developed by project contractors, including those plans required by section 210 of the Reclamation Reform Act of 1982.

(1) Criteria developed pursuant to this subsection shall be established within six months following enactment of this title and shall be reviewed periodically thereafter, but no less than every three years, with the purpose of promoting the highest level of water use efficiency reasonably achievable by project contractors using best available cost-effective technology and best management practices. The criteria shall include, but not be limited to agricultural water suppliers' efficient water management practices developed pursuant to California State law or reasonable alternatives.

(2) The Secretary, through the office established under this subsection, shall review and evaluate within 18 months following enactment of this title all existing conservation plans submitted by project contractors to determine whether they meet the conservation and efficiency criteria established pursuant to this subsection.

(3) In developing the water conservation best management practice criteria required by this subsection, the Secretary shall take into account and grant substantial deference to the recommendations for action specific to water conservation and drainage source reduction proposed in the Final Report of the San Joaquin Valley Drainage Program, entitled A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley (September 1990).

(f) INCREASED REVENUES. - All revenues received by the Secretary as a result of the increased repayment rates applicable to water transferred from irrigation use to municipal and industrial use under subsection 3405(a) of this section, and all increased revenues received by the Secretary as a result of the increased water prices established under subsection 3405(d) of this section, shall be covered to the Restoration Fund.

SEC. 3406. FISH, WILDLIFE AND HABITAT RESTORATION.

(a) AMENDMENTS TO CENTRAL VALLEY PROJECT AUTHORIZATIONS

-Act of August 26, 1937. -Section 2 of the Act of August 26, 1937 (chapter 832; 50 Stat. 850), as amended, is amended.

(1) in the second proviso of subsection (a), by inserting "and mitigation, protection, and restoration of fish and wildlife" after "Indian reservations,";

(2) in the last proviso of subsection (a), by striking "domestic uses;" and inserting "domestic uses and fish and wildlife mitigation, protection and restoration purposes;" and by striking "power" and inserting "power and fish and wildlife enhancement";

(3) by adding at the end the following: "The mitigation for fish and wildlife losses incurred as a result of construction, operation, or maintenance of the Central Valley Project shall be based on the replacement of ecologically equivalent habitat and shall take place in accordance with the provisions of this title and concurrent with any future actions which adversely affect fish and wildlife populations or their habitat but shall have no priority over them."; and,

(4) by adding at the end the following: "(e) Nothing in this title shall affect the State's authority to condition water rights permits for the Central Valley Project."

--Sec. 3406(a) - Sec. 3406(b)--

(b) FISH AND WILDLIFE RESTORATION ACTIVITIES. - The Secretary, immediately upon the enactment of this title, shall operate the Central Valley Project to meet all obligations under state and federal law, including but not limited to the federal Endangered Species Act, 16 U.S.C. s 1531, et seq., and all decisions of the California State Water Resources Control Board establishing conditions on applicable licenses and permits for the project. The Secretary, in consultation with other State and Federal agencies, Indian tribes, and affected interests, is further authorized and directed to:

(1) develop within three years of enactment and implement a program which makes 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; Provided, That this goal shall not apply to the San Joaquin River between Friant Dam and the Mendota Pool, for which a separate program is authorized under subsection 3406(c) of this title; Provided further, That the programs and activities authorized by this section shall, when fully implemented, be deemed to meet the mitigation, protection, restoration, and enhancement purposes established by subsection 3406(a) of this title; And provided further, That in the course of developing and implementing this program the Secretary shall make all reasonable efforts consistent with the requirements of this section to address other identified adverse environmental impacts of the Central Valley Project not specifically enumerated in this section.

(A) This program shall give first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection; shall be reviewed and updated every five years; and shall describe how the Secretary intends to operate the Central Valley Project to meet the fish, wildlife, and habitat restoration goals and requirements set forth in this title and other project purposes.

(B) As needed to achieve the goals of this program, the Secretary is authorized and directed to modify Central Valley Project operations to provide flows of suitable quality, quantity, and timing to protect all life stages of anadromous fish, except that such flows shall be provided from the quantity of water dedicated to fish, wildlife, and habitat restoration purposes under paragraph (2) of this subsection; from the water supplies acquired pursuant to paragraph (3) of this subsection; and from other sources which do not conflict with fulfillment of the Secretary's remaining contractual obligations to provide Central Valley Project water for other authorized purposes. Instream flow needs for all Central Valley Project controlled streams and rivers shall be determined by the Secretary based on recommendations of the U.S. Fish and Wildlife Service after consultation with the California Department of Fish and Game.

(C) The Secretary shall cooperate with the State of California to ensure that, to the greatest degree practicable, the specific quantities of yield dedicated to and managed for fish and wildlife purposes under this title are credited against any additional obligations of the Central Valley Project which may be imposed by the State of California following enactment of this title, including but not limited to increased flow and reduced export obligations which may be imposed by the California State Water Resources Control Board in implementing San Francisco Bay/Sacramento-San Joaquin Delta Estuary standards pursuant to the review ordered by the California Court of Appeals in U.S. v. State Water Resources Control Board, 182 Cal.App.3rd 82 (1986), and that, to the greatest degree practicable, the programs and plans required by this title are developed and implemented in a way that avoids inconsistent or duplicative obligations from being imposed upon Central Valley Project water and power contractors.

(D) Costs associated with this paragraph shall be reimbursable pursuant to existing statutory and regulatory procedures.

(2) upon enactment of this title dedicate and manage annually 800,000 acre-feet of Central Valley Project yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help meet such obligations as may be legally imposed upon the Central Valley Project under state or federal law following the date of enactment of this title, including but not limited to additional obligations under the federal Endangered Species Act. For the purpose of this section, the term "Central Valley Project yield" means the delivery capability of the Central Valley Project during the 1928-1934 drought period after fishery, water quality, and other flow and operational requirements imposed by terms and conditions existing in licenses, permits, and other agreements pertaining to the Central Valley Project under applicable State or Federal law existing at the time of enactment of this title have been met.

(A) Such quantity of water shall be in addition to the quantities needed to implement paragraph 3406(d)(1) of this title and in addition to all water allocated pursuant to paragraph (23) of this subsection for release to the

Trinity River for the purposes of fishery restoration, propagation, and maintenance; and shall be supplemented by all water that comes under the Secretary's control pursuant to subsections 3406(b)(3), 3408(h)-(i), and through other measures consistent with subparagraph 3406(b)(1)(B) of this title.

(B) Such quantity of water shall be managed pursuant to conditions specified by the U.S. Fish and Wildlife Service after consultation with the Bureau of Reclamation and the California Department of Water Resources and in cooperation with the California Department of Fish and Game.

(C) The Secretary may temporarily reduce deliveries of the quantity of water dedicated under this paragraph up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water; Provided, That such reductions shall not exceed in percentage terms the reductions imposed on agricultural service contractors; provided further, That nothing in this subsection or subsection 3406(e) shall require the Secretary to operate the project in a way that jeopardizes human health or safety.

(D) 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.

(3) develop and implement a program in coordination and in conformance with the plan required under paragraph (1) of this subsection for the acquisition of a water supply to supplement the quantity of water dedicated to fish and wildlife purposes under paragraph (2) of this subsection and to fulfill the Secretary's obligations under paragraph 3406(d)(2) of this title. The program should identify how the Secretary intends to utilize, in particular the following options: improvements in or modifications of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land.

(4) develop and implement a program to mitigate for fishery impacts associated with operations of the Tracy Pumping Plan. Such program shall include, but is not limited to improvement or replacement of the fish screens and fish recovery facilities and practices associated with the Tracy Pumping Plant. Costs associated with this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25

percent shall be paid by the State of California. The reimbursable share of funding for this and other facility repairs, improvements, and construction shall be allocated among project water and power users in accordance with existing project cost allocation procedures.

(5) develop and implement a program to mitigate for fishery impacts resulting from operations of the Contra Costa Canal Pumping Plant No. 1. Such program shall provide for construction and operation of fish screening and recovery facilities, and for modified practices and operations. Costs associated with this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(6) install and operate a structural temperature control device at Shasta Dam and develop and implement modifications in CVP operations as needed to assist in the Secretary's efforts to control water temperatures in the upper Sacramento River in order to protect anadromous fish in the upper Sacramento River. Costs associated with planning and construction of the structural temperature control device shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(7) meet flow standards and objectives and diversion limits set forth in all laws and judicial decisions that apply to Central Valley Project facilities, including, but not limited to, provisions of this title and all obligations of the United States under the "Agreement Between the United States and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley project and the State Water Project" dated May 20, 1985, as well as Pub. L. 99-546.

(8) make use of short pulses of increased water flows to increase the survival of migrating anadromous fish moving into and through the Sacramento-San Joaquin Delta and Central Valley rivers and streams.

(9) develop and implement a program to eliminate, to the extent possible, losses of anadromous fish due to flow fluctuations caused by the operation of any Central Valley Project storage or re-regulating facility. The program shall be patterned where appropriate after the agreement between the California Department of Water Resources and the California Department of Fish and Game with respect to the operation of the California State Water Project Oroville Dam complex.

(10) develop and implement measures to minimize fish passage problems for adult and juvenile anadromous fish at the Red Bluff Diversion Dam in a manner that provides for the use of associated Central Valley Project conveyance facilities for delivery of water to the Sacramento Valley National Wildlife Refuge complex in accordance with the requirements of subsection (d) of this section. Costs associated with implementation of this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(11) rehabilitate and expand the Coleman National Fish Hatchery by implementing the U.S. Fish and Wildlife Service's Coleman National Fish Hatchery Development Plan, and modify the Keswick Dam Fish Trap to provide for its efficient operation at all project flow release levels and modify the basin below the Keswick Dam spillway to prevent the trapping of fish. Costs associated with implementation of this paragraph shall be reimbursed in accordance with the following formula: 50 percent shall be reimbursed as main project features and 50 percent shall be considered a nonreimbursable Federal expenditure.

(12) develop and implement a comprehensive program to provide flows to allow sufficient spawning, incubation, rearing, and outmigration for salmon and steelhead from Whiskeytown Dam as determined by instream flow studies conducted by the California Department of Fish and Game after Clear Creek has been restored and a new fish ladder has been constructed at the McCormick-Saeltzer Dam. Costs associated with channel restoration, passage improvements, and fish ladder construction required by this paragraph shall be allocated 50 percent to the United States as a nonreimbursable expenditure and 50 percent to the State of California. Costs associated with providing the flows required by this paragraph shall be allocated among project purposes.

(13) develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Upper Sacramento River from Keswick Dam to Red Bluff Diversion Dam in the American and Stanislaus Rivers downstream from the Nimbus and Goodwin Dams, respectively. The program shall include preventive measures, such as re-establishment of meander belts and limitations on future bank protection activities, in order to avoid further losses of instream and riparian habitat. Costs associated with implementation of this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a

nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(14) develop and implement a program which provides for modified operations and new or improved control structures at the Delta Cross Channel and Georgiana Slough during times when significant numbers of striped bass eggs, larvae, and juveniles approach the Sacramento River intake to the Delta Cross Channel or Georgiana Slough. Costs associated with implementation of this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(15) construct, in cooperation with the State of California and in consultation with local interests, a barrier at the head of Old River in the Sacramento-San Joaquin Delta to be operated on a seasonal basis to increase the survival of young outmigrating salmon that are diverted from the San Joaquin River to Central Valley Project and State Water Project pumping plants and in a manner that does not significantly impair the ability of local entities to divert water. The costs associated with implementation of this paragraph shall be reimbursed in accordance with the following formula: 37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(16) establish, in cooperation with independent entities and the State of California, a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley to assess the biological results and effectiveness of actions implemented pursuant to this subsection. 37.5 percent of the costs associated with implementation of this paragraph shall be reimbursed as main project features, 37.5 percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(17) develop and implement a program to resolve fishery passage problems at the Anderson-Cottonwood Irrigation District Diversion Dam as well as upstream stranding problems related to Anderson-Cottonwood Irrigation District Diversion Dam operations. Costs associated with implementation of this paragraph shall be allocated 50 percent to the United States as a nonreimbursable expenditure and 50 percent to the State of California.

(18) if requested by the State of California, assist in developing and implementing management measures to restore the striped bass fishery of the Bay-Delta estuary. Such measures shall be coordinated with efforts to protect and restore native fisheries. Costs associated with implementation of this paragraph shall be allocated 50 percent to the United States and 50 percent to the State of

California. The United States' share of costs associated with implementation of this paragraph shall be nonreimbursable.

(19) reevaluate existing operational criteria in order to maintain minimum carryover storage at Sacramento and Trinity River reservoirs to protect and restore the anadromous fish of the Sacramento and Trinity Rivers in accordance with the mandates and requirements of this subsection and subject to the Secretary's responsibility to fulfill all project purposes, including agricultural water delivery.

(20) participate with the State of California and other federal agencies in the implementation of the on-going program to mitigate fully for the fishery impacts associated with operations of the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant. Such participation shall include replacement of the defective fish screens and fish recovery facilities associated with the Hamilton City Pumping Plant. This authorization shall not be deemed to supersede or alter existing authorizations for the participation of other federal agencies in the mitigation program. Seventy-five percent shall be considered a nonreimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

(21) assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to less fishery-sensitive areas. The Secretary's share of costs associated with activities authorized under this paragraph shall not exceed 50 percent of the total cost of any such activity.

(22) provide such incentives as the Secretary determines to be appropriate or necessary, consistent with the goals and objectives of this title, to encourage farmers to participate in a program, which the Secretary shall develop, under which such farmers will keep fields flooded during appropriate time periods for the purposes of waterfowl habitat creation and maintenance and for Central Valley Project yield enhancement; Provided, That such incentives shall not exceed $2,000,000 annually, either directly or through credits against other contractual payment obligations, including the pricing waivers authorized under subsection 3405(d) of this title; Provided further, That the holder of the water contract shall pass such incentives through to farmers participating in the program, less reasonable contractor costs, if any; And provided further, That such water may be transferred subject to section 3405(a) of this title only if the farmer waives all rights to such incentives. This provision shall terminate by the year 2002.

(23) in order to meet Federal trust responsibilities to protect the fishery resources of the Hoopa Valley Tribe, and to meet the fishery restoration goals of the Act of October 24, 1984, Pub. L. 98-541, provide through the Trinity River Division, for water years 1992 through 1996, an instream release of water to the Trinity River of not less than 340,000 acre-feet per year for the purposes of fishery restoration, propagation, and maintenance and,

(A) by September 30, 1996, the Secretary, after consultation with the Hoopa Valley Tribe, shall complete the Trinity River Flow Evaluation Study currently being conducted by the U.S. Fish and Wildlife Service under the mandate of the Secretarial Decision of January 14, 1981, in a manner which insures the development of recommendations, based on the best available scientific data, regarding permanent instream fishery flow requirements and Trinity River Division operating criteria and procedures for the restoration and maintenance of the Trinity River fishery; and

(B) not later than December 31, 1996, the Secretary shall forward the recommendations of the Trinity River Flow Evaluation Study, referred to in subparagraph (A) of this paragraph, to the Committee on Energy and Natural Resources and the Select Committee on Indian Affairs of the Senate and the Committee on Interior and Insular Affairs and the Committee on Merchant Marine and Fisheries of the House of Representatives. If the Secretary and the Hoopa Valley Tribe concur in these recommendations, any increase to the minimum Trinity River instream fishery releases established under this paragraph and the operating criteria and procedures referred to in subparagraph (A) shall be implemented accordingly. If the Hoopa Valley Tribe and the Secretary do not concur, the minimum Trinity River instream fishery releases established under this paragraph shall remain in effect unless increased by an Act of Congress, appropriate judicial decree, or agreement between the Secretary and the Hoopa Valley Tribe. Costs associated with implementation of this paragraph shall be reimbursable as operation and maintenance expenditures pursuant to existing law.

If the Secretary and the State of California determine that long-term natural fishery productivity in all Central Valley Project controlled rivers and streams resulting from implementation of this section exceeds that which existed in the absence of Central Valley Project facilities, the costs of implementing those measures which are determined to provide such enhancement shall become credits to offset reimbursable costs associated with implementation of this subsection.

(c) SAN JOAQUIN AND STANISLAUS RIVERS. - The Secretary shall, by not later than September 30, 1996:

(1) develop a comprehensive plan, which is reasonable, prudent, and feasible, to address fish, wildlife, and habitat concerns on the San Joaquin River, including but not limited to the streamflow, channel, riparian habitat, and water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fisheries from Friant Dam to its confluence with the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Such plan shall be developed in cooperation with the California Department of Fish and Game and in coordination with the San Joaquin River Management Program under development by the State of California; shall comply with and contain any documents required by the National Environmental Policy Act and contain findings setting forth the basis for the Secretary's decision to adopt and implement the plan as well as recommendations concerning the need for subsequent Congressional action, if any; and shall incorporate, among other relevant factors, the potential contributions of tributary streams as well as the alternatives to be investigated under paragraph (2) of this subsection. During the time that the Secretary is developing the plan provided for in this subsection, and until such time as Congress has authorized the Secretary to implement such plan, with or without modifications, the Secretary shall not, as a measure to implement this title, make releases for the restoration of flows between Gravelly Ford and the Mendota Pool and shall not thereafter make such releases as a measure to implement this title without a specific Act of Congress authorizing such releases. In lieu of such requirement, and until such time as flows of sufficient quantity, quality and timing are provided at and below Gravelly Ford to meet the anadromous fishery needs identified pursuant to such plan, if any, entities who receive water from the Friant Division of the Central Valley Project shall be assessed, in addition to all other applicable charges, a $4.00 per acre-foot surcharge for all Project water delivered on or before September 30, 1997; a $5.00 per acre-foot surcharge for all Project water delivered after September 30, 1997 but on or before September 30, 1999; and a $7.00 per acre-foot surcharge for all Project water delivered thereafter, to be covered into the Restoration Fund.

(2) in the course of preparing the Stanislaus River Basin and Calaveras River Water Use Program Environmental Impact Statement and in consultation with the State of California, affected counties, and other interests, evaluate and determine existing and anticipated future basin needs in the Stanislaus River Basin. In the course of such evaluation, the Secretary shall investigate alternative storage, release, and delivery regimes, including but not limited to conjunctive use operations, conservation strategies, exchange arrangements,

and the use of base and channel maintenance flows, in order to best satisfy both basin and out-of-basin needs consistent, on a continuing basis, with the limitations and priorities established in the Act of October 23, 1962 (76 Stat. 173). For the purposes of this subparagraph, "basin needs" shall include water supply for agricultural, municipal and industrial uses, and maintenance and enhancement of water quality, and fish and wildlife resources within the Stanislaus River Basin as established by the Secretary's June 29, 1981 Record of Decision; and "out-of-basin" needs shall include all such needs outside of the Stanislaus River Basin, including those of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary and those of the San Joaquin River under paragraph (1) of this subsection.

(d) CENTRAL VALLEY REFUGES AND WILDLIFE HABITAT AREAS. - In support of the objectives of the Central Valley Habitat Joint Venture and in furtherance of the purposes of this title, the Secretary shall provide, either directly or through contractual agreements with other appropriate parties, firm water supplies of suitable quality to maintain and improve wetland habitat areas on units of the National Wildlife Refuge System in the Central Valley of California; on the Gray Lodge, Los Banos, Volta, North Grasslands, and Mendota state wildlife management areas; and on the Grasslands Resources Conservation District in the Central Valley of California.

(1) Upon enactment of this title, the quantity and delivery schedules of water measured at the boundaries of each wetland habitat area described in this paragraph shall be in accordance with Level 2 of the "Dependable Water Supply Needs" table for those habitat areas as set forth in the Refuge Water Supply Report and two-thirds of the water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin Action Plan/Kesterson Mitigation Action Plan Report prepared by the Bureau of Reclamation. Such water shall be provided through long-term contractual agreements with appropriate parties and shall be supplemented by the increment of water provided for in paragraph (1) of this subsection; Provided, That the Secretary shall be obligated to provide such water whether or not such long-term contractual agreements are in effect. In implementing this paragraph, the Secretary shall endeavor to diversify sources of supply in order to minimize possible adverse effects upon Central Valley Project contractors.

(2) Not later than ten years after enactment of this title, the quantity and delivery schedules of water measured at the boundaries of each wetland habitat area described in this paragraph shall be in accordance with Level 4 of the "Dependable Water Supply Needs" table for those habitat areas as set forth in the Refuge Water Supply Report and the full water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin

Action Plan/Kesterson Mitigation Action Plan Report prepared by the Bureau of Reclamation. The quantities of water required to supplement the quantities provided under paragraph (1) of this subsection shall be acquired by the Secretary in cooperation with the State of California and in consultation with the Central Valley Habitat Joint Venture and other interests in cumulating increments of not less than ten percent per annum through voluntary measures which include water conservation, conjunctive use, purchase, lease, donations, or similar activities, or a combination of such activities which do not require involuntary reallocations of project yield.

(3) All costs associated with implementation of paragraph (1) of this subsection shall be reimbursable pursuant to existing law. Incremental costs associated with implementation of paragraph (2) of this subsection shall be fully allocated in accordance with the following formula: 75 percent shall be deemed a nonreimbursable Federal expenditure; and 25 percent shall be allocated to the State of California for recovery through direct reimbursements or through equivalent in-kind contributions.

(4) The Secretary may temporarily reduce deliveries of the quantity of water dedicated under paragraph (1) of this subsection up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water; Provided, That such reductions shall not exceed in percentage terms the reductions imposed on agricultural service contractors. For the purpose of shortage allocation, the priority or priorities applicable to the increment of water provided under paragraph (2) of this subsection shall be the priority or priorities which applied to the water in question prior to its transfer to the purpose of providing such increment.

(5) The Secretary is authorized and directed to construct or to acquire from non-Federal entities such water conveyance facilities, conveyance capacity, and wells as are necessary to implement the requirements of this subsection; Provided, That such authorization shall not extend to conveyance facilities in or around the Sacramento-San Joaquin Delta Estuary. Associated construction or acquisition costs shall be reimbursable pursuant to existing law in accordance with the cost allocations set forth in paragraph (3) of this subsection.

(6) The Secretary, in consultation with the State of California, the Central Valley Habitat Joint Venture, and other interests, shall investigate and report on the following supplemental actions by not later than September 30, 1997:

(A) alternative means of improving the reliability and quality of water supplies currently available to privately owned wetlands in the Central Valley and the need, if any, for additional supplies; and

(B) water supply and delivery requirements necessary to permit full habitat development for water dependent wildlife on 120,000 acres supplemental to the existing wetland habitat acreage identified in Table 8 of the Central Valley Habitat Joint Venture's "Implementation Plan" dated April 19, 1990, as well as feasible means of meeting associated water supply requirements.

(e) SUPPORTING INVESTIGATIONS. - Not later than five years after the date of enactment of this title, the Secretary shall investigate and provide recommendations to the Committee on Energy and Natural Resources of the Senate and the Committees on Interior and Insular Affairs and Merchant Marine and Fisheries of the House on the feasibility, costs, and desirability of developing and implementing each of the following, including, but not limited to, the impact on the project, its users, and the State of California:

(1) measures to maintain suitable temperatures for anadromous fish survival in the Sacramento and San Joaquin rivers and their tributaries, and the Sacramento-San Joaquin Delta by controlling or relocating the discharge of irrigation return flows and sewage effluent, and by restoring riparian forests;

(2) opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries; Provided, That additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks;

(3) measures to eliminate barriers to upstream and downstream migration of salmonids in the Central Valley, including but not limited to screening programs, barrier removal programs and programs for the construction or rehabilitation of fish ladders on tributary streams;

(4) installation and operation of temperature control devices at Trinity Dam and Reservoir to assist in the Secretary's efforts to conserve cold water for fishery protection purposes;

(5) measures to provide for modified operations and new or improved control structures at the Delta Cross Channel and Georgiana Slough to assist in the successful migration of anadromous fish; and

(6) other measures which the Secretary determines would protect, restore, and enhance natural production of salmon and steel-head trout in tributary streams of the Sacramento and San Joaquin Rivers, including but not limited to the

Merced, Mokelumne, and Calaveras Rivers and Battle, Butte, Deer, Elder, Mill, and Thomes Creeks.

(f) REPORT OF PROJECT FISHERY IMPACTS. - The Secretary, in consultation with the Secretary of Commerce, the State of California, appropriate Indian tribes, and other appropriate public and private entities, shall investigate and report on all effects of the Central Valley Project on anadromous fish populations and the fisheries, communities, tribes, businesses and other interests and entities that have now or in the past had significant economic, social or cultural association with those fishery resources. The Secretary shall provide such report to the Committee on Energy and Natural Resources of the Senate and the Committees on Interior and Insular Affairs and Merchant Marine and Fisheries of the House of Representatives not later than two years after the date of enactment of this title.

(g) ECOSYSTEM AND WATER SYSTEM OPERATIONS MODELS. - The Secretary, in cooperation with the State of California and other relevant interests and experts, shall develop readily usable and broadly available models and supporting data to evaluate the ecologic and hydrologic effects of existing and alternative operations of public and private water facilities and systems in the Sacramento, San Joaquin, and Trinity River watersheds. The primary purpose of this effort shall be to support the Secretary's efforts in fulfilling the requirements of this title through improved scientific understanding concerning, but not limited to, the following:

(1) a comprehensive water budget of surface and groundwater supplies, considering all sources of inflow and outflow available over extended periods;

(2) related water quality conditions and improvement alternatives, including improved temperature prediction capabilities as they relate to storage;

(3) surface-ground and stream-wetland interactions;

(4) measures needed to restore anadromous fisheries to optimum and sustainable levels in accordance with the restored carrying capacities of Central Valley rivers, streams, and riparian habitats;

(5) development and use of base flows and channel maintenance flows to protect and restore natural channel and riparian habitat values;

(6) implementation of operational regimes at State and Federal facilities to increase springtime flow releases, retain additional floodwaters, and assist in restoring both upriver and downriver riparian habitats;

(7) measures designed to reach sustainable harvest levels of resident and anadromous fish, including development and use of systems of tradeable harvest rights;

(8) opportunities to protect and restore wetland and upland habitats throughout the Central Valley;

(9) measures to enhance the firm yield of existing Central Valley Project facilities, including improved management and operations, conjunctive use opportunities, development of offstream storage, levee setbacks, and riparian restoration.

All studies and investigations shall take into account and be fully consistent with the fish, wildlife, and habitat protection and restoration measures required by this title or by any other state or federal law. Seventy-five percent of the costs associated with implementation of this subsection shall be borne by the United States as a nonreimbursable cost; the remaining 25 percent shall be borne by the State of California.

(h) The Secretary shall enter into a binding cost-share agreement with the State of California with respect to the timely reimbursement of costs allocated to the State in this title. Such agreement shall provide for consideration of the value of direct reimbursements, specific contributions to the Restoration Fund, and water, conveyance capacity, or other contributions in-kind that would supplement existing programs and that would, as determined by the Secretary, materially contribute to attainment of the goals and objectives of this title.

SEC. 3407. RESTORATION FUND.

(a) RESTORATION FUND ESTABLISHED. - There is hereby established in the Treasury of the United States the "Central Valley Project Restoration Fund" (hereafter "Restoration Fund") which shall be available for deposit of donations from any source and revenues provided under sections 3404(c)(3), 3405(f), 3406(c)(1), and 3407(d) of this title. Amounts deposited shall be credited as offsetting collections. Not less than 67 percent of all funds made available to the Restoration Fund under this title are authorized to be appropriated to the Secretary to carry out the habitat restoration, improvement and acquisition (from willing sellers) provisions of this title. Not more than 33 percent of all funds made available to the Restoration Fund under this title are authorized to be appropriated to the Secretary to carry out the provisions of paragraphs 3406(b)(4)-(6), (10)-(18), and (20)-(22) of this title. Monies donated to the Restoration Fund by non-Federal entities for specific purposes shall be expended for those purposes only and shall not be subject to appropriation.

(b) AUTHORIZATION OF APPROPRIATIONS. - Such sums as are necessary, up to $50,000,000 per year (October 1992 price levels), are authorized to be appropriated to the Secretary to be derived from the Restoration Fund to carry out programs, projects, plans, and habitat restoration, improvement, and acquisition provisions of this title. Any funds paid into the Restoration Fund by Central Valley Project water and power contractors and which are also used to pay for the projects and facilities set forth in section 3406(b), shall act as an offset against any water and power contractor cost share obligations that are otherwise provided for in this title.

(c) MITIGATION AND RESTORATION PAYMENTS BY WATER AND POWER BENEFICIARIES. -

(1) To the extent required in appropriation Acts, the Secretary shall assess and collect additional annual mitigation and restoration payments, in addition to the charges provided for or collected under sections 3404(c)(3), 3405(a)(1)(C), 3405(f), and 3406(c)(1) of this title, consisting of charges to direct beneficiaries of the Central Valley Project under subsection (d) of this section in order to recover a portion or all of the costs of fish, wildfish, and habitat restoration programs and projects under this title.

(2) The payment described in this subsection shall be established at amounts that will result in collection, during each fiscal year, of an amount that can be reasonably expected to equal the amount appropriated each year, subject to subsection (d) of this section, and in combination with all other receipts identified under this title, to carry out the purpose identified in subsection (b) of this section; Provided, That, if the total amount appropriated under subsection (b) of this section; Provided, That, if the total amount appropriated under subsection (b) of this section for the fiscal years following enactment of this title does not equal $50,000,000 per year (October 1992 price levels) on an average annual basis, the Secretary shall impose such charges in fiscal year 1998 and in each fiscal year thereafter, subject to the limitations in subsection (d) of this section, as may be required to yield in fiscal year 1998 and in each fiscal year thereafter total collections equal to $50,000,000 per year (October 1992 price levels) on a three-year rolling average basis for each fiscal year that follows enactment of this title.

(d) ADJUSTMENT AND ASSESSMENT OF MITIGATION AND RESTORATION PAYMENTS. -

(1) In assessing the annual payments to carry out subsection (c) of this section, the Secretary shall, prior to each fiscal year, estimate the amount that could be collected in each fiscal year pursuant to subparagraphs 2(A) and (B) of this subsection. The Secretary shall decrease all such payments on a proportionate basis from amounts contained in the estimate so that an aggregate amount is collected pursuant to the requirements of paragraph (c)(2) of this section.

(2) The Secretary shall assess and collect the following mitigation and restoration payments, to be covered to the Restoration Fund, subject to the requirements of paragraph (1) of this subsection:

(A) The Secretary shall require Central Valley Project water and power contractors to make such additional annual payments as are necessary to yield, together with all other receipts, the amount required under paragraph (c)(2) of this subsection; Provided, That such additional payments shall not exceed $30,000,000 (October 1992 price levels) on a three-year rolling average basis; Provided further, That such additional annual payments shall be allocated so as not to exceed $6.00 per acre-foot (October 1992 price levels) for agricultural water sold and delivered by the Central Valley Project, and $12.00 per acre-foot (October 1992 price levels) for municipal and industrial water sold and delivered by the Central Valley Project;

Provided further, that the charge imposed on agricultural water shall be reduced, if necessary, to an amount within the probable ability of the water users to pay as determined and adjusted by the Secretary no less than every five years, taking into account the benefits resulting from implementation of this title; Provided further, That the Secretary shall impose an additional annual charge of $25.00 per acre-foot (October 1992 price levels) for Central Valley Project water sold or transferred to any State or local agency or other entity which has not previously been a Central Valley Project customer and which contracts with the Secretary or any other individual or district receiving Central Valley Project water to purchase or otherwise transfer any such water for its own use for municipal and industrial purposes, to be deposited in the Restoration Fund; And Provided further, That upon the completion of the fish, wildlife, and habitat mitigation and restoration actions mandated under section 3406 of this title, the Secretary shall reduce the sums described in paragraph (c)(2) of this section to $35,000,000 per year (October 1992 price levels) and shall reduce the annual mitigation and restoration payment ceiling established under this subsection to $15,000,000 (October 1992 price levels) on a three-year rolling average basis. The amount of the mitigation and restoration payment made by Central Valley Project water and power users, taking into account all funds collected under this title, shall, to the greatest degree practicable, be assessed in the same proportion, measured over a ten-year rolling average, as water and power users' respective allocations for repayment of the Central Valley Project.

(e) FUNDING TO NON-FEDERAL ENTITIES. - If the Secretary determines that the State of California or an agency or subdivision thereof, an Indian tribe, or a non-profit entity concerned with restoration, protection, or enhancement of fish, wildlife, habitat, or environmental values is able to assist in implementing any action authorized by this title in an efficient, timely, and cost effective manner, the

Secretary is authorized to provide funding to such entity on such terms and conditions as he deems necessary to assist in implementing the identified action.

(f) RESTORATION FUND FINANCIAL REPORTS. - The Secretary shall, not later than the first full fiscal year after enactment of this title, and annually thereafter, submit a detailed report to the Committee on Energy and Natural Resources and the Committee on Appropriations of the Senate, and the Committee on Interior and Insular Affairs, the Committee on Merchant Marine and Fisheries, and the Committee on Appropriations of the House of Representatives. Such report shall describe all receipts to and uses made of monies within the Restoration Fund and the Restoration Account during the prior fiscal year and shall include the Secretary's projection with respect to receipts to and uses to be made of the finds during the next upcoming fiscal year.

SEC. 3408. ADDITIONAL AUTHORITIES.

(a) REGULATIONS AND AGREEMENTS AUTHORIZED. - The Secretary is authorized and directed to promulgate such regulations and enter into such agreements as may be necessary to implement the intent, purposes and provisions of this title.

(b) USE OF ELECTRICAL ENERGY. - Electrical energy used to operate and maintain facilities developed for fish and wildlife purposes pursuant to this title, including that used for groundwater development, shall be deemed as Central Valley Project power and shall, if reimbursable, be repaid in accordance with Reclamation law at a price not higher than the lowest price paid by or charged to other Central Valley Project contractors.

(c) CONTRACTS FOR ADDITIONAL STORAGE AND DELIVERY OF WATER. - The Secretary is authorized to enter into contracts pursuant to Reclamation law and this title with any Federal agency, California water user or water agency, State agency, or private non-profit organization for the exchange, impoundment, storage, carriage, and delivery of Central Valley Project and non-project water for domestic, municipal, industrial, fish and wildlife, and any other beneficial purpose, except that nothing in this subsection shall be deemed to supersede the provisions of section 103 of Pub. L. 99-546 (100 Stat. 3051).

(d) USE OF PROJECT FACILITIES FOR WATER BANKING. - The Secretary, in consultation with the State of California, is authorized to enter into agreements to allow project contracting entities to use project facilities, where such facilities are not otherwise committee or required to fulfill project purposes or other Federal obligations, for supplying carry-over storage of irrigation and other water for drought protection, multiple-benefit credit-storage operations, and other purposes. The use of such water shall be consistent with and subject to State law. All or a portion of the water provided for fish and wildlife under this title may be banked for fish and wildlife purposes in accordance with this subsection.

(e) LIMITATION ON CONSTRUCTION. - This title does not and shall not be interpreted to authorize construction of water storage facilities, nor shall it limit the Secretary's ability to participate in water banking or conjunctive use programs.

(f) ANNUAL REPORTS TO CONGRESS. - Not later than September 30 of each calendar year after the date of enactment of this title, the Secretary shall submit a detailed report to the Committee on Energy and Natural Resources of the Senate and the committee on Interior and Insular Affairs and the Committee on Merchant Marine and Fisheries of the House of Representatives. Such report shall describe all significant actions taken by the Secretary pursuant to this title and progress toward achievement of the intent, purposes and provisions of this title. Such report shall include recommendations for authorizing legislation or other measures, if any, needed to implement the intent, purposes and provisions of this title.

(g) RECLAMATION LAW. - This title shall amend and supplement the Act of June 17, 1902, and Acts supplementary thereto and amendatory thereof.

(h) LAND RETIREMENT. -

(1) The Secretary is authorized to purchase from willing sellers land and associated water rights and other property interests identified in paragraph (h)(2) which receives Central Valley Project water under a contract executed with the United States, and to target such purchases to areas deemed most beneficial to the overall purchase program, including the purposes of this title.

(2) The Secretary is authorized to purchase, under the authority of paragraph (h)(i), and pursuant to such rules and regulations as may be adopted or promulgated to implement the provisions of this subsection, agricultural land which, in the opinion of the Secretary -

(A) would, if permanently retired from irrigation, improve water conservation by a district, or improve the quality of an irrigation district's agricultural wastewater and assist the district in implementing the provisions of a water conservation plan approved under section 210 of the Reclamation Reform Act of 1982 and agricultural wastewater management activities developed pursuant to recommendations specific to water conservation, drainage source reduction, and land retirement contained in the final report of the San Joaquin Valley Drainage Program (September, 1990); or

(B) are no longer suitable for sustained agricultural production because of permanent damage resulting from severe drainage or agricultural wastewater management problems, groundwater withdrawals, or other causes.

(i) WATER CONSERVATION. -

(1) The Secretary is authorized to undertake, in cooperation with Central Valley Project irrigation contractors, water conservation projects or measures needed to meet the requirements of this title. The Secretary shall execute a cost-sharing agreement for any such project or measure undertaken. Under such agreement, the Secretary is authorized to pay up to 100 percent of the costs of such projects or measures. Any water saved by such projects or measures shall be governed by the conditions of subparagraph 3405(a)(1)(A) and (J) of this title, and shall be made available to the Secretary in proportion to the Secretary's contribution to the total cost of such project or measure. Such water shall be used by the Secretary to meet the Secretary's obligations under this title, including the requirements of paragraph 3406(b)(3). Such projects or measures must be implemented fully by September 30, 1999.

(2) There are authorized to be appropriated through the end of fiscal year 1998 such sums as may be necessary to carry out the provisions of this subsection. Funds appropriated under this subsection shall be nonreimbursable Federal expenditure.

(j) PROJECT YIELD INCREASE. - In order to minimize adverse effects, if any, upon existing Central Valley Project water contractors resulting from the water dedicated to fish and wildlife under this title, and to assist the State of California in meeting its future water needs, the Secretary shall, not later than three years after the date of enactment of this title, develop and submit to the Congress, a least-cost plan to increase, within fifteen years after the date of enactment of this title, the yield of the Central Valley Project by the amount dedicated to fish and wildlife purposes under this title. The plan authorized by this subsection shall include, but shall not be limited to a description of how the Secretary intends to use the following options:

(1) improvements in, modification of, or additions to the facilities and operations of the project;

(2) conservation;

(3) transfers;

(4) conjunctive use;

(5) purchase of water;

(6) purchase and idling of agricultural land; and

(7) direct purchase of water rights.

--Sec. 3408(i) - Sec. 3408(k)

Such plan shall include recommendations on appropriate cost-sharing arrangements and shall be developed in a manner consistent with all applicable State and Federal law.

(k) Except as specifically provided in this title, nothing in this title is intended to alter the terms of any final judicial decree confirming or determining water rights.

SEC. 3409. ENVIRONMENTAL REVIEW.

Not later than three years after the date of enactment of this title, the Secretary shall prepare and complete a programmatic environmental impact statement pursuant to the National Environmental Policy Act analyzing the direct and indirect impacts and benefits of implementing this title, including all fish, wildlife, and habitat restoration actions and the potential renewal of all existing Central Valley Project water contracts. Such statement shall consider impacts and benefits within the Sacramento, San Joaquin, and Trinity River basins, and the San Francisco Bay/Sacramento-San Joaquin River Delta Estuary. The cost of the environmental impact statement described in this section shall be treated as a capital expense in accordance with Reclamation law.

SEC. 3410. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this title. Funds appropriated under this title shall remain available until expended without fiscal year limitation.

SEC. 3411. COMPLIANCE WITH STATE WATER LAW AND COORDINATED OPERATIONS AGREEMENT.

(a) Notwithstanding any other provision of this title, the Secretary shall, prior to the reallocation of water from any purpose of use or place of use specified within applicable Central Valley Project water rights permits and licenses to a purpose of use or place of use not specified within said permits or licenses, obtain a modification in those permits and licenses, in a manner consistent with the provisions of applicable State law, to allow such change in purpose of use or place of use.

(b) The Secretary, in the implementation of the provisions of this title, shall fully comply with the United States' obligations as set forth in the "Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project: dated May 20, 1985, and the provisions of Pub. L. 99-546; and shall take no action which shifts an obligation that otherwise should be borne by the Central Valley Project to any other lawful water rights permittee or licensee.

SEC. 3412. EXTENSION OF THE TEHAMA-COLUSA CANAL SERVICE AREA.

The first paragraph of section 2 of the Act of September 26, 1950 (64 Stat. 1036), as amended by the Act of August 19, 1967 (81 Stat. 167), and the Act of December 22, 1980 (94 Stat. 3339), authorizing the Sacramento Valley Irrigation Canals, Central Valley Project, California, is further amended by striking "Tehama, Glenn, and Colusa Counties, and those portions of Yolo County within the boundaries of the Colusa County, Dunnigan, and Yolo-Zamora water districts or" and inserting "Tehama, Glenn, Colusa, Solano, and Napa Counties, those portions of Yolo County within the boundaries of Colusa Water District, Dunnigan Water-District, Yolo-Zamora Water District, and Yolo County Flood Control and Water Conservation District, or".

ATTACHMENT B

DISTRIBUTION OF FINAL PEIS

Attachment B

DISTRIBUTION OF FINAL PEIS*

Cooperating Agencies

CA Department of Fish & Game*
CA Department of Water Resources*
CA State Water Resources Control Board*
Hoopa Valley Tribal Council*
National Marine Fisheries Service*
U.S. Army Corps of Engineers*
U.S. Environmental Protection Agency*
U.S. Fish & Wildlife Service*
Western Area Power Administration*

Consulting Agencies

Natural Resources Conservation Service*
U.S. Bureau of Indian Affairs*
U.S. Geological Survey*

Other Federal State Agencies/Organizations

Bay Conservation & Development Commission
CA Air Resources Board
CA Coastal Commission
CA Coastal Conservancy
CA Department of Boating and Waterways
CA Department of Food & Agriculture
CA Department of Forestry & Fire Protection
CA Department of Health Services
CA Department of Parks & Recreation
CA Energy Commission
CA Environmental Protection Agency
CA Regional Water Quality Control Boards (9)
CA Resources Agency*
CA State Clearinghouse*
CA State Parks & Recreation
CA Water Commission
CALFED Bay-Delta Program*
Colorado River Board of CA
Council of Environmental Quality
Delta Protection Commission
Department of Pesticide Regulation
Federal Emergency Management Agency
Legislative Counsel Bureau
Native American Heritage Commission
National Park Service*
Office of Legislative Council
Office of Metro Water Planning
Office of Planning & Research
Reclamation Board
Regional Water Quality Control Board*
Sacramento National Wildlife Refuge
State Lands Commission
State of Nevada
U.S. Bureau of Land Management*
U.S. Department of Agriculture
U.S. Department of Energy
U.S. Department of the Interior

Elected Officials*

CA Assembly, Committee on Agriculture
CA Assembly, Committee on Natural Resources
CA Assembly, Committee on Utilities and Commerce
CA Assembly, Committee on Water, Parks and Wildlife
CA Senate, Committee on Energy, Utilities and Communications
CA Senate, Committee on Natural Resources and Wildlife
CA Senate, State Appropriations Committee
Office of the Governor, State of California
U.S. House of Representatives (California Delegation)
U.S. House of Representatives, Committee on
Appropriations, Energy & Water Development
U.S. House of Representatives, Committee on Resources
U.S. Senate, Committee on Agriculture & Water
U.S. Senate, Committee on Energy & Natural Resources
U.S. Senate, Senators Barbara Boxer & Diane Feinstein

Other Interested Parties

American Farmland Trust
American Whitewater Affiliation Parties
Association of CA Water Agencies
Audubon Society*
Baker, Manock & Jenson
Bank of America
Battelle Pacific Northwest Laboratory*
Bay Conservation & Development Commission
Bay Institute of San Francisco*
CA Advisory Committee Salmon & Steelhead Trout
CA Farm Bureau Federation
CA Farm Water Coalition*
CA Municipal Utilities Association
CA Striped Bass Association
Calaveras County*
California Trout
California Urban Water Agencies*
California Waterfowl Association
California Wildlife Foundation
Central Delta Water Agency*
Central Sierra Planning Council
Central Valley Project Water Users Association*
Cherokee Ranch
Citizens for Cloverdale*
City and County of San Francisco*
City of Folsom
City of Fresno Public Utilities*
City of Mendota

***Asterisk indicates organization was sent the Final PEIS. Others listed received the Executive Summary. Not listed are other organizations and individuals who have specifically requested the document. Reclamation has also distributed the PEIS to other organizations and individuals who have specifically requested the document.**

Other Interested Parties (Continued)

City of Modesto
City of Redding
City of Redding Electric Department*
City of Sacramento*
City of San Diego Water Department*
City of Stockton*
Contra Costa County Department of Agriculture*
Contra Costa Water District
County of Sacramento
County of Santa Cruz*
CVP Customer Technical Committee
De Cuir & Somach*
Delta Protection Commission*
Dooley and Herr*
Downey, Brand, Seymour & Rohwer*
EA Engineering, Science and Technology
East Bay Municipal Utility District*
East Palo Alto Historical & Agricultural*
El Dorado County Water Agency*
El Dorado County Trail Users of the Divide
Endangered Species Recovery Program
Environmental Defense Fund*
Environmental Law Foundation
Friant Water Users Authority*
Friends of Navarro Watershed
Frost, Krup & Atlas*
Gagen, McCoy, McMahon & Armstrong*
Glenn County*
Golden Gate Angling & Casting Club
Golden West Women Fly Fishers
Griffith, Masuda & Godwin
JFK University School of Law
Kahn Soares & Conway*
Kronick Moskovitz*
Lasher, Holzapfel, Sperry & Ebberson*
Law Offices of Barry Epstein*
League of Women Voters*
Los Angeles Department of Water and Power*
Los Angeles County Department of Public Works*
Lower Tule River Irrigation District
Martinez & Curtis, P.C.*
Mehlaff, Hay & Swingle*
Mendocino County
Mendocino County Courthouse
Mendota Unified School District
Metropolitan Water District of Southern California
Morongo Band of Mission Indians*
Murray, Burns & Kienlen
Native American Heritage Commission*
Natural Heritage Institute
Natural Resources Defense Council*
Neumiller & Beardslee*
Nevada County Farm Bureau*
NORCAL Fishing Guides & Sportmens*
Northern California Council Federation of Fly Fishers
Northern California Power Agency
Northern California Water Association
Northwestern University*
Oak Ridge National Laboratory*
Orange County Planning Department*
Orangevale Water Company
Pacific Coast Federation of Fisherman's Association*
Pacific Fishery Management Council
Patterson Water District*
Placer County Water Agency
Redding - Electric
Resource Management International
Rural Water Impact Network
Sacramento City and County Office of Water Planning
Sacramento Municipal Utility District
Sacramento River Council
Sacramento River Water Contractors Association
Sacramento Valley Landowners Association
Salmon Trollers Marketing Association
San Francisco Bay Regional Water Board*
San Francisco Estuary Project
Sanger Chamber of Commerce
San Joaquin County
San Luis & Delta-Mendota Water Authority*
Santa Clara County*
Santa Clara Valley Water District
Save the San Francisco Bay Association
Share the Water
Shasta County Farm Bureau
Sierra Club*
Siskiyou County Farm Bureau
Solano Irrigation District
South Delta Water Agency*
Sportsmen Council of Northern California
Stanislaus Area Association of Governments*
State Lands Commission*
State Water Contractors*
Stockton East Water District
Sutter Mutual Water Company
Tehama Fly Fishers Preservation Trust
Tehama Sportsman Club
Tehama-Colusa Canal Authority*
The Nature Conservancy
The Public Trustee*
Tribal Environmental Protection Agency*
Trinity County
Trinity County Natural Resources*
Trinity County Public Utilities District
Trout Unlimited of California
Tuolumne County*
Turlock Irrigation District
United Anglers of California
Van Ruiten Bros.
Westlands Water District*

Libraries*

Alum Rock Library
Alturas Public Library
Amador County Library
Auburn-Placer County Library
Bakersfield Library
Burbank Public Library
Butte County Library
Calaveras County Library
California State Library
College of the Redwoods
Colusa County Free Library
Concord Library

Libraries (Continued)

Contra Costa County Library
CSU - Chico, Meriam Library-Government Publications
CSU - Long Beach, Library-Government Documents
CSU - Stanislaus
Del Norte County Library District
Dixon Unified School District Library
E.P. Foster and H.P. Wright Library
El Dorado County Library
Fresno County Public Library
Grass Valley-Sierra County Library
Humboldt County Library
Kern County Public Library
Kings County Library
Lake County Library
Lassen County Free Library
Lodi Public Library
Los Angeles Public Library
Los Banos City Library
Madera County Library
Marin County Civic Center Library
Mariposa County Library
Mendocino County Library
Merced Library
Modesto City Library
Monterey County Free Library
Napa City and County Library
Nevada City Library
Oakland Public Library
Orange County Public Library
Plumas County Library
Red Bluff City Library
Redwood City-San Mateo County Library
Riverside City and County Library
Sacramento County Library
Sacramento Public Library
San Benito County Free Library
San Bernadino County Library
San Diego Public Library
San Diego State University
San Francisco Public Library
San Jose State University
San Luis Obispo City and County Library
San Rafael Civic Center Library
Santa Barbara Public Library
Santa Cruz Public Library
Shasta County Library
Siskiyou County Library
Solano County Library
Sonoma County Library
Stanford University Libraries
Stanislaus County Free Library
Stockton City Library
Stockton-San Joaquin County Public Library
Sutter County Library
Tehama County Library
Trinity County Library
Tulare County Free Library
Tulare Public Library
Tuolumne County Library
U.C. Berkeley Library
U.C. Davis Library
U.C., Hastings College of Law
U.C. Los Angeles, University Research Library
U.C. San Diego, Government Documents/Maps Department
U.C. Santa Barbara, Library-Government Publications Section
U.C. Water Resources Center
Willows Public Library
Yolo County Library
Yuba County Library

ATTACHMENT C

LIST OF PREPARERS

Attachment C

LIST OF PREPARERS

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Department of Interior			
Richard Hardt	Ph.D., Forest Ecology M.L.A., Landscape Architecture and Regional Planning B.A., Natural Sciences 5 Years	NEPA Environmental Planning Ecology	Review
Bureau of Reclamation			
Rick Breitenbach	M.S., Biological Conservation B.S., Biology 24 Years	Environmental Planning Regulatory Compliance	Project Planning Alternative Development
John "Chip" Bruss	B.S., Wildlife Biology 19 Years	Natural Resource Management Native American Issues	Vegetation and Wildlife and Indian Trust Assets Review
Alan Candlish	B.S., Civil Engineering 26 Years	Water Resource Planning Project Management	Project Management Review
Randy Christopherson	M.S., Agribusiness Management B.S., Agricultural Economics 17 Years	Agricultural Economist Resource Manager Resource Economist	Project Planning
Shannon Cunniff	M.A., Geography B.A., Biology 16 Years	Environmental Impact Assessment/NEPA Compliance Water Resources Policy	Review
Thomas Dang	B.S., Electrical Engineering 12 Years	Hydropower Modeling Power Operations and Planning FERC Licensing	Power Impact Analysis Power Review Analytical Tools
Merv de Haas	M.S., Agricultural Economics Business Management B.S., Agricultural Economics 27 Years	Repayment Contract Administration Economics	Project Planning Analytical Tools
Marian Echeverria	M.B.A. B.A., Latin American Studies 8 Years	Public Involvement Facilitation Dispute Resolution	Public Involvement
Rosalie Faubion	M.S., Education B.S., Biology 32 Years	Fish and Wildlife Biology	Vegetation and Wildlife Review
John Fields	B.S., Environmental Toxicology 19 Years	Water Quality and Toxicology	Public Health - Delta as a Source of Drinking Water Review
Kurt Flynn	B.S., Biology 15 Years	NEPA ESA	Vegetation and Wildlife Review
Gale Heffler-Scott	32 Years	Repayment Contract Administration Water Rights	Water Transfer Review

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Buford Holt	Ph.D., Botany and Plant Pathology B.S., Botany 30 Years	Plant Ecology and Population Biology Environmental Assessment mineral resource management and water resource management	Vegetation and Wildlife Review
Will Keck	M.S., International Relations B.S., Political Science 22 Years	Outdoor Recreation Planning Special Projects Coordinator	Recreation Review
Tammy Kendrick	32 Years	Acreage Limitations of Reclamation Law Environmental Compliance	Pro-ject Planning No Action Alternative
Doug Kleinsmith	M.S., Biology B.A., Biology 20 Years	Biology Environmental Compliance	NEPA Coordination Visual Resources Review
Sue Kristoff	B.S., Civil Engineering 9 Years	Hydraulic Engineering	Project Planning Analytical Tools
Ken Lentz	M.S., Fisheries Biology B.S., Fisheries Biology 27 Years	Fisheries Aquatic Biology	Fisheries Review
Peggy Manza	B.S., Hydrologic Sciences	Hydrologic Modeling	Surface Water Review
Frank Michny	M.S., Fish and Wildlife Biology B.S., Biology 25 Years	Fish and Wildlife Biology Environmental Compliance	ESA NEPA Compliance Review
David Moore	M.S., Geology B.S., Geology 18 Years	Geology and Hydrogeology	Groundwater Review
Betty Riley-Simpson	B.S., Business Administration 22 Years	Repayment Contract Administration	Review
Kirk Rodgers	26 Years	Project Management Program Management ESA	Program Manager Project Plannining
Ted Roefs	M.S., Civil Engineering B.S., Civil Engineering 40 Years	Hydrology Systems Analysis	Surface Water Review
Jeff Sandberg	M.A., Geography B.A., Geography 9 Years	Hydrologic Modeling Water Rights	Surface Water Review
Chuck Solomon	M.S., Environmental Science M.S., Biology B.A., Biology 28 Years	Terrestrial Ecology Habitat Modeling Wildlife Management	Vegetation and Wildlife Review
Craig Stroh	M.A., Economics B.A., Economics 29 Years	Economics	Economics and Social Analysis Review
Bernice Sullivan	2 Years College 37 Years Experience	Administrative Management Technical Writer/Editor Resource Management Environmental Planning Watershed Program Management/Coordination	Review
Ramona Swafford	B.A., Statistics	Hydrology	Surface Water Review

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Lenore Thomas	Post Graduate - Civil Engineering M.S., Water Resources Management B.S., Biology B.S., Secondary Education 30 Years	Hydraulic Engineer	Technical Review
Don Treasure	B.S., Wildlife Management 24 Years	Fish and Wildlife Biology Environmental Compliance	NEPA Compliance Review
Judith Troast	M.S., Biology B.S., Biology 29 Years	Environmental Impact Assessment (compliance with environmental laws, including NEPA, ESA, CWA) Water Policy	Advisory Review
Robert Turner	B.S., Geology 28 Years	Geology and Hydrogeology	Groundwater and Geology and Soils Review
Patrick Welch	B.A., Chemistry 23 Years	Cultural Resources/Archeology	Cultural Resources Review
G. James West	Ph.D. 27 Years	Cultural Resources/Archeology	Cultural Resources Review
Fish and Wildlife Service			
Jerry Bielfeldt	B.S., Biology 12 Years	Fish and Wildlife Biology	PEIS Document Review Vegetation and Wildlife Review
Roger Guinee	B.S., Wildlife Biology 24 Years	Fish and Wildlife Biology	Fisheries Review
Andrew Hamilton	M.S., Aquatic Ecology B.A., Comparative Literature 21 Years	Fish and Wildlife Biology	Fisheries Review
Derek Hilts	M.S., Water Resources B.S., Civil Engineering 17 Years	CVP/SWP Operations Computer Programming Hydrology	Surface Water Review
Michael Hoover	B.S., Biology 20 Years	Fish and Wildlife Biology Environmental Compliance	Project Planning PEIS Document Review Vegetation and Wildlife Review NEPA Compliance
Patrick Leonard	M.S., Animal Behavior B.A., Anthropology 12 Years	Fish and Wildlife Biology ESA Issues	PEIS Document Review Vegetation and Wildlife Review
Joel Miller	B.S., Wildlife Biology 29 Years	Wildlife Biology Refuge Management	Vegetation and Wildlife Review Refuge Water Supply
Steven Schoenberg	Ph.D., Biology/Ecology M.S., Biology/Ecology B.S., Biology 22 Years	Fish and Wildlife Biology Aquatic Ecology	Fisheries Review
James G. Smith	B.S., Fisheries Post Graduate Work 24 Years	Fisheries Biology	Fisheries Review
Marie Sullivan	M.S., Natural Science B.S., Environmental Planning 12 Years	Fish and Wildlife Biology	Vegetation and Wildlife Review (b) (1) “other” Program Review

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Western Area Power Administration			
P. Nannette Engelbrite	B.S., Electrical Engineering 15 Years	Power Engineering	Power Impact Analysis
Phil House	B.S., Civil Engineering 30 Years	Power Resource Planning	Power Impact Analysis
John Johannis	B.S., Civil Engineering 19 Years	Hydraulic Modeling Power Planning Water Operations Hydrology	Project Planning Project Management Review
Montgomery Watson			
David Alderete	B.S., Civil Engineering 4 years	Civil Engineer	Municipal and Industrial Land Use and Demographics, Surface Water Supplies and Facilities Operations
Michael Cornelius	M.S., Environmental Engineering B.S., Geology 7 years	Geology and Hydrogeology	Groundwater, Soils and Geology
Sarah Holmgren	M.S., Conservation Ecology B.S., Environmental Health Science 4 years	Ecology	Municipal and Industrial Land Use and Demographics
Carol Howe	B.S., Planning 23 years	Water Quality and Aquatic Habitat	Municipal and Industrial Land Use and Demographics
Colleen Montgomery	B.S., communications 7 years	Technical Editor Desktop Publisher	Technical Editor Desktop Publisher
Robert Morrow	B.S., Biology 13 years	Fisheries	Fisheries
Vanessa Nishikawa	M.S., Environmental Engineering B.S., Bioengineering 4 years	Environmental Engineer	Surface Water Supplies and Facilities Operations, PROSIM M/M
Roger Putty	M.S., Water Resources Engineering and Hydrology B.S., Civil Engineering 11 years	Environmental Engineer/ Hydrogeology	Groundwater, Surface Water Supplies and Facilities Operations, CVGSM M/M
Kevan Samsam	B.S., Civil Engineering 1 year	Civil Engineer	Groundwater, CVGSM M/M
Sandra Siems	B.S., Agriculture Business 10 years	Economist/Planner	Soils and Geology, Social
William Swanson	B.S., Civil Engineering 15 years	Environmental Engineer/Hydrology	Surface Water Supplies and Facilities Operations, Air Quality, Public Health: Mosquitoes, Indian Trust Assets, Visual Resources, SANJASM M/M
Ali Taghavi	Ph.D., Civil Engineering 15 years	Environmental Engineer/ Hydrogeologist	Groundwater, CVGSM M/M
Paul Wisheropp	M.S., Civil Engineering 15 years	Water Resources Engineer	PROSIM M/M
Derrick Wong	M.S., Environmental Engineering B.S., Civil Engineering 3 years	Environmental Engineer/ Hydrologist	Surface Water Supplies and Facilities Operations, SANJASM M/M
CH2M HILL			
Loren Bottorff	M.S., Civil Engineering 22 years	Water Resources Engineer	Development of Alternatives

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Gwendolyn M. Buchholz	M.S., Civil-Environmental Engineering B.S., Physics 22 years	Environmental Engineer/Planner	Deputy Project Manager
Earl Byron	M.S., Biology 17 years	Fisheries	Fisheries
Rhonda Detherage	14 Years	Desktop Publisher	Desktop Publisher
Neal Dixon	Ph.D., Water Resources 35 years	Water Resources Engineer	Surface Water Supplies and Facilities Operations
D'Arcy Hale	MBA 28 Years	Desktop Publisher	Desktop Publisher
Tim Hamaker	B.S., Biology 17 years	Fisheries Biologist	Fisheries
Steve Hatchett	Ph.D., Agricultural Economics M. Admin., Environmental Administration B.S., Forestry 19 Years	Agricultural and Resources Economist	Agricultural Economics, CVPM M/M, Water Transfer Opportunities, CVPTM M/M
Allan Highstreet	M.S., Agricultural Economics B.S., Agricultural Business Management 21 years	Agricultural and Resources Economist	Agricultural Economics and Land Use, CVPM M/M, Municipal Water Costs, Water Transfer Opportunities
Wendy Haydon	M.S., Recreation B.S., Environmental Studies 10 years	Environmental Planner	Public Health: Mosquitoes, Visual Resources
Umesh Laliwani	Ph.D., Environmental Engineering 5 years	Environmental Engineer	Groundwater
Roger Mann	Ph.D., Agricultural and Resource Economics M.S., Agricultural and Resource Economics B.S., Resource Economics 18 years	Agricultural and Resources Economist	Municipal Water Costs, Water Transfer Opportunities
John O'Connor	Ph.D., Agricultural Economics M.S., Agricultural Economics B.A., Economics 4 Years	Agricultural and Resources Economist	Regional Economics
Anne Sienko	B.A., Ecology and Evolution 4 years	Ecology	Public Health: The Delta as a Source of Drinking Water
F. Phillip Sharpe	Post Graduate- Economics/Statistics M.S., Biology/Statistics B.S., Fishery Science 41 years	Fisheries Biologist	Project Manager
Robert Tull	M.S.E., Environmental Engineering B.S., Environmental Planning 11 years	Environmental Engineer/ Hydrologist	Surface Water Supplies and Facilities Operations, PROSIM M/M
Melissa Williams	B.S., Biology	Environmental Planner	Public Health: Mosquitoes, Air Quality, Visual Resources
Bing Zhang	Ph.D., Agricultural Economics M.S., Agricultural Economics B.S., Agricultural Economics 12 years	Agricultural and Resources Economist	Agricultural Economics and Land Use, Municipal Water Costs, Water Transfer Opportunities, CVPTM M/M
Jones & Stokes Associates, Inc.			
Edward Beedy	Ph.D., M.A., B.S., Zoology 22 years	Zoologist	Vegetation and Wildlife

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Russ Brown	Ph.D., Civil Engineering, Water Resources M.S., Ocean Engineering B.S., Civil and Environmental Engineering 18 years	Environmental Engineer	Fish Habitat Water Quality and Fish Habitat Water Quality M/M
Roberta Childers	B.A., Political Science 7 years	Publications Specialist, Technical Editor	Cultural Resources; Fisheries; Fish Habitat Water Quality; Fish, Wildlife, and Recreation Economics; Recreation; Vegetation and Wildlife
Gregg Ellis	B.A., Geography 4 years	Environmental Compliance	Cultural Resources; Fisheries; Fish Habitat Water Quality; Fish, Wildlife, and Recreation Economics; Recreation; Vegetation and Wildlife
Mary Engbring	18 years	Graphics Artist	Graphics
Matt Gause	B.S., Botany 7 years	Botanist	Vegetation and Wildlife
Steve Holl	M.S., Vertebrate Biology B.S., Wildlife and Fisheries Biology 20 years	Wildlife Biologist	Vegetation and Wildlife and Vegetation and Wildlife M/M
Brant Jorgensen	B.S., Environment Toxicology 4 years	Environmental Compliance	Recreation and Cultural Resources
Dana McGowan	M.A., Anthropology B.A., Anthropology 13 years	Anthropologist	Cultural Resources
Tim Messick	M.A., Biology B.A., Botany 15 years	Botanist, Graphic Artist	Vegetation and Wildlife
Rick Oestman	M.S., Fisheries B.A., Fisheries 9 years	Fisheries Biologist	Fisheries
Jane Palik	8 years	Word Processing Operator	Word Processing
Gerrit Platenkamp	Ph.D., Ecology M.S., Animal and Plant Ecology B.S., Biology 14 years	Ecologist	Vegetation and Wildlife; Vegetation and Wildlife M/M
Tim Rimpo	M.S., Economics (Natural Resource and Environmental Specialization) B.A., Economics 11 years	Natural Resource Economist	Recreation
Gregg Roy	B.S., Political Economy of Natural Resources 15 years	Economist	Recreation and Recreation M/M
Warren Shaul	M.S., Fisheries B.S., Biology 19 years	Fisheries Biologist	Fisheries
Todd Sloat	B.S., Wildlife and Fisheries Biology 5 years	Wildlife Biologist	Vegetation and Wildlife
Alan Solbert	M.S., Wildlife Sciences and Ecology B.S., Biology and Zoology 19 years	Environmental Compliance	Cultural Resources; Fisheries; Fish Habitat Water Quality; Fish, Wildlife, and Recreation Economics; Recreation; Vegetation and Wildlife

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role in Preparation
Craig Stevens	B.S., Renewable Natural Resources 14 years	Environmental Compliance	Cultural Resources; Fisheries; Fish Habitat Water Quality; Fish, Wildlife, and Recreation Economics; Recreation; Vegetation and Wildlife
Stephanie Theis	M.S., Applied Ecology and Conservation Biology (pending) B.S., Fisheries Biology 6 years	Ecologist	Fisheries
Roger Trott	M.S., Agricultural Economics B.A., Economics 12 years	Economist	Fish, Wildlife, and Recreation Economics
Thomas Wegge	M.S., Environmental Economics B.A., Urban Studies 19 years	Economist	Fish, Wildlife, and Recreation Economics and Fish, Wildlife, and Recreation Economics M/M; Recreation M/M
Ray Weiss	B.A., Economics 4 years	Economist	Recreation; Fish, Wildlife, and Recreation Economics
Michael Wolanek	M.S., Forest Hydrology B.S., Forest Management 10 years	Hydrologist, Fisheries Habitat	Fisheries
Andy Wones	M.S., General Science B.S., Biology 12 years	Biologist	Fisheries
Public Affairs Management			
John Clerici	B.S., Natural Resource Management 20 Years	Environmental & Government Policy Management	Public Involvement
Bonnie Nixon	B.A., Communication 17 years	Environmental and Government Policy	Public Involvement
Charles Gardiner	B.S., Chemistry and Political Science 17 years	Environmental and Government Policy	Public Involvement
Bradd Shinn	B.S., Agricultural Business 13 years	Environmental and Government Policy	Public Involvement
Northwest Economics Associates			
Duane Paul	Ph.D., Agricultural Economics M.S., Agricultural Economics B.S., Agricultural Business 25 years	Regional Economist	Regional Economics
R.W. Beck , Inc.			
Willie Manuel	M.B.A. B.S., Mechanical Engineering 5 Years	Computer Modeling Electric Utilities	Power Impact Analysis
Peter J. Robertshaw	B.A.Sc., Civil Engineering 15 Years	Computer Modeling Electric Utilities	Power Impact Analysis
Paul G. Scheuerman	B.S., Electrical Engineering 33 Years	Power Systems Electric Utilities	Power Impact Analysis

ATTACHMENT D

GLOSSARY OF TERMS, ACRONYMS, ABBREVIATIONS, METRIC CONVERSIONS, AND READER'S GUIDE TO PEIS GRAPHS

Attachment D

GLOSSARY OF TERMS, ACRONYMS, ABBREVIATIONS, METRIC CONVERSIONS, AND READER'S GUIDE TO PEIS GRAPHS

GLOSSARY OF TERMS

A

Acre-foot—The quantity of water required to cover 1 acre to a depth of 1 foot. Equal to 1,233.5 cubic meters (43,560 cubic feet).

Affected environment—Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as a result of a proposed human action.

Air quality—Measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.

Alternatives—Courses of action which may meet the objectives of the proposal at varying levels, including the most likely future without the project or action. An environmental assessment or an environmental impact statement identifies and objectively evaluates and analyzes all reasonable alternatives including a no action alternative.

Anthropogenic—Human-created.

Anadromous—In general, this term is used to refer to fish, such as salmon or steelhead trout, that hatch in fresh water, migrate to and mature in the ocean, and return to freshwater as adults to spawn. Section 3403(a) of the CVPIA defines anadromous as "those stocks of salmon (including steelhead), striped bass, sturgeon, and American shad that ascend the Sacramento and San Joaquin rivers and their tributaries and the Sacramento-San Joaquin Delta to reproduce after maturing in San Francisco Bay or the Pacific Ocean".

Anadromous Fish Restoration Program (AFRP)—A program authorized by the CVPIA to address anadromous fish resource issues in Central Valley streams that are tributary to the Delta. This program is lead by the U.S. Fish and Wildlife Service (Service).

Applied Water (AW)—The quantity of water delivered to the intake to a city's water system and the farm headgate, the amount of water supplied to a marsh or other wetland, either directly or by incidental drainage flows.

Aquatic—Living or growing in or on the water.

Aquifer—An underground geologic formation in which water can be stored.

Artificial propagation/production—As defined in Section 3403(b) of the CVPIA, "spawning, incubating, hatching, and rearing fish in a hatchery or other facility constructed for fish production".

Authorization—An act by the Congress of the United States which authorizes use of public funds to carry out a prescribed action.

B

Baseload—Minimum load of a power system over a given time period.

Basin Irrigation Efficiency—Evapotranspiration of applied water divided by the net diversion.

Bay-Delta Plan Accord—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. The Draft Bay-Delta Water Control Plan, released in May 1995, superseded D-1485.

Beneficial use—Those uses of water as defined in the State of California Water Code (Chapter 10 of Part 2 of Division 2), including but not limited to agricultural, domestic, municipal, industrial, power generation, fish and wildlife, recreation, and mining.

Benthic—Bottom of rivers, lakes, or oceans; organisms that live on the bottom of water bodies.

Biological opinion—Document issued under the authority of the Endangered Species Act stating the Service and/or the National Marine Fisheries Service (NMFS) finding as to whether a Federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat. This document may include:

Critical habitat—A description of the specific areas with physical or biological features essential to the conservation of a listed species and which may require special management considerations or protection. These areas have been legally designated via Federal Register notices.

Jeopardy opinion—The Service or NMFS opinion that an action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. The finding includes reasonable and prudent alternatives, if any.

No jeopardy opinion—U.S. Fish and Wildlife Service or NMFS finding that an action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat.

C

CALFED—Joint federal and state program to address water-related issues in the Sacramento-San Joaquin rivers Delta.

Candidate species—Plant or animal species not yet officially listed as threatened or endangered, but which is undergoing status review by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Carryover storage—That water remaining in storage at the end of the water year.

Catch—At a recreational fishery, refers to the number of fish captured.

Central Valley Habitat Joint Venture—As defined by Section 3403(c) of the CVPIA, "the association of Federal and State agencies and private parties established for the purpose of developing and implementing the North American Waterfowl Management Plan as it pertains to the Central Valley of California".

Central Valley Project (CVP)—As defined by Section 3403(d) of the CVPIA, "all Federal reclamation projects located within or diverting water from or to the watershed of the Sacramento and San Joaquin rivers and their tributaries as authorized by the Act of August 26, 1937 (50 Stat. 850) and all Acts amendatory or supplemental thereto, ...".

Central Valley Project service area—As defined by Section 3403(e) of the CVPIA, "that area of the Central Valley and San Francisco Bay Area where water service has been expressly authorized pursuant to the various feasibility studies and consequent congressional authorizations for the Central Valley Project".

Central Valley Project water—As defined by Section 3403(f) of the CVPIA, "all water that is developed, diverted, stored, or delivered by the Secretary in accordance with the statutes authorizing the Central Valley Project in accordance with the terms and conditions of water rights acquired pursuant to California law".

Central Valley Project water service contractor—Water users that have contracted with the U.S. Bureau of Reclamation for water.

Channel—Natural or artificial watercourse, with a definite bed and banks to confine and conduct continuously or periodically flowing water.

Confined aquifer—An aquifer bounded above and below by impermeable or confining layers of distinctly lower permeability than the aquifer itself.

Confluence—The flowing together of two or more streams; the place of meeting of two streams.

Conjunctive use—The planned use of groundwater in conjunction with surface water in overall management to optimize water resources.

Conserved water—That water resulting from the contractor operations and practices that results in less use of the allocated supply.

Conveyance capacity—The rate at which water can be transported by a canal, aqueduct, or ditch. In this document, conveyance capacity is generally measured in cubic feet per second.

Conveyance losses—Evaporation, evapotranspiration and seepage losses in major conveyance canals.

Cooperating agency—This is defined as an agency that meets the following criteria: (1) is included in 40 CFR Chapter V, Council on Environmental Quality (CEQ) Rules and Regulations, Appendix 1 - Federal and Federal-State agency National Environmental Policy Act (NEPA) contacts; and/or (2) has study area-wide jurisdiction by law or special expertise on environmental quality issues; (3) has been invited by the lead agency to participate as a cooperating agency; and (4) has made a commitment of resources (staff and/or funds), for regular attendance at meetings, participation in workgroups, in actual preparation of portions of the programmatic environmental impact statement (PEIS), and in providing review and comment on activities associated with the PEIS as it progresses. The role of the cooperating agency is documented in a formal memorandum of agreement with the lead agency.

Cost-of-service water rates—The water rate charged to recover all operating and capital costs, and individual contractor operating deficits, associated with the providing of water service. Components of operation and maintenance (O&M) and capital cost vary by contractor depending on services required for water delivery. Differs from full cost in that no charge for interest on capital is included.

Cubic feet per second—A measure of the volume rate of water movement. As a rate of streamflow, a cubic foot of water passing a reference section in 1 second of time. One cubic foot per second equals 0.0283 m^3/s (7.48 gallons per minute). One cubic foot per second flowing for 24 hours produces approximately 2 acre-feet.

D

Decision -1485 (D-1485)—The SWRCB decision specifying water quality standards for the Sacramento-San Joaquin Delta and Suisun Marsh.

Dedicated Water—Refers to the 800,000 acre feet of CVP yield identified in Section 3406(b)(2) of the CVPIA that the Secretary must dedicate and manage for the primary purpose of implementing the fish and wildlife purposes and measures of the act, to help California protect the Bay-Delta estuary, and to help meet legal obligations imposed on the CVP under state and federal law, including the Federal Endangered Species Act (ESA).

Deep Percolation—Percolation of applied water and precipitation below the root zone of plants.

Deficiencies—Reductions in deliveries of contracted firm water. The amount of these reductions is expressed as the percent of full annual supply delivered.

Delta—A low, nearly flat alluvial tract of land formed by deposits at or near the mouth of a river. In this report, delta usually refers to the delta formed by the Sacramento and San Joaquin Rivers.

Density—The mass of a substance per unit of volume of that substance; i.e., the density of water changes with changes in temperature.

Depletion—Represents water consumed in a service area or no longer available as a source of supply.

Depletion study area—An analysis unit defined by the California Department of Water Resources for water resources planning investigations. Defined as the division of large drainage areas into smaller drainage and service areas from which water supplies and demands can be easily evaluated.

Dissolved oxygen (D.O.)—A commonly employed measure of water quality.

Draft PEIS No-Action Alternative—Presented in Draft PEIS and used as the baseline of comparison for Alternatives 1 through 4.

Dry-farmed—Crop production without the use of applied water.

E

Endangered species—Any species or subspecies of bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion of its range. Federally endangered species are officially designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service and published in the Federal Register.

Endemism—Native or limited to a certain region (endemic).

Enhancement—Measures which develop or improve the quality or quantity of existing conditions or resources beyond a condition or level that would have occurred without an action; i.e., beyond compensation.

Entrainment—The drawing of fish and other aquatic organisms into water diversions.

Environmental consequences—The impacts to the Affected Environment that are expected from implementation of a given alternative.

Environmental Impact Statement (EIS)—An analysis required by the National Environmental Policy Act (NEPA) for all major federal actions, which evaluates the environmental risks of alternative actions.

Escapement—Number of salmon that actually return to a stream to spawn.

Estuary—A water passage where the tide meets a river current; an arm of the sea at the lower end of a river.

Evaporation—The change of a substance from the solid or liquid phase to the gaseous (vapor) phase.

Evapotranspiration (ET)—Water evaporated from plant and soil surfaces or transpired by plant tissues.

Evapotranspiration of Applied Water (ETAW)—Portion of the evapotranspiration provided by the applied water.

Exotic species—Introduced species not native to the place where they are found.

Extirpated species—A species which has become extinct in a given area.

F

Fallowed land—Cultivated land that lies idle during a growing season.

Field Irrigation Efficiency—The efficiency of water application. Computed by dividing the evapotranspiration of applied water by applied water and converting the result to a percentage. Efficiency may be computed at three levels: farm, district, or basin.

Firm water supplies—Non-interruptible water supplies guaranteed by the supplier to be available at all times except for reasons of uncontrollable forces or continuity of service provisions.

Fish ladders—A series of ascending pools constructed to enable salmon or other fish to swim upstream around or over a dam.

Fish passage facilities—Features of a dam that enable fish to move around, through, or over without harm. Generally an upstream fish ladder or a downstream bypass system.

Flow—The volume of water passing a given point per unit of time.

Instream flow requirements—Amount of water flowing through a stream course needed to sustain instream values.

Minimum flow—Lowest flow in a specified period of time.

Peak flow—Maximum instantaneous flow in a specified period of time.

Return flow—Portion of water previously diverted from a stream and subsequently returned to that stream or to another body of water.

Fry—Life stage of fish between the egg and fingerling stages.

Full cost water rates—Adds an interest component to the cost-of-service water rates to recover costs of financing the construction of irrigation facilities placed in service. The interest component is calculated in accordance with the Reclamation Reform Act of 1982.

Full cost—As defined by Section 3403(g) of the CVPIA, "the meaning given such term in paragraph (3) of section 202 of the Reclamation Reform Act of 1982". As defined by Section 202(3)(A) of the Reclamation Reform Act of 1982, "an annual rate as determined by the Secretary that shall amortize the expenditures for construction properly allocable to irrigation facilities in service, including all operation and maintenance deficits funded, less payments, over such periods as may by required under Federal Reclamation law or applicable contract provisions, with interest on both accruing from the date of enactment of the Act on costs outstanding at that date, or from the date incurred in the case of costs arising subsequent to the date of enactment of this Act: Provided that operation, maintenance and replacement charges required under Federal reclamation law, including this title, shall be collected in addition to the full cost charge".

G

Groundwater—Water stored underground in pore spaces between rocks and in other alluvial materials and in fractures of hard rock occurring in the saturated zone.

Groundwater level—Refers to the water level in a well, and is defined as a measure of the hydraulic head in the aquifer system.

Groundwater overdraft—A 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.

Groundwater pumping—Quantity of water extracted from groundwater storage.

Groundwater table—The upper surface of the zone of saturation, except where the surface is formed by an impermeable body.

H

Habitat—Area where a plant or animal lives.

I

Indicator species—Organism, species, or community which indicates presence of certain environmental conditions.

Interest group—This is defined as an agency/entity that has expressed an interest, verbally or in writing, in becoming more intensely involved in the development of the PEIS.

Irrigation water—Water made available from the project which is used primarily in the production of agricultural crops or livestock, including domestic use incidental thereto, and the watering of livestock. Irrigation water does not include water used for domestic uses such as the watering of landscaping or pasture for animals (e.g., horses) which are kept for personal enjoyment. It generally does not include water delivered to landholdings operated in units of fewer than 2 acres, unless the contractor establishes to the satisfaction of the contracting officer that the use of the water delivered to any such landholding is a use within this definition.

J

Juvenile—Young fish older than 1 year but not having reached reproductive age.

L

Land classification—An economic classification of variations in land reflecting its ability to sustain long-term agricultural production.

Land retirement—Permanent or long-term removal of land from agricultural production.

Level 2—A term used to refer to refuge water supply deliveries. The 1989 and 1992 Refuge Water Supply Studies define Level 2 refuge water supplies as the average amount of water the refuges received between 1974 and 1983.

Level 4—A term used to refer to refuge water supply deliveries. Level 4 refuge water supplies are defined in the 1989 and 1992 Refuge Water Supply Studies as the amount of water for full development of the refuges based upon management goals developed in the 1980s.

Limnology—Scientific study of the physical characteristics and biology of lakes, streams, and ponds.

Long-term contract—Contracts with terms of more than 10 years.

M

Mainstem—The main course of a stream.

Mitigation—One or all of the following: (1) Avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and (5) compensating for an impact by replacing or providing substitute resources or environments.

Model—A tool used to mathematically represent a process which could be based upon empirical or mathematical functions. Models can be computer programs, spreadsheets, or statistical analyses.

N

Natural production—As defined by Section 3403(h) of the CVPIA, "fish produced to adulthood without direct human intervention in the spawning, rearing, or migration processes".

Net Water Diversion—Amount of water needed in a depletion study area to meet requirements, less reuse (recoverable service loss and deep percolation).

No-Action Alternative—Represents conditions that would have occurred without implementation of CVPIA.

Nonconsumptive water use—Water uses including swimming, boating, waterskiing, fishing, maintenance of stream-related fish and wildlife habitat, hydropower generation, and other uses that do not substantially deplete water supplies.

Non-Recoverable Loss—Losses to salt sinks, or evaporation and evapotranspiration in conveyance and drainage canals. Expressed as a percentage of evapotranspiration of applied water.

O

Operating non-Federal entity—A Non-Federal entity that operates and maintains Federal facilities pursuant to an agreement with the United States.

P

PEIS Alternatives—Alternatives 1 through 4; Supplemental Analysis 1a through 1i, 2a through 2d, 3a, 4a; Revised Alternative 1; and Preferred Alternative.

Percolation—In the context of this report, the downward movement of water through the soil or alluvium to the ground-water table.

Place of use—The geographic area specified in a water right permit or license issued by the California State Water Resources Control Board, wherein the water may be used.

Point of diversion—The point along a river or stream that a water right permit or license specifies water may be diverted to areas away from the river.

Programmatic environmental impact statement—EIS prepared prior to a Federal agency's decision regarding a major program, plan, or policy. It is usually broad in scope and followed by subsequent more narrowly focused NEPA compliance documents such as site-specific environmental assessments and environmental impact statements.

Project repayment—The return to the Treasury of the reimbursable funds expended to construct, operate, maintain, and replace project facilities under the terms and conditions authorized by Congress plus other costs assigned by Congress.

Proposed action—Plan that a Federal agency intends to implement or undertake and which is the subject of an environmental analysis. Usually, but not always, the proposed action is the agency's preferred alternative for a project. The proposed action and all reasonable alternatives are evaluated against the no action alternative.

Public involvement—Process of obtaining citizen input into each stage of the development of planning documents. Required as a major input into any EIS.

Q

QWEST—Computed net flow from the Central Delta to the Lower San Joaquin River at Jersey Point, as defined in the 1993 National Marine Fisheries Service winter-run chinook salmon Biological Opinion.

R

Range—Geographic region in which a given plant or animal normally lives or grows.

Reasonableness criteria—Parameters established by the AFRP for determining the "reasonableness" of restoration actions. These parameters include: consideration of potential adverse economic and social impacts, public sentiment, the magnitude of benefits, the certainty that an action will achieve projected benefits, and the authority established by existing laws and regulations.

Recharge—The processes of water filling the voids in an aquifer, which causes the piezometric head or water table to rise in elevation.

Reclamation laws—As defined by Section 3403(I) of the CVPIA, "the Act of June 17, 1902 (82 Stat. 388) and all Acts amendatory thereof or supplemental thereto".

Record of Decision (ROD)—Concise, public, legal document which identifies and publicly and officially discloses the responsible official's decision on the alternative selected for implementation. It is prepared following completion of an EIS.

Redd—Depression in river or lake bed dug by fish for the deposition of eggs.

Refuge Water Supply Report—As defined by Section 3403(j) of the CVPIA, "the report issued by the Mid-Pacific Region of the Bureau of Reclamation of the U.S. Department of the Interior entitled Report on Refuge Water Supply Investigations, Central Valley Hydrologic Basin, California (March 1989)".

Repayment contract—As defined by Section 3403(k) of the CVPIA, "the same meaning as provided in sections 9(d) and 9(e) of the Reclamation Project Act of 1939 (53 Stat. 1187, 1195), as amended". See water service contract.

Reservoir—Artificially impounded body of water.

Reservoir storage capacity—Reservoir capacity normally usable for storage and regulation of reservoir inflows to meet established reservoir operating requirements.

Flood control storage capacity—Reservoir capacity reserved for the purpose of regulating flood inflows to reduce flood damage downstream.

Restoration Fund—As defined in Section 3403(l) of the CVPIA, "the Central Valley Project Restoration Fund established by this title".

Return flows—That water returned to the natural surface water system after use by the water user.

Revised No-Action Alternative—Reflects modifications to PROSIM 99.0 as described in the Supplement to the Draft PEIS and used as the baseline of comparison for Revised Alternative 1 and Preferred Alternative.

Riparian—Areas along or adjacent to a river or stream bank whose waters provide soil moisture significantly in excess of that otherwise available through local precipitation.

S

Salmonids—Fish of the family Salmonidae, such as salmon, trout (including steelhead), and whitefish.

Scoping—The process of defining the scope of a study, primarily with respect to the issues, geographic area, and alternatives to be considered. The term is typically used in association with environmental documents prepared under the National Environmental Policy Act.

Secretary—As defined by Section 3403(m) of the CVPIA, "the Secretary of the Interior".

Seepage—Water that escapes control through canal lining, stream banks, or other holding or conveyance systems.

Shasta Criteria—Establishes when a water year is considered critical, based on inflow to Shasta Lake. When inflows to Shasta Lake fall below the defined thresholds, the water year is defined as critical, and water deliveries to Sacramento River Water Rights and San Joaquin River Exchange Contractors may be reduced up to 25 percent. A year is critical when the full natural inflow to Shasta Lake for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) is equal to or less than 3.2 million acre-feet. This is considered a single-deficit. A year is also critical when the accumulated difference (deficiency) between 4 million acre-feet and the full natural inflow to Shasta Lake for successive previous years, plus the forecasted deficiency for the current water year, exceeds 800,000 acre-feet.

Short-term contract—Contracts with a term of more than 5 years but less than 10 years.

Semi-confined Aquifer—A condition where the movement of groundwater is restricted sufficiently to cause differences in head between different depth zones of the aquifer during periods of heavy pumping, but during periods of little draft the water levels recover to a level coincident with the water table.

Smolt—A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt its body from a freshwater to a saltwater environment.

Spawning—The releasing and fertilizing of eggs by fish.

Spill—Water released from reservoirs to comply with flood control criteria.

Spillway—Overflow structure of a dam.

Stream—Natural water course.

Ephemeral stream—Flows briefly only in direct response to precipitation.

Intermittent or seasonal stream—Stream on or in contact with the groundwater table that flows only at certain times of the year when the groundwater table is high.

Perennial stream—Flows continuously throughout the year.

Subsidence—A local mass movement that involves principally the gradual downward settling or sinking of the earth's surface with little or no horizontal motion. It may be due to natural geologic processes or mass activity such as removal of subsurface solids, liquids, or gases, ground water extraction, and wetting of some types of moisture-deficient loose or porous deposits.

Supplemental analyses—Alternatives analyses conducted in addition to the five main alternatives. Examples of supplemental analyses include: 1A, 2A, 3A, and 4A.

Surface water diversion—Total quantity of water removed from a stream.

Surface Water Return Flow (SWRF)—Percent of water that directly returns by surface to the stream.

T

Tailwater—Water immediately downstream of a dam.

Target Flows—Flow goals used in development of the Draft PEIS alternatives. The goals were based upon preliminary information developed for the AFRP Restoration Plan. The target flows were developed in a iterative process.

Temporary contract—Contract with a term of less than 5 years.

Threatened species—Legal status afforded to plant or animals species that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range, as determined by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Tiering—Procedure which allows an agency to avoid duplication of paperwork through incorporation by reference of the general discussions and relevant specific discussions from an EIS of broader scope into a subsequent EIS of narrower scope.

Total supply—Total water supply available to area (surface water plus groundwater).

Transfers, sales, and exchanges—A transfer or sale is a one way transaction to another contractor usually on an annual basis, but could be on a permanent basis. An exchange is a two way transaction wherein a contractor transfers water to another contractor to be returned at a later date. CVP contractors may transfer, sell and exchange to other contractors their contractual water supply only with written consent from the United States.

Tributary—A stream feeding into a larger stream or a lake.

Turn outs—The physical structures along main canal systems for distribution of water.

W

Water acquisition—The purchase of water from willing sellers.

Water rights—California recognizes riparian and appropriative water rights.

> ***Riparian water rights***—Exists for lands which abut a waterway, or which overly an underground stream. Generally, there is no riparian right to diffused surface waters or swamps. The extent of the frontage along a waterway in no way governs the quantity of the water right. Use of water through riparian rights must be on riparian land and within the watershed of the stream. Riparian rights may not be lost as a result of nonuse.
>
> ***Appropriative water rights***—Water rights based upon the principle of prior appropriations, or "first in time, first in right". In order to maintain appropriative water rights, the right to any water must be put to beneficial use. Nonuse of appropriative water rights may result in the loss of those water rights. In a conflict between a riparian water user and an upstream appropriator, the riparian user has priority, provided that the water is being used in a reasonable and beneficial manner.

Watershed—A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water.

Water year—Usually when related to hydrology, the period of time beginning October 1 of one year and ending September 30 of the following year and designated by the calendar year in which it ends.

Wetland—A zone periodically or continuously submerged or having high soil moisture, which has aquatic and/or riparian vegetation components, and is maintained by water supplies significantly in excess of those otherwise available through local precipitation.

Wildlife habitat—An area that provides a water supply and vegetative habitat for wildlife.

Willing sellers—A term used to describe individuals who would be interested in selling water supplies under transfer guidelines established by SWRCB and other regulatory agencies.

X

X2—Salinity criteria of two parts per thousand (2 ppt) which must be maintained in Suisun Bay during the February through June spring runoff period.

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AAQS	Ambient Air Quality Standards
AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
ACID	Anderson Cottonwood Irrigation District
ACWD	Alameda County Water District
AEAWT	Authorization for Environmental Analysis of Water Transfers
af	acre-foot (feet)
af/yr	acre-feet per year
AFRP	Anadromous Fish Restoration Program
AIRFA	American Indian Religious Freedom Act
ANOVA	analysis of variance
APCD	Air Pollution Control District
APE	area of potential effect
AQAP	Air Quality Attainment Plan
AQMD	Air Quality Management District
ARB	Air Resources Board (California)
ARP	acreage reduction percentage
AUM	Animal Unit Month
AW	applied water
BAAQMD	Bay Area Air Quality Management District
BAP	San Joaquin Basin Action Plan
BAT	best available technology
Bay	San Francisco Bay
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
Bay-Delta Region	San Francisco Bay/Sacramento-San Joaquin Delta
Bay/Delta Study	Delta Outflow/San Francisco Bay Study
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
B.P.	Before Present
BPA	Bonneville Power Administration
BTI	*Bacillus thuringiensis israelensis*
CAAQS	California Ambient Air Quality Standard
CAC	County Agricultural Commissioner
Caltrans	California Department of Transportation
CAP	Clean Air Plan
CCAA	California Clean Air Act
CCTS	Central California Taxonomic System
CCWD	Contra Costa Water District
CDEC	California Data Exchange Center
Census	U.S. Bureau of the Census
CEQA	California Environmental Quality Act

CES	University of California Cooperative Extension Service
cf	cubic feet
cfs	cubic feet per second
CIMIS	California Irrigation Meteorologic Information System
CNPS	California Native Plant Society
CO	carbon monoxide
COA	Coordinated Operating Agreement
COE	U.S. Army Corps of Engineers
CPFV	commercial passenger-carrying fishing vessel
CRHR	California Register of Historic Resources
CRW	Colorado River Water
CSU	California State University
CT	In disinfection operations, the concentration of a disinfectant multiplied by its time of contact with the water.
CUWA	California Urban Water Agency
CVGSM	Central Valley Groundwater - Surface Water Simulation Model
CVHJV	Central Valley Habitat Joint Venture
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVPM	Central Valley Production Model
CVP-OCAP	Central Valley Project Operations Criteria and Plan
CVPTM	Central Valley Production and Transfer Model
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWD	Chowchilla Water District
D-1485	Decision 1485 (State Water Resources Control Board)
DAU	Detailed Analysis Unit
DBP	disinfection by-product
DCAA	dichloroacetic acid
D/DBP	disinfectant/disinfection by-product
DCC	Delta Cross Channel
DDE	dichloro-diphenyl-dichloroethylene
DDT	dichloro-diphenyl-trichloroethane
Delta	Sacramento-San Joaquin River Delta
Delta Plan	Delta Water Quality Control Plan
DFA	California Department of Food and Agriculture
DFF	California Department of Forestry and Fire Protection
DFG	California Department of Fish and Game
DHS	California Department of Health Services
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DOC	California Department of Conservation
DOF	California Department of Finance
DPR	California Department of Parks and Recreation
DWR	California Department of Water Resources

EA	environmental assessment
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EDD	Employment Development Department
EDF	Environmental Defense Fund
EID	El Dorado Irrigation District
EIR	environmental impact report
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESWTR	Enhanced Surface Water Treatment Rule
ET	evapotranspiration
ETAW	evapotranspiration of applied water
FCAA	Federal Clean Air Act
FERC	Federal Energy Regulatory Commission
FIP	Federal Implementation Plan
FIRE	Finance, insurance, and real estate
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
GAC	granular activated carbon
GATT	General Agreement on Tariffs and Trade
GCID	Glenn Colusa Irrigation District
GIS	geographic information system
GRCD	Grasslands Resource Conservation District
HAA	haloacetic acids
HC	Hydrocarbons
HCl	Hydrochloric Acid
I	Interstate
I-5	Interstate 5
IAG	Interagency Group Meetings
IEP	Interagency Ecological Program
IFIM	instream flow incremental methodology
IGM	Interested Group Meetings
IID	Imperial Irrigation District
IMPLAN	regional economic input-output model
Interior	U.S. Department of the Interior
IRF	Intermediate Regional Flood
ITA	Indian Trust Asset
KCWA	Kern County Water Agency
KMZ	Klamath Management Zone
kW	kilowatt
LLNL	Lawrence Livermore National Laboratory
M&I	municipal and industrial
MAD	Mosquito Abatement District

MBF	million board feet
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MCL	maximum contaminant level
MCLGs	Maximum Contaminant Level Goals
mg/l	milligrams per liter
MID	Modesto Irrigation District
M/M	Methodology/Modeling
MMWD	Marin Municipal Water District
MOU	memorandum of understanding
mph	miles per hour
MRDL	Maximum Residual Disinfectant Level
MSA	Metropolitan Statistical Area
msl	mean sea level
mS/cm	millisiemens per centimeter
MVCD	Mosquito and Vector Control District
MWD	Municipal Water District of Southern California; Metropolitan Water District
MWT	mid-water trawl
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection Repatriation Act
NAHC	Native American Heritage Commission
NAWMP	North American Waterfowl Management Plan
NCCAB	North Central Coast Air Basin
NCRWQCB	North Coast Regional Water Quality Control Board
NDDB	Natural Diversity Database
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Services
NO_X	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NPDWR	National Primary Drinking Water Regulations
NPS	National Park Service
NRA	National Recreation Area
NRCS	National Resources Conservation District
NRHP	National Register of Historic Places
NSDWR	National Secondary Drinking Water Regulations
NSVAB	Northern Sacramento Valley Air Basin
NTU	nephelometric turbidity units
NWR	National Wildlife Refuge
NWS	National Weather Service
O_3	Ozone
O&M	Operations and Maintenance
OHV	off-highway vehicle

OID	Oakdale Irrigation District
OPR	California Office of Planning and Research
ORV	off-road vehicle
P_b	Lead
PA	Programmatic Agreement
PCBs	polychlorinated biphenyls
PDA	Public Domain Allotment
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric Company
PHABSIM	Physical Habitat Simulation
PM	particulate matter
PM_{10}	PM of 10 microns in aerometric diameter or less
POW	Place of work
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion; parts per thousand
PROSIM	Project Simulation Model
PSA	planning subarea
psi	pounds per square inch
PSMFC	Pacific States Marine Fisheries Commission
RBDD	Red Bluff Diversion Dam
RCD	Resource Conservation District
Reclamation	U.S. Bureau of Reclamation
Reg-Neg	Regulatory Negotiations
RGO	resident, government, and other demands
RM	river mile
ROD	Record of Decision
ROG	reactive organic gases
ROP	Record of Progress
RVD	recreational visitor day
RWQCB	California Regional Water Quality Control Board
SANJASM	San Joaquin Area Simulation Model
SBA	South Bay Aqueduct
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCCAB	South Central Coast Air Basin
SCS	U.S. Department of Agriculture Soil Conservation Service (now known as National Resources Conservation District)
SCVWD	Santa Clara Valley Water District
SCWA	Sacramento County Water District
SDAB	San Diego Air Basin
SDWA	Safe Drinking Water Act
Secretary	Secretary of the Interior

Service	U.S. Fish and Wildlife Service
SF	San Felipe
SFBAAB	San Francisco Bay Area Air Basin
SFSA	San Felipe Service Area
SFWD	San Francisco Water District
SIP	State Implementation Plan
SHPO	California State Historic Preservation Officer
SJRMP	San Joaquin River Management Program
SJVAB	San Joaquin Valley Air Basin
SJVDP	San Joaquin Valley Drainage Program
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utility District
SNA	Significant Natural Area
SO_X	Oxides of Sulfur
SO_2	Sulfur Dioxide
SPF	Standard Project Flood
SPW	State Project Water
SR	State Route
SRA	shaded riverine aquatic
SRBT model	Sacramento River Basin Temperature model
SS	suspended solids
SSJID	South San Joaquin Irrigation District
SSWD	South Sutter Water District
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWRF	Surface Water Return Flow
SWTR	Surface Water Treatment Rule
SYMVCD	Sacramento-Yolo Mosquito and Vector Control District
TAC	Toxic Air Contaminants
taf	thousand acre-feet
TCC	Tehama-Colusa Canal
TCD	temperature control device
TCPs	traditional cultural properties
TCR	total coliform rule
TDS	total dissolved solids
TFPC	total trihalomethane formation potential carbon
THAAs	total haloacetic acids
THM	trihalomethane
THMFP	trihalomethane formation potential
TID	Turlock Irrigation District
TNC	The Nature Conservancy
TNS	toe net survey

TOC	total organic carbon
TOG	Total Organic Gases
TOX	total organic halogen
TRH	Trinity River Hatchery
TSP	Total Suspended Particulates
TTHMFP	total trihalomethane formation potential
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
VAR	Magnetic or inductive power
VCAPCD	Ventura County Air Pollution Control District
VELB	valley elderberry longhorn beetle
VMT	Vehicle Miles of Travel
VOC	Volatile Organic Compound
VMS	Visual Management System
VRM	Visual Resource Management
Western	Western Area Power Administration
WHR	wildlife habitat relationships
WMA	Wildlife Management Area
WMP	Water Management Plan
WR	water rights
WUA	weighted usable area
WWD	Westlands Water District
WY	water year
X2	isocline
YCWA	Yuba County Water Agency
YSAPCD	Yolo-Solano Air Pollution Control District
Zone 7	Zone 7 of the Alameda County Flood Control and Water Conservation District
μS/cm	microsiemens per centimeter
°F	degrees Fahrenheit

CONVERSION TABLES

U.S. CUSTOMARY TO METRIC

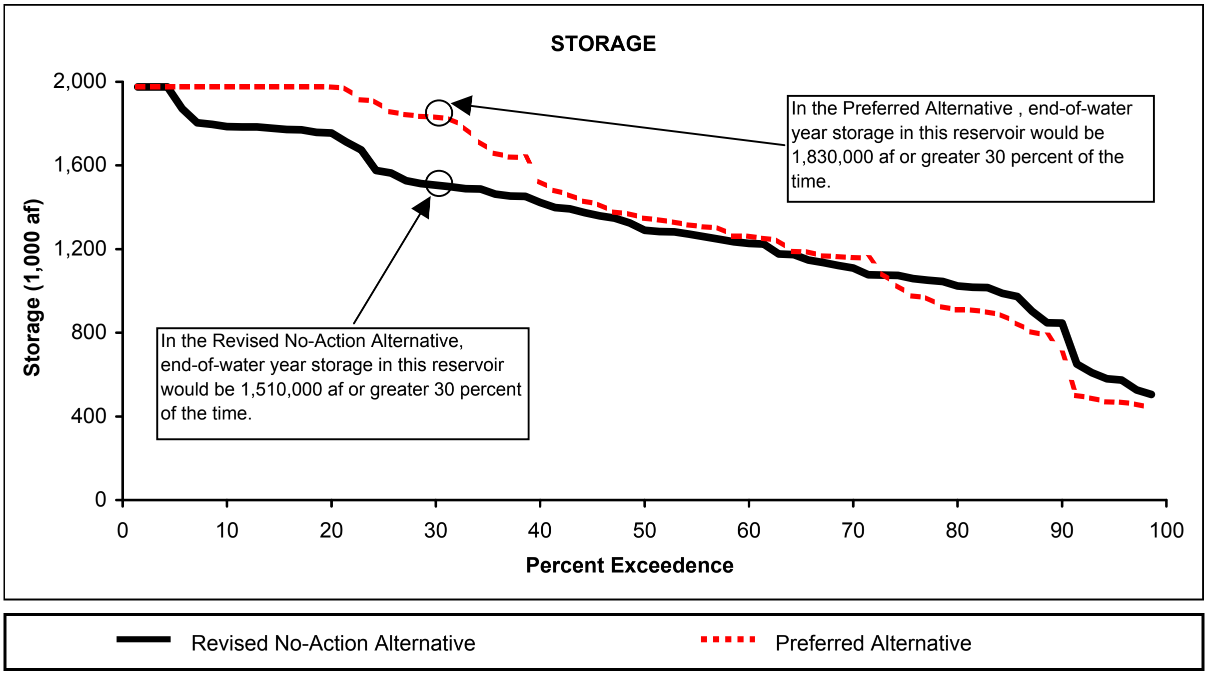
Multiply	By	To Obtain
inches (in)	25.4	millimeters
inches (in)	2.54	centimeters
feet (ft)	0.3048	meters
miles (mi)	1.609	kilometers
square feet (ft^2)	0.0929	square kilometers
acres (ac)	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02832	cubic meters
acre-feet (af)	1,233.0	cubic meters
pounds (lb)	0.4536	kilograms
tons (ton)	0.9072	metric tons

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows:
°C = 5/9 (°F - 32)

OTHER USEFUL CONVERSION FACTORS

Multiply	By	To Obtain
acre-feet (af)	43,560	cubic-feet
acre-feet (af)	325,851	gallons
cubic feet per second (cfs)	1.9835	acre-feet per day
cubic feet per second (cfs)	724.0	acre-feet per year

HOW TO READ A FREQUENCY DISTRIBUTION CURVE



HOW TO READ AN ADDITIVE BAR CHART

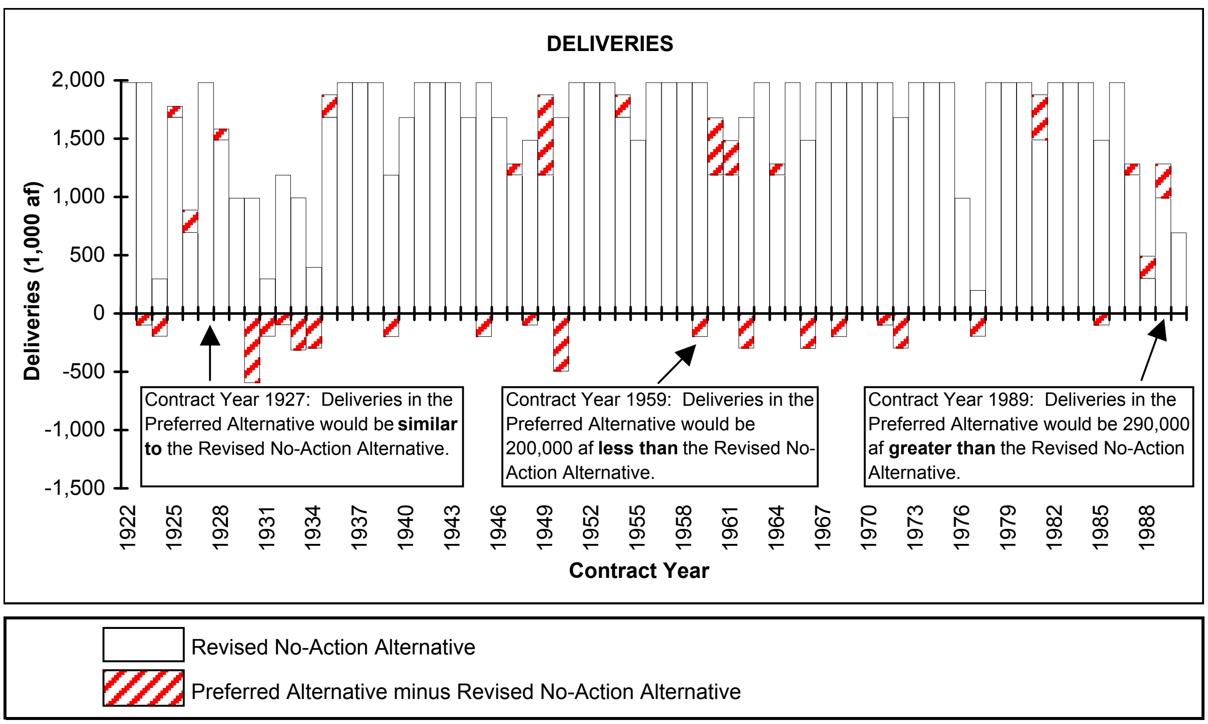


FIGURE D-1

HOW TO READ A COMPARATIVE BAR CHART

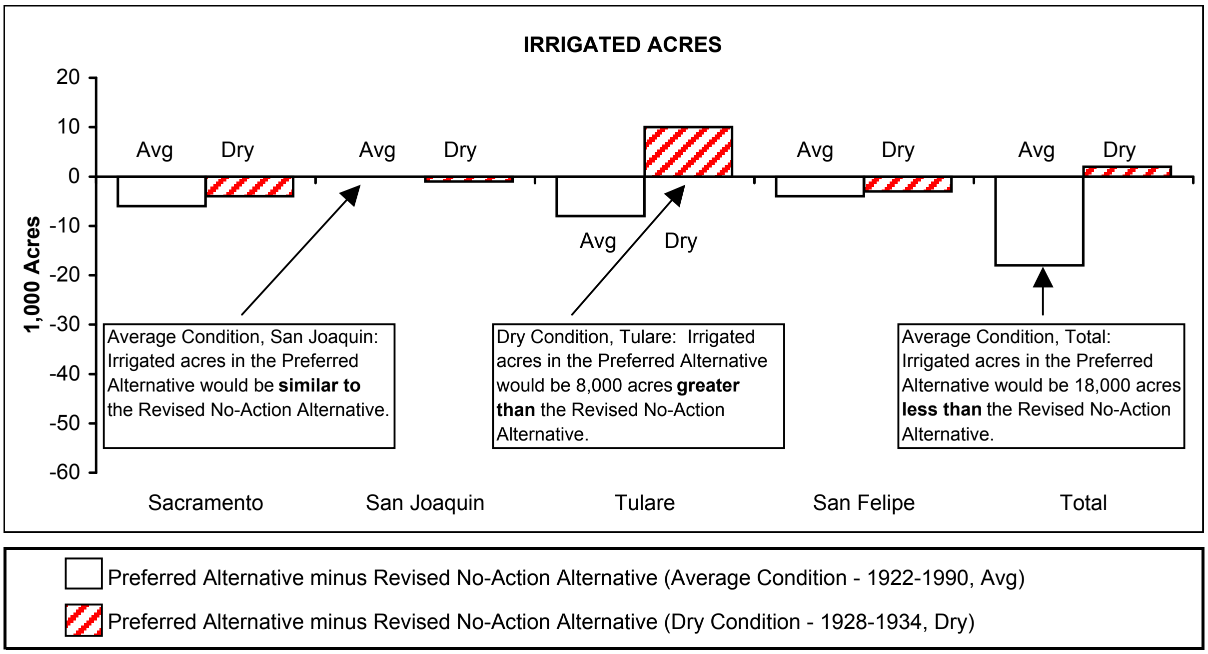


FIGURE D-2

ATTACHMENT E

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Attachment E

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ATTACHMENT F

NON-FLOW ACTIONS CONSIDERED IN PEIS ALTERNATIVES

Attachment F

NON-FLOW ACTIONS CONSIDERED IN PEIS ALTERNATIVES

Preliminary information from the AFRP was used in the development of the PEIS alternatives. The non-flow actions presented in the December 1995 Draft Restoration Plan were included in all of the PEIS alternatives. Programmatic cost estimates were developed for these actions to determine an order of magnitude costs for use of the Restoration Fund for non-flow actions. The cost estimates are presented in Chapter II of the Final PEIS. The non-flow actions included in all of the PEIS alternatives and the anticipated benefits are included in Table F-1.

TABLE F-1
NON-FLOW FISH MANAGEMENT ACTIONS UNDER ANADROMOUS FISH RESTORATION PROGRAM

WATERSHED	ACTION	ANTICIPATED BENEFITS
Upper and Middle Sacramento River and Tributaries		
	Shasta Temperature Device	Increase survival of spawning, incubation and rearing chinook salmon and steelhead trout lifestages
	Correct fish passage problem at ACID diversion	Increase survival of migrating adult and juvenile chinook salmon and steelhead trout due to reduced delay and entrainment
	Red Bluff Diversion Dam fish passage	Increase survival of migrating adult and juvenile chinook salmon and steelhead trout due to reduced delay and entrainment
	Screen unscreened or inadequately screened diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Spawning gravel restoration	Increase spawning success and productivity of adult chinook salmon and steelhead trout
	Correct problems at Glenn-Colusa ID diversion	Increase outmigrant survival of juvenile chinook salmon and steelhead trout due to reduced entrainment loss
	Evaluate a meander belt from Keswick to Colusa to provide gravel recruitment, large woody debris, moderate air temperatures, and nutrient input to the biotic system	Increase survival of rearing and outmigrant juvenile chinook salmon and steelhead trout
Lower Sacramento River and Tributaries		
	Colusa Basin Drain Outfall Exclusion Device at Knights Landing	Increase survival of juvenile chinook salmon
Clear Creek		
	Channel restoration, sediment removal, and fish passage at McCormick - Saeltzer Dam	Increase survival and spawning success of adult chinook salmon and steelhead trout
	Restrict gravel mining and restore degraded channel	Improved instream and riparian habitat, Increase survival of juvenile chinook salmon and steelhead trout
	Restore gravel and spawning habitat	Increase spawning success of adult chinook salmon and steelhead trout
	Prevent habitat degradation due to sedimentation and urbanization	Increase survival of incubating and rearing lifestages of chinook salmon and steelhead trout

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Cow Creek		
	Screen diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Fence riparian corridors to exclude livestock	Increase survival of salmon and steelhead trout
	Provide passage, spawning, and rearing flows for fall run	Reduce delay of migrating and increase productivity of adult chinook salmon and steelhead trout
	Improve upstream passage at diversions dams	Reduce delay of migrating adult chinook salmon and steelhead trout
Cottonwood Creek		
	Limit instream gravel mining, and protect and enhance spawning gravel recruitment	Increase survival and spawning success of chinook salmon and steelhead trout
	Restore stream channel at ACID siphon and avoid the barrier	Improve passage of migrating adult chinook salmon and steelhead trout
	Improve land use practices-improve habitat, reduce siltation of existing gravels	Improve instream and riparian habitat and survival of rearing fry and juvenile chinook salmon and steelhead trout
	Eliminate attraction flows or provide adult barrier at Crowley Gulch	Reduce delay and straying of adult chinook salmon and steelhead trout
Bear Creek		
	Install fish screens on unscreened diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Provide instream flows for adult and juvenile passage in spring and early fall	Improved instream conditions for adult and juvenile chinook salmon and steelhead trout during the spawning and rearing lifestages

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Battle Creek		
	Install fish screen on Orwick diversion	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Screen 6 unscreened hydropower diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Construct barrier gates at Gover diversion and adult waste gates for chinook salmon	Improved passage and reduce delay of migrating adult chinook salmon and steelhead trout
	Improve Fish passage at Eagle Canyon	Improved passage and reduce delay of migrating adult chinook salmon and steelhead trout
	Install adult barrier at tailrace of Coleman powerhouse	Improved passage and reduce delay of migrating adult chinook salmon and steelhead trout
	Continue to allow adult spring-run and steelhead trout passage above Coleman National Fish Hatchery weir and screen intakes #2 and #3	
Paynes Creek		
	Provide instream flows for adult and juvenile passage in spring and early fall	Improve instream conditions for adult and juvenile steelhead trout during critical life stages
	Restore and enhance spawning gravel	Increase spawning success for survival of adult steelhead trout
Antelope Creek		
	Provide instream flows for adult and juvenile passage in spring and early fall	Improve instream conditions for adult and juvenile chinook salmon and steelhead trout during critical life stages

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Mill Creek		
	Improve spawning areas in lower Mill Creek	Increase spawning success for chinook salmon and steelhead trout
	Establish, restore, and maintain riparian habitat along lower Mill Creek	Increase survival of rearing fry and juvenile chinook salmon and steelhead trout
	Preserver habitat productivity through cooperative watershed management	Increase survival of spawning, incubating, rearing and outmigrant life stages of chinook salmon and steelhead trout through improved instream and riparian conditions
Deer Creek		
	Improve instream flows to provide passage over 3 diversions	Reduced delay in migration and improved spawning success of adult chinook salmon and steelhead
	Improve spawning areas in lower Deer Creek	Increase spawning success of chinook salmon and steelhead
	Restore and preserve riparian habitat along lower reaches in Deer Creek	Increase survival of rearing and outmigrant lifestages of chinook salmon and steelhead trout
	Develop a watershed management plan to preserve chinook salmon and steelhead habitat	Increase survival of all life stages of chinook salmon and steelhead trout through improved instream
	Flood management activities with the least damage to fish and habitat	Improve instream and riparian conditions and increased survival of adult and rearing juvenile chinook salmon and steelhead trout
Elder Creek		
	Adopt an erosion control ordinance to minimize sediment input	Increase survival of spawning, incubating, and rearing lifestages of chinook salmon and steelhead trout
Thomes Creek		
	Modify gravel mining methods	Increase survival for chinook salmon and steelhead trout
	Modify timber harvest practices	Increase survival for chinook salmon and steelhead trout
	Modify grazing practices	Increase survival for chinook salmon and steelhead trout
	Improve fish passage at diversions	Increase migration survival due to reduced delay of adult chinook salmon and steelhead trout

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Bear Creek		
	Install fish screens on unscreened diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Provide instream flows for adult and juvenile passage in spring and early fall	Improve for adult and juvenile chinook salmon and steelhead trout during the spawning and rearing
Big Chico Creek		
	Relocate M & T Ranch diversion	Increase survival by reduced entrainment of juvenile chinook salmon and steelhead
	Replenish spawning gravel in flood control channels	Increase spawning success of adult fall-run chinook salmon
	Protect summer holding areas for spring-run chinook salmon	Increase survival of adult spring-run chinook salmon
	Revegetate stream reaches, maintain protected riparian habitat	Increase rearing success of juvenile chinook salmon and steelhead trout
	Repair Iron Canyon fish ladder	Increase survival provided by reduced delay of adult chinook salmon and steelhead trout
	Repair Lindo Channel weir and fishway at 5-mile diversion	Increase survival provided by reduced delay of adult chinook salmon and steelhead trout
	Improve cleaning at One-Mile Pool	Increase survival of juvenile chinook salmon and steelhead trout
	Develop a watershed management plan to preserve chinook salmon and steelhead habitat	Increase survival of all life stages of chinook salmon and steelhead trout through improved instream

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Butte Creek		
	Replace Western Canal Siphon	Increase survival of adult and juvenile lifestages of chinook salmon and steelhead trout
	Remove McPherrin and McGowan diversion dams	Increase survival by reduced delay of adult chinook salmon and steelhead trout outmigration
	Adams Dam screens and ladders	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Gorille Dam screens and ladders	Increase survival of migrating adult and juvenile chinook salmon and steelhead trout
	Durham Mutual Dam screens and ladders	Increase survival by reduced delay in migration of adult chinook salmon and steelhead trout
	White Mallard Dam screen and ladder	Increase survival by reduced delay in migration of adult chinook salmon and steelhead trout
	Little Dry Creek diversion channel pumps with screens	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Eliminate salmon stranding at White Mallard Duck Club outfall	Increase survival of juvenile chinook salmon and steelhead trout
	Renovate and maintain existing culvert and riser at Drumheller Slough outfall	Increase survival of juvenile chinook salmon and steelhead trout
	Restore, maintain, and protect riparian habitat through land use plans and buffer zones	Increase survival of spring-run chinook salmon
	Parrott-Phelan screens and ladders	Increase survival of migrating adult and juvenile chinook salmon and steelhead trout
Yuba River		
	Install fish screens at three diversions	Increase survival due to reduced entrainment of outmigrant juvenile chinook salmon and steelhead trout
	Purchase streambank conservation easements	Increase survival of rearing chinook salmon and steelhead trout
	Modify ladders at Daguerre Point Dam	Reduced delay providing improved spawning success of chinook salmon and steelhead trout
	Modify Daguerre Point Dam to facilitate outmigration	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Improve fish bypasses at diversion dams	Increase survival due to reduced delay of migrating adult chinook salmon and steelhead trout

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Bear River		
	Screen all diversions	Increase survival of outmigrant juvenile steelhead trout
	Remove culvert or modify crossing at Patterson Sand and Gravel	Reduce delay and blockage of migrating adult steelhead trout
American River		
	Improve fish screen at Fairbairn diversion	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Replenish spawning gravel and/or restore existing spawning grounds and riparian habitat	Increase survival provided by improved instream habitat conditions for spawning chinook salmon and steelhead trout
	Develop riparian corridor management plan: improve and protect habitat and instream cover	Increase survival provided by improved instream habitat conditions for rearing and juvenile chinook salmon and steelhead trout
	Terminate current programs that remove woody debris from the river channels	Increase survival provided by improved instream habitat conditions for rearing and juvenile chinook salmon and steelhead trout
	Reconfigure Folsom release shutters for better temperature control	Increase survival provided by improved instream temperatures for spawning, rearing and juvenile adult chinook salmon and steelhead trout
Mokelumne River		
	Screen all diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Screen smaller diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Replenish gravels suitable for salmonid spawning habitat	Increase spawning success of adult chinook salmon and steelhead trout through improved instream habitat conditions
	Cleanse spawning gravel of fine sediments	Increase spawning success of adult chinook salmon and steelhead trout through improved instream habitat conditions
	Eliminate or restrict gravel mining operations	Increase spawning success of adult chinook salmon and steelhead trout through improved instream habitat conditions
	Enhance and maintain riparian corridor: improve streambank and channel rearing for juvenile salmonids	Increase survival provided by improved instream and riparian habitat conditions of rearing and juvenile chinook salmon and steelhead trout
	Establish and enforce new water quality standards	Increase survival provided by instream habitat

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Cosumnes River		
	Screen Diversions and enforce prohibition of unlicenced dams	Increase survival of outmigrant juvenile chinook salmon
	Establish riparian corridor protection zone: preserve existing salmonids habitat from incompatible land use and moderate water temperature	Watershed management coordination and improved instream and riparian conditions provide increased survival for all lifestages of chinook salmon and steelhead trout
	Rehabilitate damaged areas: Remedy incompatible land use practices that have increased sedimentation of the river and elevate water temperatures	Improve instream and riparian conditions affecting the survival of all lifestages of chinook salmon
Calaveras River		
	Facilitate passage of adult and juvenile chinook salmon at existing diversion dams	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Screen diversions	Reduced migration delay provides an increased spawning success of migrating adult chinook salmon and steelhead
Merced River		
	Screen diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Establish streamwatch program and improve watershed management program	Watershed management coordination and improved instream and riparian conditions provide increased survival for all lifestages of chinook salmon and steelhead trout
Tuolumne River		
	Screen Diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Establish streamwatch program and improve watershed management program	Watershed management coordination and improved instream and riparian conditions provide increased survival for all lifestages
	Support Tuolumne River Interpretive Center and coordinate efforts with Riparian and Recreation Improvement Fund	Increase spawning success for chinook salmon and steelhead trout

TABLE F-1. CONTINUED

WATERSHED	ACTION	ANTICIPATED BENEFITS
Stanislaus River		
	Screen diversions	Increase survival of outmigrant juvenile chinook salmon and steelhead trout
	Replenish spawning gravel	Increase spawning success for chinook salmon and steelhead trout
	Improve watershed management program	Watershed management coordination and improved instream and riparian conditions provide increased survival for all lifestages of chinook salmon and steelhead trout
San Joaquin River		
	Install fish protective device at Banta-Carbona ID	Reduced entrainment provides increased survival of outmigrants
	Install fish protective device at West Stanislaus ID	Reduced entrainment provides increased survival of outmigrants
	Install fish protective device at Patterson ID	Reduced entrainment provides increased survival of outmigrants
	Install fish protective device at El Solyo ID	Reduced entrainment provides increased survival of outmigrants
	Screen small riparian diversions	Reduced entrainment to increased survival of outmigrants
Sacramento-San Joaquin Delta		
	Improve Tracy Pumping Plant fish protection facilities	Increase survival due to reduced entrainment of outmigrant juvenile chinook salmon and steelhead trout
	Improve Contra Costa Pumping Plant fish protection facilities	Increase survival due to reduced entrainment of outmigrant juvenile chinook salmon and steelhead trout
	Install fish barrier at Georgiana Slough	Increase survival due to reduced entrainment of outmigrant juvenile chinook salmon and steelhead trout
	Install fish barrier at head of Old River	Increase survival due to reduced delay in migration route for outmigrant juvenile chinook salmon and steelhead trout
	Reduce predation at SWP and CVP fish salvage facilities	Increase survival due to reduced predation of outmigrant juvenile chinook salmon and steelhead trout
	Screen or relocate riparian diversions in the Delta	Increase survival due to reduced entrainment of outmigrant juvenile chinook salmon and steelhead trout

ATTACHMENT G

DEVELOPMENT OF ALTERNATIVE ACTIONS TO IMPLEMENT ANADROMOUS FISH RESTORATION PROGRAM FLOW MANAGEMENT PROVISIONS

Attachment G

DEVELOPMENT OF ALTERNATIVE ACTIONS TO IMPLEMENT ANADROMOUS FISH RESTORATION PROGRAM FLOW MANAGEMENT PROVISIONS

Attachment G1	**Biological Priorities for Flow Actions**
Attachment G2	**Development of Reoperation and (b)(2) Water Management Methodology**
Attachment G3	**Development of Water Acquisition Methodology**
Attachment G4	**U.S. Fish and Wildlife Service Draft Guidelines for Allocation of Water Acquired Pursuant to Section 3406(b)(3) of the CVPIA (memorandum of October 22, 1996)**
Attachment G5	**U.S. Fish and Wildlife Service Draft Justification of 1997 Delta Flow and Habitat Objectives Using CVPIA Tools Pursuant to Section 3406(b)(1)(B), (b)(2), and (b)(3) of the CVPIA (memorandum of October 25, 1996)**
Attachment G6	**Minimum Instream Fishery Releases for Trinity River**
Attachment G7	**U.S. Department of the Interior Final Administrative Proposal on Management of Section 3406(b) (2) Water (November 20, 1997)**
Attachment G8	**Decision on Implementation of Section 3406(b)(2) of the Central Valley Project Improvement Act**

Attachment G1

Biological Priorities for Flow Actions

Attachment G1

BIOLOGICAL PRIORITIES FOR FLOW ACTIONS

One of the purposes of the CVPIA was to develop and implement the Anadromous Fish Restoration Program (AFRP). The purpose of the AFRP is to develop reasonable efforts to ensure that by the Year 2002, natural production of anadromous fish in the Central Valley rivers and streams would be sustainable on a long-term basis at levels not less than twice the average levels attained during the period of 1967 through 1991. The AFRP is being developed to: 1) attain the best available scientific and commercial data; 2) develop a long-term Restoration Plan that identifies the general approaches and actions to attain the goal; and 3) develop short-term implementation plans as tiers to the Restoration Plan. The tiered implementation plans would be revised at least every 3 to 5 years. The AFRP also will be reviewed and updated as needed every 5 years.

Information used in the AFRP was collected from available reports, input from stakeholders, and input from the scientific community. The objective of AFRP is to meet the anadromous fisheries goals, including the doubling goals, of CVPIA, if possible. Based on current information, Interior believes that doubling goals can be achieved for some species and discrete runs on some streams. In almost all cases, Interior believes that improvement can occur even if doubling goals are not achieved. Monitoring will be used extensively to provide crucial information about ecosystem responses to specific project implementation. Information from the monitoring program will be used with Adaptive Management to modify the actions. In addition, Interior would use partnerships with other Federal, state, and private entities to meet the overall goals.

The AFRP goals were based upon best available scientific information to provide a platform on which participating agencies and the public could develop reasonable actions. In December 1995, the Service prepared a Draft Restoration Plan. The purpose of this plan was to identify general approaches and actions to attain the goals and objectives of AFRP. The Draft Restoration Plan was reviewed by the public and interested agencies and groups. The Revised Draft Restoration Plan was released in June 1997. The Revised Draft Restoration Plan included actions based upon scientific knowledge and the following reasonableness criteria.

- ♦ The intent, technical, and legal basis of the actions must be reasonable
- ♦ Interior or supportive partners must have the authority to implement the actions
- ♦ Potential partners that would be required to implement actions must be supportive

The AFRP was implemented in the Draft PEIS alternatives through the instream and Delta habitat and flow improvements. The habitat improvements were included in the Draft and Revised Draft Restoration Plans as "ACTIONS" to be completed in each watershed (a list is included in Attachment F of the PEIS).

The flow improvements were developed based upon information developed by the Service in October 1996. The preliminary information used scientific data to develop long-term goals that could be achieved using the three tools provided by the CVPIA: 1) Reoperation in accordance with Section 3406(b)(1)(B) of the CVPIA; 2) Dedication of 800,000 acre-feet of CVP water in accordance with Section 3406(b)(2) (also known as "(b)(2) Water"); and Water Acquisitions in accordance with Section 3406(b)(3).

In October 1996, the Service developed two memoranda. One of the memos included Draft Guidelines for Allocation of Acquired Water for Each Central Valley Stream Tributary to the Delta. These guidelines are included in Attachment G4. For each stream, historic flow patterns were reviewed and compared to the needs of the species that used the stream for appropriate life stages. Minimum flows under existing standards were identified and used to develop hydrographs. Then, incremental minimum flow recommendations were developed based upon existing reports and scientific data. The incremental flow recommendations were translated into blocks of water that could be acquired through normal water operations or acquisitions. The blocks of water were prioritized based upon biological criteria. The memo did not identify any specific targets within the prioritized blocks of water. It was anticipated that as more water became available through the Reoperation, (b)(2) water management, or acquisition programs, that the higher priorities would be met and more benefits would be realized. Prioritized flow schedules were developed for multiple year types for each river. The overall goal of the prioritization method was to attempt to increase flows in the rivers towards conditions that occurred in wetter years for all water year types.

In the other memo, the Service identified preliminary flow and water quality goals for CVP-controlled streams. This memo is provided in Attachment G5. Both of these memoranda were presented in October 1996 as preliminary in nature to obtain public input. Comments on this information will be used in the development of the Long-Term Water Management Plan and the Long-Term Water Acquisition Program. However, information was required to complete the impact assessment in the Draft PEIS and was utilized to develop alternatives as described in Attachments G2 and G3.

Attachment G2

Development of Reoperation And (B)(2) Water Management Methodology

ATTACHMENT G2

DEVELOPMENT OF REOPERATION AND (b)(2) WATER MANAGEMENT METHODOLOGY

INTRODUCTION

Water management provisions were developed to utilize two of the tools provided by CVPIA, 3406(b)(1)(B) Re-operation and 3406(b)(2) Water Management, toward meeting the target flows for chinook salmon and steelhead trout in the CVP-controlled streams in the Delta. In the PEIS, the term "(b)(2) Water Management" is used to indicate the integrated use of 3406(b)(1)(B) Re-operation and 3406(b)(2) Water Management.

The goal of the PEIS (b)(2) Water Management analysis was to develop a simplified strategy for use in the analysis of the PEIS Alternatives. The PEIS analysis was purposely limited to a planning level evaluation, due to the many uncertainties associated with the prioritization, allocation, and accounting of (b)(2) water. The approach consisted of development of preliminary prescriptions designed to attempt to meet the target flows on CVP-controlled streams and in the Delta as developed by the Service and presented in Attachment G-5 of the PEIS. It is recognized that this simplified analysis is for the purposes of the PEIS only. An ongoing formal Water Management Plan (WMP) process, involving the U.S. Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service), will provide a detailed evaluation of the use of (b)(2) water.

This attachment summarizes (b)(2) Water Management in the PEIS as developed in Alternatives 1 and 4 and Supplemental Analysis 1a.

METHODOLOGY

The first priority for the use of (b)(2) water was in the Delta to meet the Bay-Delta Plan Accord requirements in the May 1995 Draft Water Quality Control Plan. This Bay-Delta Plan Component is included in all Alternatives and Supplemental Analyses. Next, instream (b)(2) Water Management actions were added to the No-Action Alternative, which includes the Bay-Delta Plan Accord, based on the target flows and operational priorities. The strategy attempted to meet the target flows in all years, without violating existing operational criteria. This instream component is included in all Alternatives and Supplemental Analyses. Needs for (b)(2) water use were evaluated on each of the CVP controlled rivers, as compared to the No-Action Alternative. In addition, Alternative 4 and Supplemental Analysis 1a include the use of (b)(2) water to attempt to meet fishery objectives in the Delta, as well as on CVP-controlled streams.

Operational rules were developed that integrate the target flow objectives with No-Action Alternative CVP project operations to create a (b)(2) Water Management strategy for Alternative 1. To provide an estimate of the total use of (b)(2) water in the Alternative or Supplemental

Analysis, a No Bay-Delta Plan Accord (D-1485) base scenario, at a 2022 level of development, was required for comparative purposes. This base scenario was needed because the No-Action Alternative includes use of (b)(2) water to meet the Bay-Delta Plan Accord requirements. The reduction in CVP deliveries between the base scenario and the (b)(2) Water Management component of the Alternative or Supplemental Analysis provides a measure of the total amount of (b)(2) water used. Due to the programmatic nature of the PEIS, reductions in CVP deliveries were evaluated on an average annual basis for the 1922-1990 simulation period. (b)(2) Water Management cannot adversely impact non-CVP water rights holders (including the SWP), Sacramento River Water Rights Contractors, or San Joaquin River Exchange Contractors as compared to the No-Action Alternative.

In addition to long-term average conditions, average annual impacts to deliveries were evaluated for seven hydrologic periods within the simulation period, ranging from wet to critical dry, to show the range of possible impacts under varying hydrologic conditions. The potential use of (b)(2) water in any given year may vary significantly between wet and dry hydrologic year types. For example, in many wet years, reservoir storages and inflows are adequate to meet full deliveries and all target flows without additional releases, thereby limiting the amount of (b)(2) water required. However, in many dry periods, CVP reservoir releases for target flows may be limited by the need to use remaining reservoir storage to meet the Biological Opinion, Delta water quality, or water rights requirements. Therefore, a number of different hydrologic periods were selected to evaluate the average annual delivery impacts of the use of (b)(2) water under wet, above normal, below normal, and dry hydrologic conditions. The 1976 - 1977 period was not selected as a period of evaluation because it is an extremely dry period, and it is assumed that under such a condition, Reclamation, NMFS, and the Service would reconsult to determine appropriate operations. Table G2-1 shows the hydrologic periods selected for analysis.

TABLE G2-1
HYDROLOGIC PERIODS OF EVALUATION
FOR PEIS (b)(2) WATER MANAGEMENT

Contract Years Included in Simulation Period			Period Type
1928	-	1934	Dry
1944	-	1950	Below Normal
1951	-	1957	Above Normal
1959	-	1962	Below Normal
1967	-	1971	Wet
1978	-	1980	Above Normal
1987	-	1990	Dry

The following guidelines were established for the PEIS (b)(2) Water Management.

- Proposed management actions could not interfere with existing operational requirements, including the Winter-Run Biological Opinion and the Bay-Delta Plan Accord. In comparison to the No-Action Alternative simulation, increases in the number of violations of Winter-Run Biological Opinion temperature criteria in the Sacramento River were not allowed.

- Proposed management actions should produce a feasible operational scenario.

- Management actions would not include modifications to existing reservoir flood control rules.

- The primary goal of (b)(2) Water Management was to provide water for salmon and steelhead target flows.

PEIS (b)(2) WATER MANAGEMENT IN ALTERNATIVE 1

To develop an initial (b)(2) Water Management strategy, CVP-controlled river flow conditions in the No-Action Alternative simulation were compared to target flows. This comparison was used to identify rivers where target flows were not met, and to develop operational objectives to meet the target flows where possible. The actions on each CVP-controlled river were evaluated, using the PROSIM and SANJASM models, to determine the specific (b)(2) water needs and possible operational constraints on each river. The actions on all of the CVP-controlled rivers were then integrated into a combined simulation to analyze the overall system wide impacts of (b)(2) Water Management.

CLEAR CREEK OPERATIONS

The operational criteria for minimum flow requirements on Clear Creek in the No-Action Alternative are based on a modified version of Reclamation's 1963 Whiskeytown Dam release schedule. Reclamation's release schedule was developed and implemented (but never formalized) in conjunction with the Service to enhance fishery and recreational values for the Whiskeytown National Recreation Area. As developed by Reclamation, the minimum flows on Clear Creek are:

- Jan. 1 through Oct. 31: 50 cfs (normal year) or 30 cfs (critical year); and
- Nov 1 through Dec. 31: 100 cfs (normal year) or 70 cfs (critical year).

In the No-Action Alternative simulation, both normal and critical year minimum flow requirements are 50 cfs from January 1 through October 31.

The target flows developed by the Service on Clear Creek were based on an instream flow study (DWR, 1986) and hydrologic data at Whiskeytown Dam for the period 1923 to 1994. Flows were prescribed for fall/late-fall chinook salmon and steelhead, as well as spring-run salmon. The Clear Creek flow targets are prescribed for every month of the year, based on the Shasta Index water year-type. Target flows are 200 cfs from October through May (regardless of water year type) and 150 cfs for the remainder of the year (variable spring-time releases depending on water year type). During drought conditions, a 25 percent reduction in instream flow is allowed.

The No-Action Alternative simulation flows meet the target flows in less than 10 percent of the months in the 69-year PEIS simulation period. However, several factors, including limited inflows and reservoir storage capacity, constrain the ability to re-operate water and use (b)(2) water during dry periods. In critically dry years, inflow to Whiskeytown Lake is insufficient to support the target flows.

Monthly inflows to Whiskeytown Lake and target flows for the critical dry period 1928-1934 are presented in Figure G2-1. Inflows in winter and spring months often exceed the releases needed to meet the target flows. The limited storage of 241,000 acre-feet in Whiskeytown Lake makes it difficult to store this water for use in subsequent dry months when inflows are significantly less than the releases needed to meet target flows. In many years, the volume of spring inflow that can be stored in excess of target flows is not sufficient to meet target flows in later summer months. During these dry periods, water diversions from the Trinity River Basin are reduced to maintain minimum Clair Engle Lake storage. Outside of the critical dry period, inflows and Trinity River diversions to Whiskeytown Lake provide enough water to meet target flows.

Because it would not be possible to meet the target flows in all years, priorities for re-operation and use of (b)(2) water were established. The flow objectives in critical dry years were reduced to 30 percent of the target flow value and the revised objectives were used in the (b)(2) Water Management simulation. As a result of this adjustment, target flows are met in all but critical dry years, thereby maintaining minimum storage levels in Clair Engle and Whiskeytown lakes for temperature control purposes.

SACRAMENTO RIVER OPERATIONS

The operational criteria included in the No-Action Alternative for the Sacramento River below Keswick are in accordance with the 1993 Winter-Run Biological Opinion, as summarized below.

- Maintain minimum carryover (end-of-September) storage of 1.9 million acre-feet in Shasta Lake, except in the driest ten percent of years.
- Maintain temperature control below Keswick Dam from April 1 through September 30.
- Maintain minimum flow of 3,250 cfs below Keswick Dam from October 1 through April 30.

The target flows developed by the Service on the Sacramento River at Keswick Dam were based on historical operations of Shasta Lake and existing operational criteria. The target flows were developed to balance instream flow needs for habitat with carryover storage needs for temperature control. Flow stability, for winter-run chinook salmon rearing and spring/fall-run chinook spawning, was a primary consideration. The minimum flow requirement at Keswick for October through April is based on the October 1 storage in Shasta Lake. A storage target of between 3.0 and 3.2 million acre-feet is set for April 30 to maintain enough water for summer temperature control releases. The storage-based target flows are presented in Table G2-2.

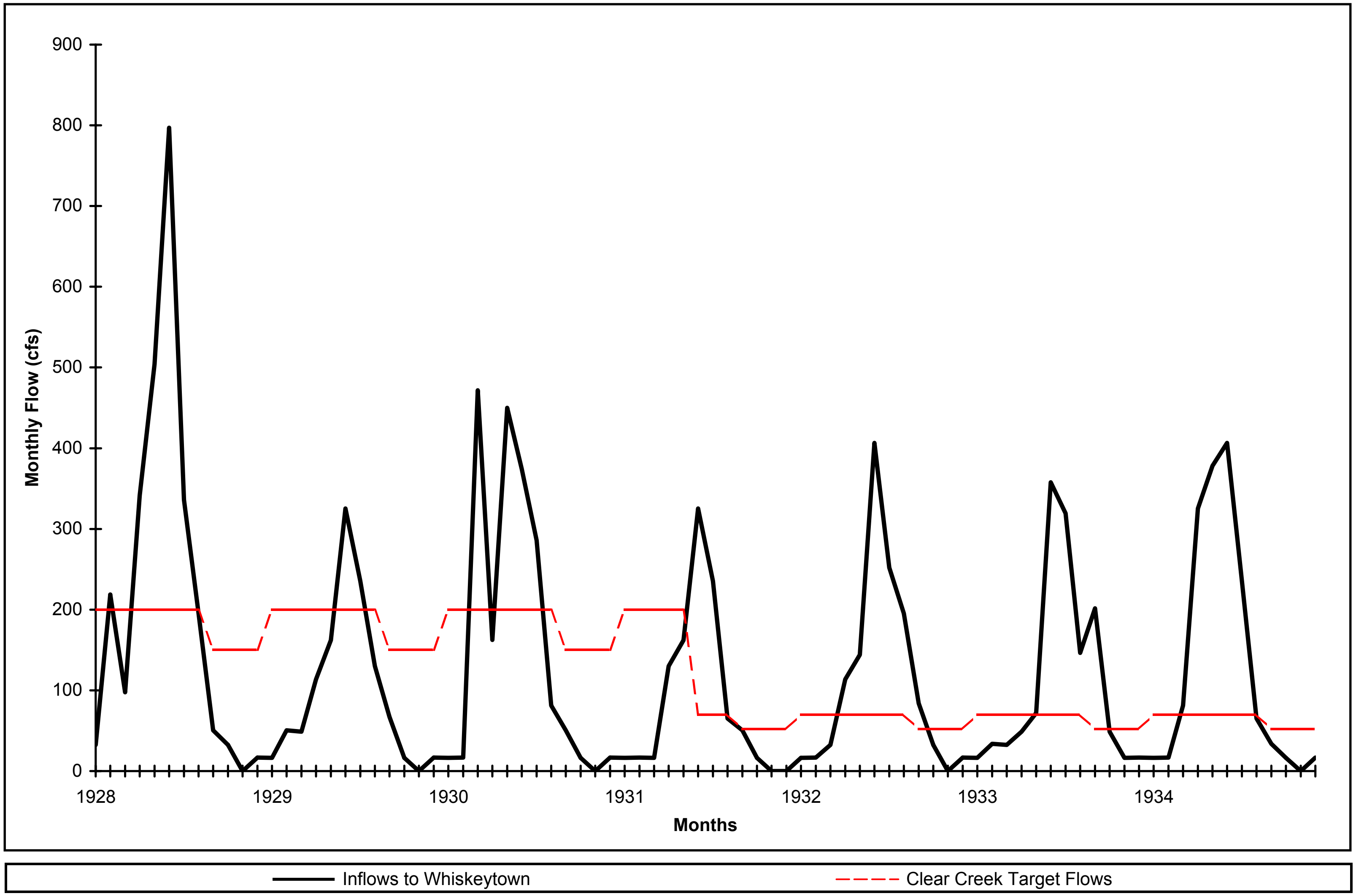

FIGURE G2-1

COMPARISON OF ESTIMATED MONTHLY INFLOWS TO WHISKEYTOWN AND TARGET FLOWS ON CLEAR CREEK

TABLE G2-2
MINIMUM SACRAMENTO RIVER TARGET FLOWS AT KESWICK DAM FOR THE PERIOD OCTOBER 1 THROUGH APRIL 30

Carryover Storage (in million af)	Keswick Dam Release (in cfs)	Carryover Storage (in million af)	Keswick Dam Release (in cfs)
1.9	3,250	2.5	4,250
2.0	3,250	2.6	4,500
2.1	3,250	2.7	4,750
2.2	3,500	2.8	5,000
2.3	3,750	2.9	5,250
2.4	4,000	3.0	5,500

NOTES:
Based on October 1 carryover storage in Shasta Lake and critically dry runoff conditions (driest decile runoff of 2.5 million af) to produce a target April 30 Shasta Lake storage of 3.0 to 3.2 million af for temperature control.

In the No-Action Alternative simulation, these target flows are met in nearly all months during October through April in wet years, but only in about 50 percent of the months in dry years. This indicates that the need for the use of (b)(2) water is primarily in drier years.

In the (b)(2) Water Management simulation, the October through April target flows are based on October 1 storage in Shasta Lake and are therefore achieved in 100 percent of the months. This revised operation utilizes Shasta Lake storage to increase October through April river flows. In all but critical low runoff years which follow wet years, operations under the storage/flow relationship result in April 30 Shasta Lake storage levels between 3.0 and 3.2 million acre-feet. When Shasta Lake storage on October 1 is high (near or at flood control), minimum required releases are also high. If subsequent reservoir inflow is critically low, it may not be sufficient to meet the target flows and the April 30 storage target, so the resulting storage may be below the target.

The end-of-water year storage targets, as set in the Winter-Run Biological Opinion, can be met in all but some dry and critical dry years. The target cannot be met in some critical years because reservoir inflows are extremely low and spring and summer reservoir releases are required for temperature control and water rights deliveries. Although deliveries to agricultural water service contractors may be reduced to zero, releases for temperature control, water rights, M&I contractors, and Exchange and Water Rights contractors must still be made. In these extreme dry years, Reclamation would reconsult with the National Marine Fisheries Service (NMFS) to determine appropriate actions under the Winter Run Biological Opinion.

Operation under (b)(2) Water Management results in reduced Shasta Lake releases for CVP water users in the spring and summer months, to provide additional fall and winter releases to meet flow targets. This shift in Shasta Lake releases is limited by the need to make spring and summer releases to meet Winter Run Biological Opinion temperature control requirements. The modeling conducted for the PEIS provides a general indication of how much summer releases can be reduced without negatively impacting the ability to meet winter run temperature requirements. The minimum average monthly release required to meet the 56 degree minimum temperature threshold varies and is a function of ambient air temperature, the volume and temperature of downstream accretions, and the volume and temperature of cold water storage in Shasta Lake. Based on PEIS monthly temperature modeling analyses, it appears that during the hot summer months of June through August there needs to be a minimum release of about 10,000 to 12,000 cfs to meet the biological opinion temperature requirements during this critical winter run salmon mortality period.

In most dry and critical dry years Shasta Lake Reservoir releases are governed by water rights and fisheries objectives including the target flows, Winter Run Biological Opinion, and Delta water quality requirements. During these periods, CVP Delta exports are limited to incidental Delta inflows resulting from upstream releases for fisheries, and return flows from water rights diversions.

AMERICAN RIVER OPERATIONS

Operational criteria included in the No-Action Alternative are summarized below.

- Maintain COE (Corps of Engineers) 400 fixed Folsom flood control requirements.
- Maintain American River minimum streamflow requirements based on recent operational practices which attempt to meet some of the requirements of California State Water Resources Control Board (SWRCB) Decision 1400 with minimum flow requirements per SWRCB Decision 893.

Under Alternative 1, target flows are prescribed for the lower American River for the entire reach downstream of Nimbus Dam to provide adequate flow for the fall/winter spawning and incubation of chinook salmon and steelhead trout. A September 30 Folsom Lake storage target of 610,000 acre-feet is also included to attempt to provide a sufficient volume of water to maintain increased stable spawning and incubation flows during the fall and winter months. The target flows for the American River, by year-type, are presented in Table G2-3.

The No-Action Alternative simulation flows meet the target flows on the American River below Nimbus Dam in 60 percent of the months in wet years and in 20 percent of the months in critical dry years, based on the 40-30-30 year type index. During the critical spawning and incubation period of October through February, target flows are only met in 10 percent of the above normal years and in zero percent of the dry and critical dry years. The Folsom Lake September 30 storage target of 610,000 acre-feet is met in 40 percent of the years. This indicates the need to use (b)(2) water is primarily in dry to above normal year types.

TABLE G2-3
AMERICAN RIVER MINIMUM FLOW OBJECTIVES

Month	Flow for Each of Four Year Types (in cfs)			
	Wet	Normal	Dry/Critical	Critical Relaxation
October	2,500	2,000	1,750	800
November - February	2,500	2,000	1,750	1,200
March - May	4,500	3,000	2,000	1,500
June	4,500	3,000	2,000	500
July	2,500	2,500	1,500	500
August	2,500	2,000	1,000	500
September	2,500	1,500	500	500

NOTES:

A multi-agency and interested party management team should be formed to review and adjust flows in consideration of carryover storage and hydrologic conditions as needed to provide for the long-term needs of anadromous fish.

Year types should be based on an American River index, or on consideration of carryover storage and hydrologic conditions in the American River watershed.

The use of (b)(2) water on the American River is limited by extremely variable inflow hydrology, the limited storage capacity of Folsom Lake, and the high level of M&I demands along the river. Annual inflows to Folsom Lake are highly variable, as shown in Figure G2-2, ranging from less than 1 acre-feet to greater than 6 million acre-feet over the 69-year PEIS simulation period. In wet years, inflows to Folsom Lake often exceed the releases needed to meet the target flows, but the limited storage capacity of 972,000 acre-feet in Folsom Lake prevents storage of this water for use in subsequent dry years when inflows may be significantly less than the releases needed to meet target flows. In addition, COE flood control restrictions further limit fall storage to about 600,000 acre-feet in November.

M&I demands along the American River also limit the ability to re-operate and use (b)(2) water. Between the projected 1995 and 2022 levels of development, M&I demands along the American River are projected to increase from 240,000 acre-feet to 510,000 acre-feet. Over 90 percent of this increase, approximately 250,000 acre-feet, is attributable to water rights contractors which are not subject to any CVP shortage criteria. The remaining 10 percent, approximately 20,000 acre-feet, is attributable to CVP M&I contractors, which are subject to a maximum shortage of 25 percent. This water must be released for water rights and M&I contractors on a monthly pattern which does not necessarily coincide with the target flows. Thus, the majority of the increase in American River demand cannot be reduced substantially to provide water toward meeting target flows.

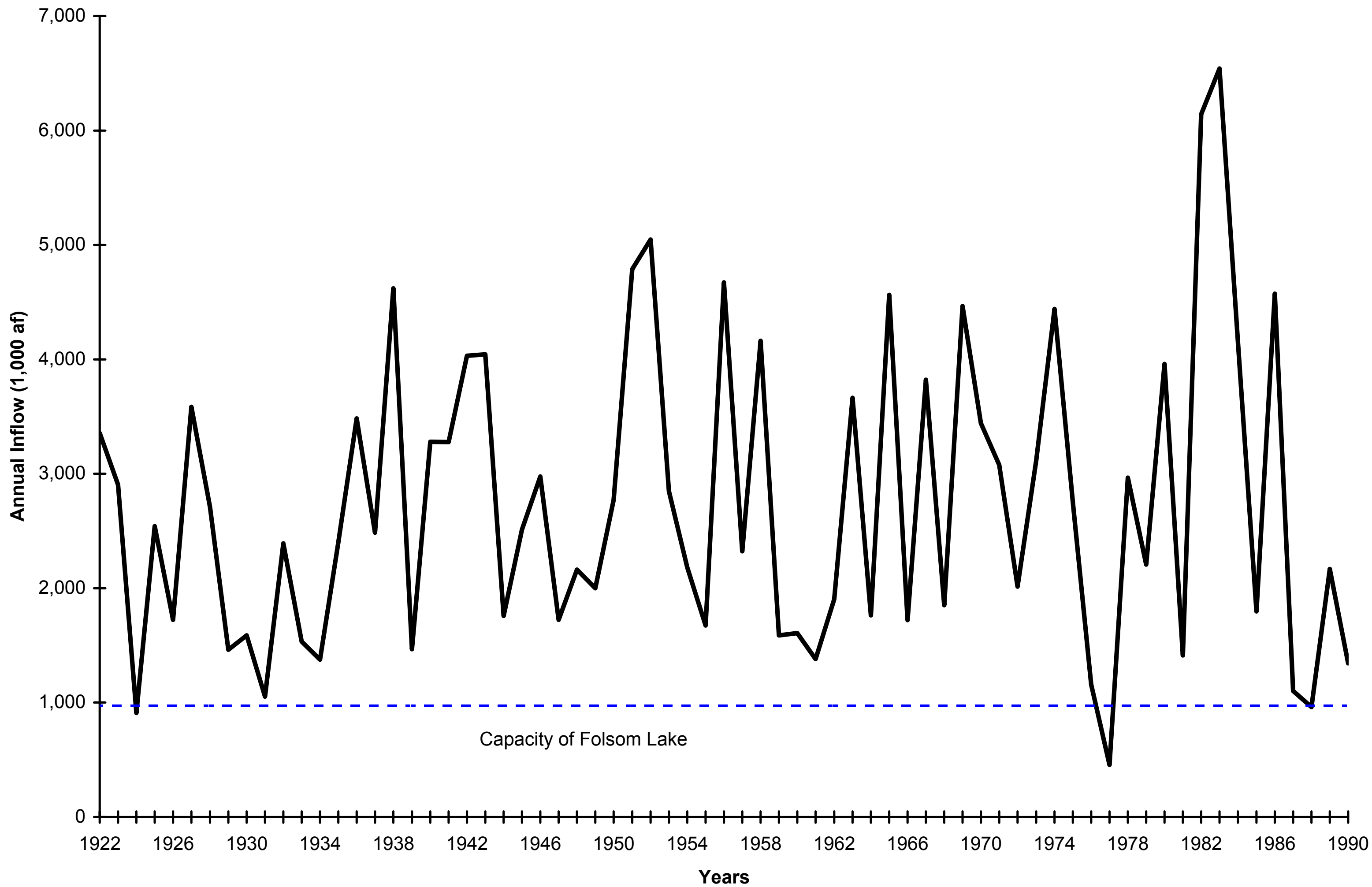

FIGURE G2-2

SIMULATED ANNUAL INFLOW TO FOLSOM RESERVOIR 1922 - 1990

Because it would not be possible to meet all target flows on the lower American River, priorities for use of (b)(2) water were established. The Service assigned the highest biological priorities to maintenance of stable fall and winter flows October through February and increasing Folsom Lake end-of-month September storage. The year-type flow requirements were transformed into reservoir storage/inflow based flow requirements to allow additional operational flexibility during dry and critical years. The reach of the American River over which the target flows were prescribed was limited to the section from Nimbus Dam to the "H" Street bridge.

The revised PEIS American River (b)(2) water target flows for the October through February period are based on October 1 storage in Folsom Lake. Flow targets for the remaining months, March through September, are determined by the previous month's storage and remaining water year projected inflow. The spring pulse flows in the March through June months are considered by the Service to be a lower priority than the October through February target flows. The storage/inflow based flow relationship developed for PEIS (b)(2) Water Management on the American River is presented in Table G2-4.

TABLE G2-4
STORAGE-BASED FLOW RELATIONSHIP DEVELOPED FOR (b)(2) WATER MANAGEMENT ON THE AMERICAN RIVER AT NIMBUS DAM

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Criteria and Flow	S	W	W	W	W	S + I	S + I	S + I	S + I	S + I	S + I	S + I
Criteria (1,000 af)	600	600	600	600	600	2,850	2,450	2,050	1,550	1,250	1,200	1,150
Flow (cfs)	2,500	2,500	2,500	2,500	2,500	4,500	4,500	4,500	4,500	2,500	2,500	2,500
Criteria (1,000 af)	500	500	500	500	500	2,600	2,250	1,875	1,425	1,150	875	850
Flow (cfs)	2,000	2,500	2,500	2,250	2,000	3,750	3,750	3,750	3,750	2,500	2,250	2,000
Criteria (1,000 af)	410	410	410	410	410	2,350	2,050	1,700	1,300	1,050	750	700
Flow (cfs)	2,000	2,000	2,000	2,000	2,000	3,000	3,000	3,000	3,000	2,500	2,000	1,500
Criteria (1,000 af)	350	350	350	350	350	1,500	1,350	1,200	850	700	550	500
Flow (cfs)	1,500	2,000	2,000	1,750	1,500	2,500	2,500	2,500	2,250	1,875	1,500	1,000
Criteria (1,000 af)	300	300	300	300	300	1,300	1,150	1,000	750	600	500	0
Flow (cfs)	800	1,500	1,500	1,250	1,250	1,500	1,500	1,500	1,500	1,250	1,000	500
Criteria (1,000 af)	250	250	250	250	250	1,100	1,000	900	650	500	0	
Flow (cfs)	500	1,000	1,000	1,000	1,000	1,250	1,250	1,250	1,250	1,000	500	
Criteria (1,000 af)	0	0	0	0	0	900	700	600	500	0		
Flow (cfs)	500	500	500	500	500	750	750	750	500	500		
Criteria (1,000 af)						0	0	0	0			
Flow (cfs)						250	250	250	250			

NOTES:

American River at Nimbus Dam storage-based flow relationship developed for PEIS PROSIM runs

S = end-of-previous month's Folsom Lake storage

W = beginning of water year's Folsom Lake storage (end-of-September Folsom Reservoir storage, previous water year)

I = inflow to Folsom Lake (current month + all months until end of water year)

In comparison to the No-Action Alternative simulation, the Folsom Lake releases in the (b)(2) water simulation are shifted from the spring and summer months to the fall and winter months, in accordance with the prioritized target flows. For the October through February period, the original Year type target flows are achieved in 100 percent of the October through February periods of wet, above normal, and below normal years. For the same period, target flows are met in 80 percent of the dry years and 40 percent of critically dry years. In addition, the flow reductions during spring and summer months increase end-of-September storage by an average of 80,000 acre-feet. The Folsom Lake September storage target is met in 50 percent of the years simulated.

The (b)(2) Water Management on the American River results in reductions in spring and summer releases from Folsom Lake, which consequently decrease American River flows entering the Delta. This reduction in American River inflow to the Delta requires that additional water be released from Shasta Lake to meet Delta water rights and water quality requirements. These additional Shasta Lake releases limit some of the CVP's flexibility to maintain spring and summer cold water storage in Shasta Lake for Winter Run Biological Opinion temperature control requirements. This loss of flexibility is partially offset by increased fall and winter Folsom Lake releases that reduce the need to make Shasta Lake releases during that period to meet Delta water quality requirements or supply water for Tracy Pumping Plant exports.

STANISLAUS RIVER OPERATIONS

Target flows for the Stanislaus River below Goodwin Dam are presented in Table G2-5. The flows are intended to supplement instream flow releases made pursuant to the 1987 agreement between Reclamation and DFG, described in the Affected Environment.

TABLE G2-5
TARGET FLOWS ON THE STANISLAUS RIVER BELOW GOODWIN DAM

	Requirement by Water Year Type (cfs)				
	Wet	**Above Normal**	**Below Normal**	**Dry**	**Critical**
October	350	350	250	250	200
November-March	400	350	300	275	250
April	1,500	1,500	300/1,500 (1)	300/1,500 (2)	300/1,500 (3)
May	1,500	1,500	1,500/300 (1)	1,500/300 (2)	1,500/300 (3)
June	1,500	800	250	200	200
July-September	300	300	250	200	200

NOTES:
(1) In a below normal water year, April-May flow would be maintained for 45 days at 1,500 cfs and 16 days at 300 cfs.
(2) In a dry water year, April-May flow would be maintained for 30 days at 1,500 cfs and 31 days at 300 cfs.
(3) In a critical water year, April-May flow would be maintained for 30 days at 1,500 cfs and 31 days at 300 cfs.
(4) Based on the San Joaquin Valley 60-20-20 water year type classification.

In the No-Action Alternative, target flows would be met in approximately 50 percent of the months in the summer, fall, and winter . Spring pulse flows would be met only in very wet conditions, when releases are made to maintain flood control storage. Re-operation of New Melones Reservoir and (b)(2) Water Management on the Stanislaus River focused on these two objectives and was accomplished in two steps.

The first step included operation of New Melones to meet the target flows in July through March of non-critical years. Because this would result in lower storage in New Melones, operational targets were initially reduced in April through June in order to maintain minimum New Melones storage criteria. Due to the limited water supplies, no increase in the instream flows would be made in critical year types.

The second step applied (b)(2) Water Management to CVP contracts. In years when target flows would not be met, CVP contractors would not receive deliveries. The water would be stored in New Melones Reservoir and released toward meeting the target flows, primarily in April through June. In addition, where possible, flood control ramping releases in the summer and fall would be released earlier in the year, primarily in April through June to help meet target flows.

SUMMARY OF (b)(2) WATER MANAGEMENT IN ALTERNATIVE 1

The (b)(2) Water Management component of Alternative 1 incorporates an integrated package of target flows for all CVP-controlled rivers in the Central Valley. As described previously, the measure of (b)(2) water use in the PEIS is based on the reduction in CVP average annual deliveries as compared to a No Bay-Delta Plan Accord base condition, at a 2022 level of development. The average annual reduction in CVP deliveries, as a result of the use of (b)(2) water in Alternative 1, is presented in Table G2-6 for each of the hydrologic periods selected for evaluation. A negative value indicates a reduction in average annual CVP deliveries due to the use of (b)(2) water during that simulated hydrologic period. A positive value indicates an increase in average annual deliveries.

In each hydrologic period of evaluation, (b)(2) water is used to meet the Bay-Delta Plan Accord requirements and to help meet the target flows. The greatest amount of (b)(2) water is used during dry and below normal hydrologic periods when natural river flows and CVP reservoir releases are at their lowest. In wet and above normal periods, the (b)(2) water component is less than during below normal and dry periods. This is because target flows may be satisfied by reservoir flood control releases, spills, and other CVP operations during wetter periods and no additional releases of water may be necessary to meet the target flows.

It should be noted that the average annual reduction in CVP deliveries does not reach 800,000 acre-feet during any of the hydrologic periods. This is because the CVP is over-constrained due to the multiple needs and operational criteria that govern operations. The (b)(2) water is measured as reductions in deliveries to CVP water service contractors north and south of the Delta. However, many CVP operational criteria take priority before deliveries are made to CVP water service contractors and, therefore, use of (b)(2) water is limited. These operational priorities include water rights, the Winter Run Biological Opinion, flood control operations, and water quality requirements. These operational criteria, in combination with limited water availability, often constrain the amount of water which may be used towards (b)(2) Water Management objectives.

TABLE G2-6
CVP DELIVERY IMPACTS OF THE INSTREAM (b)(2) WATER MANAGEMENT COMPONENT OF ALTERNATIVE 1 AS COMPARED TO THE 2022 D-1485 BASE SCENARIO

Hydrologic Period	Period Type	Simulated Average Annual CVP Deliveries (in 1,000 af)		Change in Average Annual CVP Deliveries (in 1,000 af)
		2022 D-1485 Base Scenario	Simulation with Instream (b)(2) Water Management	
1922 - 1990	Simulation Period	5,890	5,530	-360
1928 - 1934	Dry	4,900	4,340	-560
1944 - 1950	Below Normal	5,900	5,410	-490
1951 - 1957	Above Normal	6,300	6,100	-200
1959 - 1962	Below Normal	5,890	5,360	-530
1967 - 1971	Wet	6,310	6,120	-190
1978 - 1980	Above Normal	6,320	6,190	-130
1987 - 1990	Dry	5,330	4,590	-740
Note: Does not include CVP refuge deliveries				

The impacts to SWP deliveries, resulting from (b)(2) Water Management in Alternative 1, are presented in Table G2-7. A negative value indicates that SWP deliveries are reduced as a result of (b)(2) Water Management. A positive value indicates that SWP deliveries are increased as a result of (b)(2) Water Management.

The table shows that SWP deliveries generally increase as a result of (b)(2) Water Management actions included in Alternative 1. This is because Delta inflow increases during the fall and winter due to greater upstream CVP reservoir releases for target flows. In many years, these inflows exceed the capacity of the CVP's Tracy Pumping Plant. Under the current Coordinated Operations Agreement (COA) assumptions used for the PEIS analysis, this excess Delta inflow may be pumped by the SWP when capacity is available at Banks Pumping Plant, reducing the need for Lake Oroville releases.

As stated above, the impacts to the CVP and SWP are a function of the COA assumptions used to represent the coordinated operations of the two projects at a 2022 level of development. It must be recognized that the impacts to SWP deliveries could vary substantially under a different set of Delta water quality requirements and/or COA sharing assumptions. It is also possible that wheeling agreements could be negotiated with the SWP to pump excess CVP water, above the Tracy Pumping Plant capacity, to CVP water users south of the Delta.

TABLE G2-7
SWP DELIVERY IMPACTS OF INSTREAM
(b)(2) WATER MANAGEMENT COMPONENT OF THE ALTERNATIVE 1

Hydrologic Period	Period Type	Simulated Average Annual SWP Deliveries (in 1,000 af)		Change in Average Annual SWP Deliveries (in 1,000 af)
		2022 D-1485 Base Scenario	Simulation with Instream (b)(2) Water Management	
1922 - 1990	Simulation Period	3,400	3,460	+60
1928 - 1934	Dry	2,380	2,200	-180
1944 - 1950	Below Normal	3,300	3,450	+150
1951 - 1957	Above Normal	3,950	3,830	-120
1959 - 1962	Below Normal	3,130	3,080	-50
1967 - 1971	Wet	4,050	4,140	+90
1978 - 1980	Above Normal	4,080	4,220	+140
1987 - 1990	Dry	1,930	2,140	+210

PEIS (b)(2) WATER MANAGEMENT IN SUPPLEMENTAL ANALYSIS 1a

The operational criteria for the Delta in the No-Action Alternative and Alternative 1 include the Bay-Delta Plan Accord, the COA with assumptions to allow use with the SWRCB's May 1995 Draft Water Quality Control Plan, and the 1993 Winter-Run Biological Opinion as amended in 1995 by NMFS. In addition to using (b)(2) water to help meet fishery target flow goals on CVP-controlled streams, Supplemental Analysis 1a also includes the Delta (b)(2) water component to attempt to meet fishery objectives in the Delta. As is the case with Alternative 1, a simplified version of the (b)(2) Water Management in the Delta was developed for the PEIS analysis. The Delta (b)(2) actions evaluated in Supplemental Analysis 1a are based on preliminary actions proposed by the Service in February 1996.

In Supplemental Analysis 1a, the assumptions regarding the COA are particularly important since many of the proposed (b)(2) Delta actions assume cooperative implementation by both the CVP and SWP. The relative impacts to the CVP and SWP described under Supplemental Analysis 1a are a function of the associated COA assumptions.

DELTA OPERATIONS

Delta actions to benefit anadromous fish include operational targets and supplemental actions (Delta (b)(2) actions). The operational targets are recommendations to the Operations Coordination Group (Ops Group) that do not involve costs to water supply in excess of the Bay-Delta Plan Accord. The Delta (b)(2) actions include changes in operations that extend beyond the authority of the Ops Group and that further contribute to meeting the goals. Delta (b)(2) actions are limited by the water available through the management of the 800,000 acre-feet of

CVP yield as defined in Section 3406(b)(2) of CVPIA. These Delta (b)(2) actions are intended to be consistent and supportive of the Bay-Delta Plan Accord.

The simplified analysis used for the PEIS focuses on the use of major (b)(2) actions for the protection of anadromous fish, assuming that the SWP would cooperate by reducing exports during specified periods and making releases to contribute to additional levels of Delta protection. As shown in Alternative 1, the SWP would gain some limited export benefits at Banks Pumping Plant as a result of reservoir releases for (b)(2) water purposes on CVP streams. It is assumed for Supplemental Analysis 1a, that any negative impact to the SWP due to this cooperation would not exceed the benefits shown in Alternative 1. Therefore, there would be no net impact to SWP deliveries as compared to the No-Action Alternative. The resulting reductions in deliveries estimated based on this simplified analysis do not include the potential for SWP pumping of CVP water in fall and winter months to make up water costs associated with (b)(2) actions for Delta purposes earlier in the year.

The Delta (b)(2) actions incorporated into Supplemental Analysis 1a, in addition to the instream (b)(2) Water Management described in Alternative 1, are listed below.

- Maintain a 1,500 cfs maximum for total CVP/SWP exports during the 30-day pulse flow period from April 15 through May 15. The 1,500 cfs maximum pumping limit approximates the Service's desired San Joaquin River pulse flow export/inflow ratio under each of the different water year types.

- Increase level of protection targeted by the May and June X2 requirement to a 1962 level of development. This represents an increase in the number of days when X2 would be required at Chipps Island in Table A of the SWRCB May 1995 Water Quality Control Plan, as shown in Table G2-8.

- Reduce CVP Tracy Pumping Plant exports in November and December to decrease the fall Delta export/inflow ratio. This action is intended to reduce the direct and indirect entrainment effects of export pumping on migrating juvenile chinook salmon.

SUMMARY OF (b)(2) WATER MANAGEMENT SUPPLEMENTAL ANALYSIS 1a

The reduction in deliveries due to the Delta (b)(2) actions in Supplemental Analysis 1a are presented in Table G2-9, for each of the hydrologic periods of evaluation. If the average annual change in deliveries is negative, then (b)(2) water is used during that period.

In each hydrologic period of evaluation, (b)(2) water would be used to meet the Bay-Delta Plan Accord requirements, instream target flows, and Delta (b)(2) actions. During dry and below normal periods, the greatest amount of (b)(2) water is used. In many instances, this is because the greatest need for (b)(2) water occurs during dry periods when reservoir releases are lowest. During none of the periods does the average annual (b)(2) water component reach 800,000 acre-feet. As described under Alternative 1, operational criteria such as biological opinion temperature requirements, reservoir flood control, water rights demands, and Delta water quality requirements often limit the amount of (b)(2) water which may be used. Delta (b)(2) actions were also limited to prevent negative impacts to SWP deliveries as compared to the No-Action Alternative.

TABLE G2-8
INCREASE IN X2 DAYS FOR 1962 LEVEL OF DEVELOPMENT

Previous Month Index	1962 Level of Development May	1962 Level of Development June	May 1995 Water Quality Control Plan May	May 1995 Water Quality Control Plan June
500	0	0	0	0
750	0	0	0	0
1000	0	0	0	0
1250	0	0	0	0
1500	0	0	0	0
1750	1	0	0	0
2000	4	0	1	0
2250	13	1	3	0
2500	24	3	11	1
2750	29	7	20	2
3000	30	12	27	4
3250	31	18	29	8
3500	31	23	30	13
3750	31	26	31	18
4000	31	28	31	23
4250	31	29	31	25
4500	31	29	31	27
4750	31	30	31	28

TABLE G2-9
CVP DELIVERY IMPACTS OF THE INSTREAM AND DELTA (b)(2)
WATER MANAGEMENT COMPONENTS OF THE SUPPLEMENTAL ANALYSIS 1a

Hydrologic Period	Period Type	Simulated Average Annual CVP Deliveries (in 1,000 af): 2022 D-1485 Base Scenario	Simulated Average Annual CVP Deliveries (in 1,000 af): Instream and Delta (b)(2) Water Management	Average Annual Change in Deliveries (in 1,000 af)
1922 - 1990	Simulation Period	5,890	5,430	-460
1928 - 1934	Dry	4,900	4,270	-630
1944 - 1950	Below Normal	5,900	5,310	-590
1951 - 1957	Above Normal	6,300	5,980	-320
1959 - 1962	Below Normal	5,890	5,360	-530
1967 - 1971	Wet	6,310	6,000	-310
1978 - 1980	Above Normal	6,320	6,020	-300
1987 - 1990	Dry	5,330	4,570	-760

Note: Does not include refuge deliveries

The (b)(2) water component would be less in wet and above normal periods, than during below normal and dry periods. In many instances, this is because the target flows would already be met with existing reservoir releases and no additional releases or use of (b)(2) water would be necessary.

The impact to SWP deliveries resulting from (b)(2) Water Management in Supplemental Analysis 1a is presented in Table G2-10. If the SWP Impact of (b)(2) Water Management is a negative value, SWP deliveries would be reduced as a result of (b)(2) Water Management. If the SWP Impact of (b)(2) Water Management is a positive value, SWP deliveries would be increased as a result of (b)(2) Water Management.

TABLE G2-10
SWP DELIVERY IMPACTS OF INSTREAM AND DELTA (b)(2) WATER MANAGEMENT COMPONENTS OF SUPPLEMENTAL ANALYSIS 1a

Hydrologic Period	Period Type	Simulated Average Annual SWP Deliveries (in 1,000 af)		Average Annual Change in Deliveries (in 1,000 af)
		2020 D-1485 Base Scenario	Instream and Delta (b)(2) Water Management	
1922 - 1990	Simulation Period	3,400	3,410	+10
1928 - 1934	Dry	2,380	2,230	-150
1944 - 1950	Below Normal	3,300	3,360	+60
1951 - 1957	Above Normal	3,950	3,860	-90
1959 - 1962	Below Normal	3,130	3,080	-50
1967 - 1971	Wet	4,050	4,100	+50
1978 - 1980	Above Normal	4,080	4,080	0
1987 - 1990	Dry	1,930	2,190	+260

Note: Does not include refuge deliveries

During the fall and winter months, Delta inflows are increased because of greater upstream CVP reservoir releases for target flows. In many years, these inflows exceed the capacity of the Tracy Pumping Plant. In many of these years, excess pumping capacity is available at Banks Pumping Plant so the SWP is able to export additional water in some of the fall and winter months, and increase deliveries. The ability of the SWP to increase deliveries is dependent upon several operational constraints, including pumping capacity at the Banks Pumping Plant, the COA, Delta water quality requirements, and SWP San Luis Reservoir operations.

PEIS (b)(2) WATER MANAGEMENT IN ALTERNATIVE 4

The operational criteria for the Delta in the No-Action Alternative and Alternative 1 include the Bay-Delta Plan Accord, the COA with assumptions to allow use with the SWRCB's May 1995 Draft Water Quality Control Plan, and the 1993 Winter-Run Biological Opinion as amended in 1995 by NMFS. As in Supplemental Analysis 1a, Alternative 4 includes the Delta (b)(2) water component to attempt to meet fishery objectives on CVP-controlled streams and in the Delta. In contrast to the proposed preliminary February 1996 Delta (b)(2) actions that were evaluated in Supplemental Analysis 1a, the Delta (b)(2) actions evaluated in Alternative 4 were developed based on preliminary information released by the Service in October 1996, which is presented in Attachment G-5 of the PEIS. The Delta (b)(2) actions outlined in this Alternative are a refinement of the preliminary potential actions originally proposed in February 1996, and evaluated in Supplemental Analysis 1a.

As in Supplemental Analysis 1a, the assumptions regarding the COA are particularly important since the proposed (b)(2) Delta actions assume cooperative implementation by both the CVP and SWP. The relative potential impacts to the CVP and SWP described under Alternative 4 are a function of the associated COA assumptions.

DELTA OPERATIONS

A simplified version of (b)(2) Water Management was developed that integrated the nine proposed Delta (b)(2) water actions into Alternative 4. These actions are listed below according to priority, **as developed by the Service**. The highest priority action is assigned the number 1.

1. Limit CVP/SWP April and May exports to a percent of San Joaquin River at Vernalis flow based on water year type.

2. Head of Old River barrier in place April through May.

3. Increase level of May and June X2 requirement to 1962 level of development.

4. Provide 13,000 cfs at the "I" Street Bridge and 9,000 cfs at Knights Landing on the Sacramento River in May.

5. Ramp total CVP/SWP export/inflow ratio levels April 1 to April 15 and May 15 through May 31.

6. Close Delta Cross Channel Gates November 1 through January 31.

7. Limit CVP/SWP exports to 35 percent of Delta inflow in July.

8. Establish conditions for a late fall run smolt survival experiment.

9. Limit CVP/SWP total exports to 35 percent of Delta inflow in November through January.

The same methodology described under Alternative 1 was used for the analysis of the combined instream and Delta (b)(2) water actions integrated into CVP operations in Alternative 4. The simplified analysis used for the PEIS focuses on the major Delta (b)(2) actions for the protection of anadromous fish, assuming that the SWP would cooperate with implementation of the actions by reducing exports during specified periods and making releases to contribute to additional levels of Delta protection. As shown in Alternative 1, the SWP would gain some limited export benefits at Banks Pumping Plant as a result of reservoir releases for (b)(2) water purposes on CVP streams. It is assumed that any negative impacts to the SWP, due to this cooperation in Alternative 4, would not exceed the benefits shown in Alternative 1. Therefore, there would be no net impact to average annual SWP deliveries as compared to the No-Action Alternative. The resulting reductions in deliveries estimated based on this simplified analysis do not include the potential for SWP pumping of CVP water in fall and winter months to make up water costs associated with (b)(2) actions for Delta purposes earlier in the year.

The potential impacts of all nine Delta (b)(2) actions could not be assessed in the model simulations conducted for the PEIS. The simulations were programmatic in nature and did not have the capability to assess the specific changes that might occur as a result of the implementation of actions 2, 5, and 8. Although the models did not allow quantification of the potential impacts, some general assessments were made where possible.

Delta actions 1 and 3 were met throughout the simulation, regardless of year type (40-30-30 year type index). Delta action 6 was met in wet and above normal years only. In Delta action 4, the minimum flows at the "I" Street Bridge and Knights Landing in Sacramento were met in 59 and 22 percent of the months of May, respectively, during the simulation period. Delta action 7 was met in 56 percent of the months of July during the simulation period. Delta action 9 was met in 32 percent of the months of November, 38 percent of the months of December, and 57 percent of the months of January during the simulation period.

SUMMARY OF (b)(2) WATER MANAGEMENT IN ALTERNATIVE 4

The reduction in deliveries due to the Delta (b)(2) actions in Alternative 4 are presented in Table G2-11, for each of the hydrologic periods of evaluation. If the average annual change in deliveries is negative, then (b)(2) water is used during that period.

TABLE G2-11
CVP DELIVERY IMPACTS OF THE INSTREAM AND DELTA (b)(2) WATER MANAGEMENT COMPONENT OF ALTERNATIVE 4

Hydrologic Period	Period Type	Simulated Average Annual CVP Deliveries (in 1,000 af)		Average Annual Change in CVP Deliveries (in 1,000 af)
		2022 D-1485 Base Scenario	Simulation with Instream and Delta (b)(2) Water Management	
1922 - 1990	Simulation Period	5,890	5,410	-480
1928 - 1934	Dry	4,900	4,280	-620
1944 - 1950	Below Normal	5,900	5,290	-610
1951 - 1957	Above Normal	6,300	5,950	-350
1959 - 1962	Below Normal	5,890	5,310	-580
1967 - 1971	Wet	6,310	6,060	-250
1978 - 1980	Above Normal	6,320	6,020	-300
1987 - 1990	Dry	5,330	4,460	-770

Note: Does not include refuge deliveries

In each hydrologic period of evaluation, (b)(2) water would be used to meet the Bay-Delta Plan Accord requirements, instream target flows, and Delta (b)(2) actions. During dry and below normal periods, the greatest amount of (b)(2) water is used. In many instances, this is because the greatest need for (b)(2) water occurs during dry periods when reservoir releases are lowest. As described under Alternative 1, operational criteria such as biological opinion temperature requirements, reservoir flood control, water rights demands, and Delta water quality requirements often limit the amount of (b)(2) water which may be used. Delta (b)(2) actions were limited primarily by the need to prevent negative impacts to SWP deliveries as compared to the No-Action Alternative.

The (b)(2) water component would be less in wet and above normal periods, than during below normal and dry periods. In many instances, this is because the target flows would already be met with existing reservoir releases and no additional releases or use of (b)(2) water would be necessary.

The impact to SWP deliveries resulting from (b)(2) Water Management in Alternative 4 is presented in Table G2-12. If the SWP Impact of (b)(2) Water Management is a negative value, SWP deliveries are reduced as a result of (b)(2) Water Management. If the SWP Impact of (b)(2) Water Management is a positive value, SWP deliveries are increased as a result of (b)(2) Water Management. The table shows primarily negative numbers indicating a reduction in SWP deliveries due to the use of (b)(2) water. This reduction is caused by a combination of Delta (b)(2) actions and the Delta actions in the Bay-Delta Plan Accord that are included in the (b)(2) analysis as compared to the 2022 No Bay-Delta Plan Accord (2022 D-1485) simulation that is used as the basis for measurement of impacts. In the comparisons in previous Alternatives, the incidental benefits to the SWP of the use of (b)(2) water on CVP controlled rivers offset the impacts of the Bay-Delta Plan Accord.

TABLE G2-12
SWP DELIVERY IMPACTS OF THE INSTREAM AND DELTA (b)(2) WATER MANAGEMENT COMPONENTS OF ALTERNATIVE 4

Hydrologic Period	Period Type	Simulated Average Annual SWP Deliveries (in 1,000 af)		Average Annual Change in SWP Deliveries (in 1,000 af)
		2022 D-1485 Base Scenario	Simulation with Instream and Delta (b)(2) Water Management	
1922 - 1990	Simulation Period	3,400	3,320	-80
1928 - 1934	Dry	2,380	2,050	-330
1944 - 1950	Below Normal	3,300	3,270	-30
1951 - 1957	Above Normal	3,950	3,830	-120
1959 - 1962	Below Normal	3,130	2,970	-160
1967 - 1971	Wet	4,050	4,100	+50
1978 - 1980	Above Normal	4,080	4,080	0
1987 - 1990	Dry	1,930	1,930	0

Attachment G3

Development of Water Acquisition Methodology

Attachment G3

DEVELOPMENT OF WATER ACQUISITION METHODOLOGY

Water would be acquired from willing sellers in Alternatives 2, 3, and 4 and the associated Supplemental Analyses. Water was acquired to increase the instream flows towards the target flows identified for chinook salmon and steelhead in Attachment G4. The amount of water to be acquired would be limited by the willingness of water rights holders to sell their water and economic considerations.

The specific plans for water acquisitions need to be developed on a case-by-case basis. The water acquisitions may need to be approved by the State Water Resources Control Board. This approval process would require compliance with the State Water Code. The Water Code prevents transfers that would have an unreasonable impact on fish, wildlife, or instream uses (Water Code Sections 1025.5(b), 1725, 1736). The Water Code also prevents public agencies from conveying transferred water if fish, wildlife, or other beneficial instream uses are unreasonably affected or if the overall economy or environment in the county where the water originates would be unreasonably affected (Water Code Section 1810(d)). The State Water Resources Control Board may need to confirm that these adverse impacts would not occur prior to approval of the transfer. These conditions would require mitigation of potentially adverse economic impacts, including economic impacts, by the willing seller prior to consideration of purchase of the water under the water acquisition program.

Impacts which could occur to third parties if groundwater was used to replace the loss in surface water diversions due to the water acquisition would need to be considered. The additional use of groundwater would generally either increase the rate of groundwater overdraft or reduce water levels in adjacent rivers and streams. These impacts would not be allowed under the Draft PEIS water transfers analysis.

The water acquisition program also would be defined to avoid impacts to downstream water users. A portion of historical agricultural diversions have returned to the river during the irrigation season. These return flows in addition to the remaining river flows serve as water supplies to downstream users. When the water is acquired for increased flows during the non-irrigation season and the diversions during the irrigation season are reduced, flows in the river downstream of the sellers could be reduced unless a portion of the water acquisition is used to replace the loss of return flows. Therefore, the acquisition also included an amount of water to be released during the irrigation season to provide adequate water supplies to the downstream users.

In Alternatives 2 and 4 and the associated Supplemental Analyses, the water would be acquired for instream and Delta purposes, and could not be used to increase Delta exports by the CVP and SWP over exports determined in Alternative 1. In Alternative 3 and Supplemental Analysis 3a, the water would only be used to increase instream flows, and therefore could be used to increase CVP and SWP Delta exports if all other conditions allowed exports.

The following sections of Attachment G3 describe the methods used to define the amount of water to be acquired in Alternatives 2, 3, and 4 and the associated Supplemental Analyses.

ALTERNATIVE 2

The December 1995 Draft Restoration Plan identified priorities for flow improvements under AFRP. The first priority was the Delta. This priority was partially addressed through Reoperation and the use of (b)(2) water. The second priority was water acquisition on the upper Sacramento River tributaries. This water acquisition was included in Alternatives 2, 3, and 4. The third priority was the San Joaquin River tributaries. Therefore, acquisitions on these rivers were the focus of Alternative 2. The amount of water acquired under Alternative 2 was dependent upon available funding. As described in Chapter II of the Draft PEIS, funding estimates were developed for the non-flow actions to be completed under the alternatives. The remaining amount of funds available (assuming that $50 million (1992 dollars) was collected every year) was used for water acquisition. It was assumed that the cost of acquired water would reflect actions taken by users to reduce water demands.

For the purposes of this analysis, it is assumed that the maximum quantity of water to be acquired from each source would be the same in all years. This assumption approximates a condition of a long term acquisition agreement that would stipulate a maximum annual quantity. Depending on hydrologic conditions, the actual amount of water that would be acquired in any year could be less than the maximum quantity. The acquisition targets and long-term average acquisition quantities for water purchased from willing sellers for instream flows on the Stanislaus, Tuolumne, and Merced rivers in Alternative 2 are 60,000; 60,000; and 50,000 acre-feet/year, respectively. These target flows include pulse flow components on the Tuolumne and Merced rivers during April through June. Therefore, the primary emphasis for use of acquired water in Alternative 2 is during the months of April, May, and June. Alternative 2 also includes purchase of water on Sacramento River tributaries that support spring-run chinook salmon. The quantity for purchase is not quantified at this time.

Acquisition of water from willing sellers would be associated with reduced agricultural water use, and would therefore result in reduced return flows to downstream portions of the rivers. To avoid unintended impacts to downstream water users not involved in the sale or acquisition of water, base flow conditions would be maintained in portions of rivers that would be affected by the use of acquired water.

ALTERNATIVES 3 AND 4

In Alternatives 3 and 4, the amount for water acquisition was determined using the four criteria developed by the AFRP planning process to identify reasonable actions. The criteria included Biological Priorities, Water Availability, Cost of Water, and Fund Availability, as described below.

- **Biological Priorities -** Flows must be managed in a way to support biological priorities, including species and lifestages. Use of water for the lifestages of species of concern would be prioritized. Preliminary biological priorities developed through the AFRP process were used to prioritize use of acquired water and the (b)(2) Water.

- **Water Availability -** Flows must be physically available assuming existing facilities.

- **Cost of Water** - The costs of acquiring water are dependent upon the watershed and the use of the water by users. The marginal cost of water analysis was used in the initial analysis for determining the range of average annual quantities that could be acquired. It is assumed that the cost of acquired water would reflect actions taken by users to reduce water demands. Cost curves were developed for each river to evaluate cost per acre-foot acquired. The break-points in the cost curves were compared with biological priorities. For the purposes of the third phase of the screening process, water costs in excess of $150/acre-foot were considered to be high and possibly unreasonable on most rivers.

- **Fund Availability -** Most of the actions considered in the PEIS are funded through the Restoration Fund, nonreimbursable Federal funds, and State of California funds. The Restoration Fund collections are limited to a maximum of $50 million/year, and are frequently less due to limitations on CVP water deliveries. Therefore, the initial fund limitation was considered to be limited by the $50 million/year Restoration Fund limitation. However, other federal, state, and local programs are currently evaluating projects that are similar to programs included in the PEIS alternatives. As a result of other funding sources, the total funds available through all sources may be greater than $50 million/year. For this analysis, a total funding capability of about $100 - 120 million/year was considered to be "available" to fund the portions of the project to be funded by the "Restoration Fund". It was assumed that funds for all projects would be available.

The Biological Priorities were determined based upon the information presented in Attachment G4. For Alternatives 3 and 4, it was determined that water would be acquired on all rivers that had quantifiable target flows identified in the preliminary AFRP memoranda.

Water Availability was determined based upon early screening analyses, and further refined during the development of Alternatives 3 and 4. For the PEIS it has been assumed that water used by urban users and the State Water Project would not be available due to both cost and willingness of the sellers.

The Cost of Water and Fund Availability were key criteria in determining the amount of water to acquire under Alternatives 3 and 4.

Based upon these criteria, instream goals for water acquisition quantities for the major streams were developed in Alternatives 3 and 4, as summarized below. Water also was acquired on the upper Sacramento River tributaries that support spring-run chinook salmon, however quantities are not known at this time. It should be recognized that these may be upper limits, and that no water would be acquired if the water rights holders did not want to sell their water to Interior.

- Yuba River - 100,000 acre-feet
- Mokelumne River - 70,000 acre-feet
- Calaveras River - 40,000 acre-feet
- Stanislaus River - 200,000 acre-feet
- Tuolumne River - 200,000 acre-feet
- Merced River - 200,000 acre-feet

Water acquisitions were not included on the Sacramento or American rivers because such actions could not occur while maintaining compliance levels under the winter-run chinook salmon biological opinion or maintaining deliveries to municipal users.

Use of the acquired water was prioritized on each stream through comparison of the available water and associated storage, and the biological priorities identified by the Service (as presented in Attachment G4).

It was assumed that water would be acquired from agricultural water users on these rivers that possess diversion and storage rights. The acquired water would be stored during the period of a contract year, and released in a manner to increase flows toward the targets. It was assumed that acquired water would be stored and released from Lake McClure on the Merced River, New Don Pedro Reservoir on the Tuolumne River, New Melones Reservoir on the Stanislaus River, New Hogan Reservoir on the Calaveras River, Camanche Reservoir on the Mokelumne River, and New Bullards Bar Reservoir on the Yuba River.

The flow targets include spring pulse flow components on the Stanislaus, Tuolumne, and Merced rivers during April through June. Therefore, the primary emphasis for use of acquired water in Alternatives 3 and 4 is generally during the months of April, May, and June. Releases of acquired water during these months would also provide increased flows at Vernalis, which would contribute toward meeting the Bay-Delta Plan Accord pulse flow requirements, if a portion of the pulse was unmet due to lack of available CVP supplies.

Attachment G4

U.S. Fish And Wildlife Service Draft Guidelines For Allocation of Water Acquired Pursuant to Section 3406(b)(3) of the CVPIA (Memorandum of October 22, 1996)

Draft Guidelines for Allocation of Water Acquired Pursuant to Section 3406 (b)(3) of the Central Valley Project Improvement Act

A Tool for Use in Developing an Implementation Plan for the Water Acquisition Program and in Developing a New Alternative for the Programmatic Environmental Impact Statement

Prepared for distribution at a public workshop
by the Anadromous Fish Restoration Program of the
United States Fish and Wildlife Service.

October 22, 1996

PREFACE

The Central Valley Project Improvement Act (CVPIA) directs the Secretary of the Interior to develop and implement "a program which makes 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" (Section 3406(b)(1)). This program is known as the Anadromous Fish Restoration Program (AFRP).

The CVPIA also directs the Secretary to develop and implement a program for the acquisition of water to contribute to at least doubling the natural production of anadromous fish. This program is known as the Water Acquisition Program.

We developed this document to handout following a public workshop held on October 23, 1996 in Sacramento. The objective of the workshop was to present and discuss our approach to developing flow scenarios that might be achieved through water acquisition for streams on which Central Valley Project structures do not control flows (non-CVP streams). Three programs authorized by the CVPIA are involved in developing these flow scenarios. These are the AFRP, the Water Acquisition Program, and the Programmatic Environmental Impact Statement. Each of these has a specific role in the process. The workshop focused on the role of the AFRP, specifically on our approach to developing draft guidelines for allocation of acquired water. This handout contains the initial drafts of guidelines for the Feather, Bear, Yuba, Mokelumne, Calaveras, Merced, Tuolumne, and Stanislaus rivers. The intention of both the workshop and this handout is to initiate discussion with interested parties on the approach and guidelines, with the objective of improving the approach and guidelines.

We invite your comments on the approach and guidelines. For your comments on the approach to be considered for incorporation in the final Anadromous Fish Restoration Plan (scheduled to be released in December), we will need to receive them by November 29, 1996. We intend to use the guidelines to help develop a long-term implementation plan for the Water Acquisition Program in early 1997, and therefore the deadline for comments on the draft guidelines will occur sometime in early 1997.

We are available to answer questions about the approach and to meet with those individuals or groups that want to discuss the guidelines for an individual stream. If you need more information or are interested in meeting with us, call or write us and express your interest and needs. To reach us, contact:

Martin A. Kjelson, Program Manager
Anadromous Fish Restoration Program
U.S. Fish and Wildlife Service
Sacramento-San Joaquin Estuary Fishery Resource Office
4001 North Wilson Way
Stockton, CA 95205-2486
(209) 946-6400

TABLE OF CONTENTS

DRAFT GUIDELINES FOR ALLOCATION OF ACQUIRED WATER FOR EACH STREAM

LOWER SACRAMENTO RIVER AND DELTA TRIBUTARIES

Feather River

Feather River stream flows are regulated primarily by water released from Oroville Dam and Thermalito Afterbay, facilities of CDWR State Water Project (SWP). The Yuba and Bear rivers contribute flows to the lower Feather River. Fall- and spring-run chinook salmon, steelhead, striped bass, American shad, and white and green sturgeon are found in the Feather River. Flow standards were established by a FERC licence to CDWR and an agreement between CDWR and CDFG. Flow recommendations were provided by the CDFG and USFWS.

Species and life-history stage priorities

Fall- and spring-run chinook salmon, steelhead, striped bass, American shad, and white and green sturgeon are present in the Feather River. Because spring-run chinook salmon have unknown restoration potential and questionable genetic integrity in the Feather River (CDFG 1996a) and because the CDFG do not note management objectives for steelhead in the Feather River (CDFG 1996b), we considered fall-run chinook salmon the primary species of concern. Needs for anadromous, non-salmonids are less well know than those for salmonids. We assumed that the needs for non-salmonids could be partially met by meeting the needs of fall-run chinook salmon. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Feather River.

Table 1. Draft water allocation priorities for acquired water on the Feather River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Feather River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and American shad.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Feather River; and contribute to improved conditions for survival of fall-run chinook salmon migrating through the lower Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows.
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

White and green sturgeon and American shad were also considered in allocating acquired water. For sturgeon, water is allocated during February-May to first provide conditions suitable for adult migration (February and March), and then to improve conditions for juvenile survival (April and May). For American shad, water is allocated during April-June to first provide conditions suitable for spawning (April and May), and then to improve conditions for survival of eggs and larvae (June). Flow needs for striped bass in the Feather River were not identified (USFWS 1995)

Existing standards

The CDWR was licenced to operate the Oroville Project by FERC (Project No. 2100) in 1957. The FERC licence was amended in 1964, 1966, 1968, 1977, and 1982 (Agreement between CDWR and CDFG concerning the operation of the Oroville Division of the State Water Project for management of fish and wildlife, 26 August 1983). In 1983, CDWR and CDFG revised a 1967 agreement that provided minimum flows for fish and wildlife and complies with the FERC licence. We considered flows provided by the 1983 agreement the existing standard for the Feather River.

Power is generated from water released from Oroville Dam and diverted into Thermalito Power Canal and another powerhouse. The diverted water then flows into Thermalito Afterbay and enters the Feather River through the Thermalito Afterbay outlet. The reach of the Feather River between the power canal and Thermalito Afterbay is known as the low-flow channel. Increasing flow in the low-flow channel reduces power generation at the Thermalito Power Canal.

1983 CDWR-CDFG agreement: The 1983 agreement established standards at two locations in the Feather River. One location is the low-flow channel between Thermalito Diversion Dam and the outlet of Thermalito Afterbay, and the other location is the reach downstream of the outlet of Thermalito Afterbay to the Sacramento River confluence at Verona.

The agreement stipulated a minimum flow of 600 cfs in the low-flow channel, which results in an annual release of about 434,000 af. In the reach downstream of Thermalito Afterbay outlet, the agreement provided two minimum flow schedules. The schedules are based on unimpaired runoff of the Feather River near Oroville for April through June the preceding year and storage in Oroville Reservoir. Provided that normal operations and the appropriate minimum flow schedule would not reduce storage below about 1,500,000 af, the first schedule would result in an annual release of about 784,000 af when forecasted runoff is less than 55% of normal, and the second schedule would result in an annual release of about 977,000 when forecasted runoff is 55% or greater than normal. Normal runoff was defined as mean April through July unimpaired runoff for 1911 through 1960, 1,942,000 af. The first schedule (runoff less than 55% normal) would apply when forecasted runoff is less than 60% of normal for two or more consecutive water years. Both flow schedules stipulated flows for three time periods, October through February, March, and April through September.

The agreement provided for reductions in minimum flows downstream of Thermalito Afterbay outlet if the 1 April runoff forecast indicates that storage would fall below about 1,500,000 af under normal operation of Oroville Reservoir. Minimum flows would be reduced proportional to reductions in deliveries, up to a maximum of 25%.

In addition to the minimum flow in the low-flow channel and the two minimum flow schedules downstream of Thermalito Afterbay outlet, the agreement also provides objectives, additional conditions, and flexibility in minimum releases. Additional conditions are contingent on existing conditions and flexibility in minimum releases require concurrence between the CDWR and CDFG. Objectives for CDWR are the provision of suitable water temperatures for fall-run chinook salmon no later than 15 September and the provision of suitable water temperatures for American shad, striped bass, and other warm water fish downstream of Thermalito Afterbay outlet and between 1 May and 1 September. Additional conditions concern flow fluctuations and guidelines to maintain flows in excess of the standard that are contingent on flow events. With concurrence of CDWR, CDFG has the option to exercise flexibility in releases of water from Thermalito Afterbay from April through June. Water may be released in a fluctuating pattern to assist emigration of salmonids.

Recommendations

Minimum flow recommendations for the Feather River were made by CDFG (1993) and the USFWS identified flow needs in the AFRP Working Paper (USFWS 1995).

California Department of Fish and Game: The CDFG (1993) provides recommendations measured at two locations, the riffle one mile below Thermalito Afterbay outlet and Shanghai Bend. Shanghai Bend is downstream of the Yuba River confluence with the Feather River but upstream of the Bear River confluence. For our purposes here, we assumed that upstream recommendations were to primarily benefit salmonids, and recommendations downstream of the Yuba River were to benefit non-salmonids. In addition to minimum flows recommendations, CDFG (1993) recommended water temperatures at both locations. The recommendations consist of a flow schedule for each location.

AFRP Working Paper: The AFRP Working Paper (USFWS 1995) identified flow needs at three locations, the low-flow channel, Gridley, and Nicolaus. Gridley is downstream of Thermalito Afterbay outlet, but relatively close to the riffle one mile downstream of the outlet noted in CDFG (1993). Nicolaus is in the lowest reach of the Feather River downstream of the Bear River confluence. Flows to benefit salmonids are identified for the low-flow channel and at Gridley, needs for white and green sturgeon are identified at Gridley and Nicolaus, and needs for American shad identified at Nicolaus.

For the low-flow channel, the AFRP Working Paper needs are based on an IFIM study conducted by CDWR and CDFG. Needs are presented as flows to be used in evaluations (USFWS 1995), because there was uncertainty about the appropriate assumptions pertaining to water-depth preferences of spawning salmonids made in the IFIM study. Therefore, the needs contain two flow schedules, each to evaluate assumptions about water-depth preferences. Schedule B provides a constant flow of 800 cfs, assuming that salmonids prefer to spawn at a water depth of 1.5 feet. Schedule A provides higher flows (800-1700 cfs and 1,100-2,500 cfs, for critical-dry and below normal-wet water years, respectively), assuming that salmonids prefer to spawn at water depths greater than or equal to 1.5 feet.

Needs for salmonids at Gridley were based on a draft instream flow report by CDWR and assumptions that increased flows would improve habitat maintenance (e.g., reduce vegetation encroachment) and water temperature. The AFRP Working Paper proposed that an IFIM study should be completed to evaluate the flows (USFWS 1995). The needs consist of monthly flows for three water-year types.

Flow needs for white and green sturgeon are identified at Gridley and Nicolaus. They were calculated using a year-class index and February through May mean monthly flow at gaging stations in rivers with sturgeon. The year-class index was derived from sturgeon data collected at the SWP salvage facility, and classified as indicating either a good or poor recruitment year. Generally, the lowest mean monthly flow for a good recruitment year was adopted as the flow need for the various gaging stations. Needs apply only to above normal and wet water years.

Flow needs for American shad are presented at Nicolaus, and were calculated using historic Delta inflow from April through June and data from the CDFG midwater trawl for young-of-the-year. Delta inflow for years in which American shad exceeded the AFRP production target (1974 and 1982) was identified. For these years, mean Delta inflow was scaled to mean unimpaired flow and apportioned to rivers in which American shad spawn to produce flow needs. Flow needs are identified for five water-year types.

Draft guidelines for allocation of acquired water

The flowing tables contain draft guidelines for allocation of acquired water. Because water acquired from CDWR can be released at two locations, upstream and directly downstream of the low-flow channel, and because standards and recommendations apply to several locations and anadromous fish species, we allocated water primarily at three reaches of the Feather River, the low-flow channel, downstream of Thermalito Afterbay outlet, and Nicolaus.

Table 2 allocates water in the low-flow channel for fall-run chinook salmon. Tables 3 through 5 allocates water directly downstream of Thermalito Afterbay outlet primarily for fall-run chinook salmon and also for sturgeon. A table is developed for using each of the existing standards, flow schedule for less than 55% normal forecasted runoff with a maximum 25% reduction in all months, flow schedule for less than 55% normal forecasted runoff, and flow schedule for 55% normal or greater forecasted runoff. We made no assumptions concerning flows from the low-flow channel, and considered flow recommendations measured at the riffle one mile downstream of Thermalito Afterbay outlet (CDFG 1993) and at Gridley (USFWS 1995).

Table 6 allocates water primarily at Nicolaus for non-salmonids. However, the table also includes recommendations made for Shanghai Bend (CDFG 1993). We assumed that flows in tables 3 through 5 would be achieved before allocations in Table 6 would be made. The total volume of water in the Feather River resulting from satisfying recommendations in tables 3 through 5 is 2,713,000 af. Therefore, the volumes of acquired water in Table 6 are in addition to that needed to satisfy tables 3 through 5. We acknowledge that flows from the Yuba and Bear rivers would contribute to Feather River flows at Nicolaus, for which existing standards range from 126,000 to 174,000 af for the Yuba River and the existing standard is 10,000 af for the Bear River. However, we do not account for Yuba and Bear river flows in Table 6.

Table 2. Draft guidelines for allocation of acquired water for use in the low-flow channel of the Feather River. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	36	36	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B.
2	Rearing and outmigration (April through May)	24	60	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B.
3	Incubation and rearing (January through March)	36	96	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B.
4	Over-summering (June through September)	48	144	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B.
5	Spawning and incubation (October through December)	165	309	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
6	Rearing and outmigration (April through May)	109	418	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years.
7	Incubation and rearing (January through March)	160	578	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years.
8	Over-summering (June through September)	54	632	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years.
9	Spawning and incubation (October through December)	146	778	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years.
10	Rearing and outmigration (April through May)	157	935	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years.
11	Incubation and rearing (January through March)	143	1078	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years.
12	Over-summering (June through September)	102	1180	AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years.

Table 3. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for less than 55% normal forecasted runoff and 25% reduction in all months. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 15 and 16.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	55	55	Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af.
2	Rearing and outmigration (April through May)	30	85	Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af.
3	Incubation and rearing (January through March)	50	135	Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af.
4	Over-summering (June through September)	60	195	Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af.
5	Spawning and incubation (October through December)	91	286	Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af.
6	Incubation and rearing (January through March)	102	388	Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af.
7	Rearing and outmigration (April through May)	133	521	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
8	Over-summering (June through September)	24	545	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.
9	Rearing and outmigration (April through May)	81	626	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
10	Incubation and rearing (January through March)	54	680	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
11	Over-summering (June through September)	65	745	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
12	Spawning and incubation (October through December)	146	891	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
13	Rearing and outmigration (April through May)	28	919	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
14	Incubation and rearing (January through March)	89	1008	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
15	Adult sturgeon migration and spawning (February through March)	526	1534	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.
16	Juvenile sturgeon survival (April through May)	484	2018	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.

Table 4. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for less than 55% normal forecasted runoff. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 11 and 12.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	91	91	Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af.
2	Incubation and rearing (January through March)	102	193	Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af.
3	Rearing and outmigration (April through May)	133	326	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.
4	Over-summering (June through September)	24	350	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.
5	Rearing and outmigration (April through May)	81	431	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
6	Incubation and rearing (January through March)	54	485	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
7	Over-summering (June through September)	65	550	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
8	Spawning and incubation (October through December)	146	696	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
9	Rearing and outmigration (April through May)	28	724	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
10	Incubation and rearing (January through March)	89	813	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
11	Adult sturgeon migration and spawning (February through March)	526	1339	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.
12	Juvenile sturgeon survival (April through May)	484	1823	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.

Table 5. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for 55% normal or greater forecasted runoff. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 9 and 10.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Rearing and outmigration (April through May)	133	133	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.
2	Over-summering (June through September)	24	157	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years.
3	Rearing and outmigration (April through May)	81	238	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
4	Incubation and rearing (January through March)	54	292	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
5	Over-summering (June through September)	65	357	CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay.
6	Spawning and incubation (October through December)	146	503	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
7	Rearing and outmigration (April through May)	28	531	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
8	Incubation and rearing (January through March)	89	620	AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years.
9	Adult sturgeon migration and spawning (February through March)	526	1146	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
10	Juvenile sturgeon survival (April through May)	484	1630	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years.

Table 6. Draft guidelines for allocation of acquired water for the Feather River at Shanghai Bend and Nicolaus, assuming that allocations in tables 3 through 5 have been satisfied. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of white and green sturgeon and American shad in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Early adult migration (January)	12	12	CDFG (1993) recommended minimum releases at Shanghai Bend to benefit non-salmonids.
2	Juvenile survival (July through August)	159	171	CDFG (1993) recommended minimum releases at Shanghai Bend to benefit non-salmonids.
3	Adult migration and spawning (February through March)	527	698	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Nicolaus during above normal and wet water years.
4	Juvenile survival (April through May)	544	1242	AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Nicolaus during above normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
5	Survival of eggs and larvae (June)	8	1250	AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during below normal water years.
6	Adult attraction and spawning (April through May)	29	1279	AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during above normal water years.
7	Survival of eggs and larvae (June)	47	1326	AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during above normal water years.
8	Adult attraction and spawning (April through May)	673	1999	AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during wet water years.
9	Survival of eggs and larvae (June)	304	2303	AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during wet water years.

Yuba River

The following tables present priorities (Table 1) and draft guidelines (Tables 2 through 5) for allocation of acquired water on the Yuba River for all water year types specified in the existing standard for mimimum instream flows. The primary species of concern are fall-run chinook salmon, steelhead trout, and American shad. Water allocation guidelines focus specifically on benefiting life history needs of these species in addition to ancillary downstream benefits to anadromous fish in the Sacramento River and Delta (Table 1).

For the following guidelines we consider the 1965 existing fisheries agreement between the California Department of Fish and Game (CDFG) and the Yuba County Water Agency (YCWA) as our baseline to allocate to, given that water is available and can be acquired. In addition to the 1965 standard described below, we consider four additional minimum instream flow alternatives that we use as guidance for allocating acquired water by water-year type (tables 2 through 5). The four alternatives are: 1) YCWA (Beak 1996, Draft Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River), 2) CDFG 1991 (CDFG 1991, Lower Yuba River

Fisheries Management Plan), 3) Federal Energy Regulatory Commission (FERC) staff, 1992 (FERC 1992, Environmental Assessment for Hydropower Licence) and, 4) the Anadromous Fish Restoration (AFRP) Working Paper (USFWS 1995). The guidelines for each of the water-year types are bracketed on the lower end by the 1965 standard for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Although the allocation tables use the designated standards as the foundation that we add acquired water to, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

Table 1. Draft water allocation priorities for (b)(3) water on the Yuba River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Yuba River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to Sacramento River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Yuba River; and contribute to improved migration and spawning conditions for American shad. Also, contribute to improved conditions for survival of Sacramento basin fall-run chinook salmon migrating through the Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows.
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

1965 Agreement between the CDFG and the YCWA: The existing standard is defined in the 1965 agreement between the Yuba County Water Agency (YCWA) and the California Department of Fish and Game (CDFG); this standard specifies minimum water releases from Englebright Reservoir to maintain in the Yuba River immediately below Daguerre Point Dam. The standard only identifies one instream flow schedule to be met in normal and above water year types. Normal and above is defined as an April 1 Department of Water Resources (DWR) water-year projection that is 51% or greater than the historical streamflow average at

Smartville. Guidance for reduction in the fisheries flows is given for what the standard identifies as critical dry years as follows: 46% to 50% of a normal water year, then 15% reduction in water releases; 41% to 45% of a normal water year, then 20% reduction in water releases; and 40% or less of a normal water year, then 30% reduction in water releases. We consider each of the ranges as separate below-normal water year types. Percent streamflow reduction is allocated equitably among months for each month of the below normal water-year types, however, flow reductions may not decrease below a minimum of 70 cubic feet per second (cfs). In addition to the fore-described standard, the 1965 agreement specifies an additional range of minimum flows below Englebright Dam for the period of October 16 through January 15. However, we only use the specified minimum flows targeted below Daguerre Point Dam as part of our standard, and assume that the additional range of flows will be accounted in the predicted existing conditions by either the PEIS process or the water acquisition program.

FERC 1993 Order Issuing New License to Pacific Gas and Electric (PG&E) for continued operation of the Narrows Project: This additional standard, or an adaptively managed standard, is described in the 1993 Federal Energy Regulatory Commission (FERC) Re-licensing Order to Pacific Gas and Electric (PG&E) for their Narrows Project, number 1403-004. The order requires that PG&E supplement YWCA's project releases with up to 45,000 acre-feet (af) per year from its reservoir storage to help maintain minimum flows recommended by the CDFG in their 1991 management plan. Differing from the above standard, compliance location is specified for the Smartville gage and not Marysville, as recommended by CDFG. The FERC order gives the conditions when this standard applies, but in general, release of this water will occur when Englebright Reservoir storage exceeds 60,000 af, or when PG&E is entitled to dispatch releases of water from New Bullards Bar Reservoir per their power purchase agreement with YCWA. This standard is not used in the following allocation guidelines because we could not predict when and how it would be applied. Although we were unable to include this portion of the standard in the following tables, it is important that this 45,000 af be accounted for as part of the existing standard in allocating acquired water.

Recommendations

YCWA: The YCWA alternative for minimum flows, specified for the Marysville gage, uses stage and discharge and weighted usable area (WUA) relationships, based on fisheries studies conducted by Beak Consultants from 1986 to 1988, a water temperature model developed by Bookman-Edmunston Engineering, Inc. (1992), and operational constraints to maximize available water by year type for fall-run chinook salmon and steelhead life history requirements. Salmon life stage requirements are prioritized by two time periods, first is spawning and incubation (October 15 through March 31), and second is rearing and out-migration (April through June). The YCWA recommends minimum instream flows at Marysville for six water-year types in the draft report. They define water-year type using an index derived from the comparison of estimated annual and historical (1922 to 1992) unimpaired runoff at the Smartville gage. The annual 60:40 index is a weighted average of the percent of annual runoff to average historical runoff in the snowmelt period, April through July, weighted 60%; averaged with the percent of annual runoff to historical runoff for the entire year, weighted 40%. Using this index, two water-year allocations account for "normal and above" conditions and four water-year allocations are specified for below normal water years. Allocation within a water year first looks to achieve water temperature targets set at Marysville, and secondarily at Daguerre Point Dam from June through October 14 if the Marysville temperature criteria cannot be met. Secondly, an attempt to maximize physical habitat ($\geq$90% of the maximum WUA value) for a given salmon life-history stage, within the range of flows that could meet the water temperature targets was determined using a stepwise iterative process.

CDFG: In their Lower Yuba River Fisheries Management Plan (CDFG 1991), the CDFG recommended instream flows at Marysville for normal and wetter water-years. Similar to the YCWA recommendation, CDFG's minimum flow recommendation targets specific benefits for fall-run chinook salmon and steelhead and secondarily for American shad, recognizing that there is little conflict between the needs for shad and salmon and steelhead. The CDFG based their water-year type designations on a comparison of the estimated unimpaired runoff at the Smartville gage for the current year, as reported in the May 1 Report of Water Conditions in California by the DWR. For below normal water years CDFG states that reductions to the recommended fishery flows shall be made, but does not specify how water would be allocated for fish in these water-year types, other than equitable reductions to for all users. CDFG's minimum flow recommendations derive from integrating information from a three-year study that included basic fisheries investigations; Instream Flow Incremental Methodology (IFIM), to determine salmon life-stage physical habitat requirements; and temperature modeling, coupled with Pacific coast anadromous fish temperature requirements. CDFG's recommendation hinges on balancing physical habitat requirements (WUA and streamflow indices) for overlapping life history stages with other concurrent fish needs such as maintenance of flows to prevent redd de-watering, juvenile standing, and juvenile out-migration.

FERC staff: FERC staff recommended minimum instream flows in their 1992 Environmental Assessment (EA) for the Narrows Project. Although FERC specified that these minimum fisheries flows were to be met below Englebright Reservoir, we generated a Marysville flow equivalent using a conversion factor generated from averaged mean monthly flows for a range of percent exceedence levels (0%, 10%, 50%, 90% and 100%) from both locations. This conversion is based on conditions that existed from 1970 to 1990, and may differ from future conditions if project operations change. Their recommendation started with the maximum and minimum flow boundaries proposed in CDFG's 1991 recommendation, the release capacity of the Narrows Project, and CDFG's WUA curves by life stage to produce a flow schedule that they felt would enhance the fishery relative to existing conditions. The recommendation is for all water-year types and considers all three anadromous species in the system.

AFRP Working Paper: The AFRP Working Paper recommends two sets of minimum instream flows, one set for salmon and steelhead and another for shad. The shad recommendation allocates water in addition to salmon flows during the April through May period for shad attraction, migration and spawning. The shad recommendation is divided into five water-year types of wet, above-normal, below-normal, dry, and critical; the salmon recommendation serves all water-year types. Water-year types for salmon and shad recommendations are based on the Sacramento River Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year.

Draft guidelines for allocation of acquired water

Table 2. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 40% or less of normal.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	7	7	1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA).
2	Rearing and outmigration (April through May)	3	10	1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year.
3	Incubation and rearing (January through March)	4	14	1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year.
4	Over-summering (June through September)	1	15	1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year.
5	Spawning and incubation (October through December)	4	19	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
6	Rearing and outmigration (April through May)	1	20	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
7	Incubation and rearing (January through March)	2	22	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
8	Over-summering (June through September)	1	23	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
9	Spawning and incubation (October through December)	11	34	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
10	Rearing and outmigration (April through May)	4	38	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
11	Incubation and rearing (January through March)	7	45	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
12	Over-summering (June through September)	2	47	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
13	Rearing and outmigration (April through May)	19	66	YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996).
14	Incubation and rearing (January through March)	28	94	YCWA's 1996 recommended minimum instream flow for extra critical water years.
15	Over-summering (June through September)	12	106	YCWA's 1996 recommended minimum instream flow for extra critical and critical water years.
16	Spawning and incubation (October through December)	5	111	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
17	Rearing and outmigration (April through May)	14	125	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
18	Incubation and rearing (January through March)	9	134	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
19	Over-summering (June through September)	3	137	YCWA's 1996 recommended minimum instream flow for below-normal water years.
20	Spawning and incubation (October through December)	13	150	YCWA's 1996 recommended minimum instream flow for normal water years.
21	Rearing and outmigration (April through June)	56	206	YCWA's 1996 recommended minimum instream flow for normal water years.
22	Incubation and rearing (January through March)	9	215	YCWA's 1996 recommended minimum instream flow for normal water years.
23	Over-summering (June through September)	56	271	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
24	Spawning and incubation (October through December)	30	301	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
25	Rearing and outmigration (April through June)	64	365	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
26	Incubation and rearing (January through March)	36	401	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
27	Over-summering (July through September)	45	446	YCWA's 1996 recommended minimum instream flow in a normal water year.
28	Spawning and incubation (October through December)	7	453	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad.
29	Rearing and outmigration (April through June)	120	573	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad.
30	Over-summering (July through September)	28	601	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
31	Rearing and outmigration (April through June)	218	819	AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad.
32	Over-summering (July through September)	228	1047	YCWA's 1996 recommended minimum instream flow in a wet water year.
33	Rearing and outmigration (April through June)	218	1265	AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad.
34	Rearing and outmigration (April through June)	109	1374	AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad.
35	Rearing and outmigration (April through June)	266	1640	AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad.

Table 3. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 41% to 45% of normal.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	4	4	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA).
2	Rearing and outmigration (April through May)	1	5	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
3	Incubation and rearing (January through March)	2	7	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
4	Over-summering (June through September)	1	8	1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year.
5	Spawning and incubation (October through December)	11	19	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
6	Rearing and outmigration (April through May)	4	23	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
7	Incubation and rearing (January through March)	7	30	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
8	Over-summering (June through September)	2	32	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
9	Rearing and outmigration (April through May)	19	51	YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996).
10	Incubation and rearing (January through March)	28	79	YCWA's 1996 recommended minimum instream flow for extra critical water years.
11	Over-summering (June through September)	12	91	YCWA's 1996 recommended minimum instream flow for extra critical and critical water years.
12	Spawning and incubation (October through December)	5	96	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California.
13	Rearing and outmigration (April through May)	14	110	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
14	Incubation and rearing (January through March)	9	119	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
15	Over-summering (June through September)	3	122	YCWA's 1996 recommended minimum instream flow for below-normal water years.
16	Spawning and incubation (October through December)	13	135	YCWA's 1996 recommended minimum instream flow for normal water years.
17	Rearing and outmigration (April through June)	56	191	YCWA's 1996 recommended minimum instream flow for normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
18	Incubation and rearing (January through March)	9	200	YCWA's 1996 recommended minimum instream flow for normal water years.
19	Over-summering (June through September)	56	256	FERC, 1992 staff recommendation for minimum instream flow for all water year types.
20	Spawning and incubation (October through December)	30	286	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
21	Rearing and outmigration (April through June)	64	350	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
22	Incubation and rearing (January through March)	36	386	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
23	Over-summering (July through September)	45	431	YCWA's 1996 recommended minimum instream flow in a normal water year.
24	Spawning and incubation (October through December)	7	438	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad.
25	Rearing and outmigration (April through June)	120	558	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad.
26	Over-summering (July through September)	28	586	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
27	Rearing and outmigration (April through June)	218	804	AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad.
28	Over-summering (July through September)	228	1032	YCWA's 1996 recommended minimum instream flow in a wet water year.
29	Rearing and outmigration (April through June)	218	1250	AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad.
30	Rearing and outmigration (April through June)	109	1359	AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad.
31	Rearing and outmigration (April through June)	266	1625	AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad.

Table 4. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 46% to 50% of normal.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	11	11	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA).

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
2	Rearing and outmigration (April through May)	4	15	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
3	Incubation and rearing (January through March)	7	22	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
4	Over-summering (June through September)	2	24	1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types.
5	Rearing and outmigration (April through May)	19	43	YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996).
6	Incubation and rearing (January through March)	28	71	YCWA's 1996 recommended minimum instream flow for extra critical water years.
7	Over-summering (June through September)	12	83	YCWA's 1996 recommended minimum instream flow for extra critical and critical water years.
8	Spawning and incubation (October through December)	5	88	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California.
9	Rearing and outmigration (April through May)	14	102	FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License.
10	Incubation and rearing (January through March)	9	111	FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
11	Over-summering (June through September)	3	114	YCWA's 1996 recommended minimum instream flow for below-normal water years.
12	Spawning and incubation (October through December)	13	127	YCWA's 1996 recommended minimum instream flow for normal water years.
13	Rearing and outmigration (April through June)	56	183	YCWA's 1996 recommended minimum instream flow for normal water years.
14	Incubation and rearing (January through March)	9	192	YCWA's 1996 recommended minimum instream flow for normal water years.
15	Over-summering (June through September)	56	248	FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License.
16	Spawning and incubation (October through December)	30	278	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
17	Rearing and outmigration (April through June)	64	342	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
18	Incubation and rearing (January through March)	36	378	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
19	Over-summering (July through September)	45	423	YCWA's 1996 recommended minimum instream flow in a normal water year.
20	Spawning and incubation (October through December)	7	430	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
21	Rearing and outmigration (April through June)	120	550	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad.
22	Over-summering (July through September)	28	578	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
23	Rearing and outmigration (April through June)	218	796	AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad.
24	Over-summering (July through September)	228	1024	YCWA's 1996 recommended minimum instream flow in a wet water year.
25	Rearing and outmigration (April through June)	218	1242	AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad.
26	Rearing and outmigration (April through June)	109	1351	AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad.
27	Rearing and outmigration (April through June)	266	1617	AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad.

Table 5. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for normal and wetter water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Rearing and outmigration (April through May)	19	19	YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996).
2	Incubation and rearing (January through March)	28	47	YCWA's 1996 recommended minimum instream flow for extra critical water years.
3	Over-summering (June through September)	12	59	YCWA's 1996 recommended minimum instream flow for extra critical and critical water years.
4	Spawning and incubation (October through December)	5	64	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types.
5	Rearing and outmigration (April through May)	14	78	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types.
6	Incubation and rearing (January through March)	9	87	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types.
7	Over-summering (June through September)	3	90	YCWA's 1996 recommended minimum instream flow for below-normal water years.
8	Spawning and incubation (October through December)	13	103	YCWA's 1996 recommended minimum instream flow for normal water years.
9	Rearing and outmigration (April through June)	56	159	YCWA's 1996 recommended minimum instream flow for normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
10	Incubation and rearing (January through March)	9	168	YCWA's 1996 recommended minimum instream flow for normal water years.
11	Over-summering (June through September)	56	224	Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types.
12	Spawning and incubation (October through December)	30	254	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
13	Rearing and outmigration (April through June)	64	318	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
14	Incubation and rearing (January through March)	36	354	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.
15	Over-summering (July through September)	45	399	YCWA's 1996 recommended minimum instream flow in a normal water year.
16	Spawning and incubation (October through December)	7	406	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad.
17	Rearing and outmigration (April through June)	120	526	AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad.
18	Over-summering (July through September)	28	554	CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
19	Rearing and outmigration (April through June)	218	772	AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad.
20	Over-summering (July through September)	228	1000	YCWA's 1996 recommended minimum instream flow in a wet water year.
21	Rearing and outmigration (April through June)	218	1218	AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad.
22	Rearing and outmigration (April through June)	109	1327	AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad.
23	Rearing and outmigration (April through June)	266	1593	AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad.

Bear River

The following tables present priorities and draft guidelines for allocation of acquired water on the Bear River. Species documented to occur in the bear include the fall-run chinook salmon, steelhead, and white and green sturgeon. Water allocation guidelines focus on benefiting life history needs of these species in addition to ancillary downstream benefits to anadromous fish in the Sacramento River and Delta (Table 1).

Water allocation guidance for the Bear River in the form of existing instream flow recommendations is limited. For the following guidelines we use the existing minimum instream flow standard in the 1989 amended Federal Energy Regulatory Commission (FERC) license number 2997 to the South Sutter Water District, and consider this as our baseline to build from, given that water is available and can be acquired. The remaining three recommendations are from the AFRP Working Paper (USFWS 1995).

Species and life-history stage priorities

On the Bear River, species considered include fall-run chinook salmon, steelhead and sturgeon. Priorities are specified primarily for chinook salmon, but steelhead should coincidentally benefit from the flow schedule prioritized for fall-run chinook salmon. Sturgeon are ranked secondarily to the salmonids as they are known to use the lower Bear River, but only sporadically and generally in wet years. Enough information on Bear River sturgeon exists to warrant specific allocation of water to benefit the species given that acquisition of water is feasible. Table 1 prioritizes salmon life-history stages for use in conjunction with the existing standards to generate guidelines for allocating acquired water in the Bear River. Sturgeon life-history priorities are not presented here per se. In the Working Paper, 650 cubic feet per second (cfs) of water is additionally allocated to that recommended for salmon from February through May. Thus, given that enough water can be acquired, allocation of water to improve sturgeon production would follow priorities two and three for salmon in the table below. This would encompass the allocation of water from February through May and would be implemented chronologically.

Table 1. Draft water allocation priorities for (b)(3) water on the Bear River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Bear River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to Sacramento River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Bear River; and contribute to improved conditions for survival of Sacramento basin fall-run chinook salmon migrating through the Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows.
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

The existing minimum instream flow release requirement from Camp Far West Reservoir is defined in the Order Amending License, number 2997 issued by the Federal Energy Regulatory Commission (FERC) to the South Sutter Water District. This requirement is specified for the gage immediately below the Camp Far West diversion. The standard applies for all water-year types but may be reduced to Camp Far West Reservoir inflow if this is less than the specified standard. Species and life-history priorities or specific rationale are not evident from information presented in the FERC order.

Recommendations

The remaining three recommendations come from the Working Paper, including results of a cited PHABSIM analyses. The Working Paper salmon and PHABSIM recommendations are for normal and above water-year types and the Working Paper sturgeon recommendation is only for above normal and wet water-year types. These recommendations are specified for the Wheatland gage below Camp Far West Reservoir. Water-year types for the Working Paper recommendations are based on the Sacramento River Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year. The Working Paper salmon and steelhead recommendation considers flows that will create passage for salmon and steelhead and provide favorable water temperatures in most months. The difference between the PHABSIM salmon recommendation and the Working Paper salmon recommendation is that PHABSIM values only represent interpreted physical habitat needs of rearing salmon from January to June. The rationale for the sturgeon recommendation is based on previous years flow conditions during above-normal and wet years when sturgeon production has been qualitatively been classified as good.

Draft guidelines for allocation of acquired water

Table 2. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Bear River.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	40	40	AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon.
2	Rearing and outmigration (April through May)	9	49	PHABSIM minimum releases for normal and wetter water-year types as cited in the AFRP Working Paper (USFWS 1995).
3	Incubation and rearing (January through March)	32	81	PHABSIM minimum releases for normal and wetter water-year types as cited in the AFRP Working Paper (USFWS 1995).
4	Over-summering (June through September)	14	95	AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
5	Rearing and outmigration (April through May)	18	113	AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon.
6	Incubation and rearing (January through March)	11	124	AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon.
7	Sturgeon migration and spawning (February through March)	77	201	AFRP Working Paper (USFWS 1995) for minimum flow releases for above normal and wetter water-year types, including releases targeted specifically for sturgeon.
8	Sturgeon spawning and requirements for early life-history stages of the progeny (April through May)	79	280	AFRP Working Paper (USFWS 1995) for minimum flow releases for above normal and wetter water-year types, including releases targeted specifically for sturgeon.

Mokelumne River

The following is a presentation of the draft guidelines for allocation of acquired water in the Mokelumne River. Water allocation guidelines focus specifically on benefiting life history needs of the Mokelumne River fall-run chinook salmon and steelhead, however, benefits to other species are considered (Table 1). Current minimum instream flow requirements are based on the 1961 agreement between the California Department of Fish and Game (CDFG) and East Bay Municipal District (EBMUD). This fish flow standard only requires that total water releases below Camanche Reservoir be either 13 thousand acre feet (TAF) or 5.4 TAF from November through March depending on normal and wetter water year or dry year conditions, respectively. However, if this standard were minimally complied with, actual water releases from April through September would not be zero because of Camanche releases to meet the downstream water rights of the Woodbridge Irrigation District. This standard is not considered further.

For the following guidelines we consider the 1996 Principles of Agreement (POA) as our baseline standard to build from, given that water for acquisition is available. In addition to the POA standard described below, we consider five additional minimum instream flow recommendations to form the foundation of our prioritized water allocation by water-year type (tables 2 through 5). They are: 1) FERC staff (FERC 1993, Final EIS for Proposed Modifications to the Lower Mokelumne River Project, California), 2) EBMUD (EDAW, Inc. 1993, Updated Water Supply Management Plan), CDFG (CDFG 1991, Lower Mokelumne River Management Plan), U.S. Fish and Wildlife Service (USFWS 1993 letter commenting on the draft EIS), and the Anadromous Fish Restoration Program (AFRP) Working Paper (USFWS 1995). The guidelines for each of the water-year types are bracketed on the lower end by the 1996 POA for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Although these tables use the designated standards as the foundation to which we add acquired water, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

Table 1. Draft water allocation priorities for (b)(3) water on the Mokelumne River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Mokelumne River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Mokelumne River; and contribute to improved migration and spawning conditions for American shad. Also improve conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows.

4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

This standard is defined in the 1996 Principles of Agreement (POA) between the East Bay Municipal Utility District (EBMUD), the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG). The POA flows are specified for release from Camanche Reservoir, but we use its projected flow equivalent below Woodbridge in order to be comparable to the recommendations that follow. The POA allocates water by four different water-year types: 1) critically dry, 2) dry, 3) below-normal, and 4) normal and above, using a dual water-year type determination. Flows from October through March are allocated using a water-year type classification determined by November 5 combined storage in Pardee and Camanche reservoirs; year type storage limits are based on the capacities of Pardee and Camanche reservoirs in 1995. Flows from April through September are allocated using a water-year type classification determined by the water-year unimpaired runoff into Pardee Reservoir as forecasted by the California Department of Water Resources (DWR) in the April 1 Bulletin 120 Report except when combined Pardee and Camanche November 5 storage is projected to be less than 200 TAF.

For the months of April, May, and June during normal and above year types, additional releases ranging from 50 cubic feet per second (cfs) to 200 cfs are required depending on combined Pardee and Camanche storage levels relative to the maximum allowable for the end of the prior month. This water is not factored into these guidelines because its use is contingent on additional existing condition information over and above the fixed water-year type prescription described above. However, this water should be included as part of the existing conditions considered by the water acquisition program.

Recommendations

FERC Staff: The FERC staff alternative for minimum flows below Woodbridge Dam is based on an independent analysis of available data, including required Camanche conveyance releases, CDFG's 1991 IFIM study, and a temperature model (SNTMP) produced by the USFWS (Theurer et al. 1984). The staff integrated these habitat and temperature data to "optimally" allocate water for anadromous salmonids during two time periods. In October through February they attempt to maximize thermal conditions and weighted usable area (WUA) for upstream migration, spawning and incubation. A second priority is from May through June to maximize the same conditions for rearing and out-migration. In March through April when temperatures are not limiting, they reduce flows to maximize salmon rearing conditions based solely on the use of WUA values or physical habitat for juvenile rearing. FERC staff water-year types are based on a combination of end-of-the-year reservoir storage and unimpaired flow into Pardee Reservoir. Contrasting the POA, FERC staff only identifies three water-year types: 1) dry, 2) below-normal, and 3) above-normal, but uses a similar fall (September 30) reservoir storage criteria for October through February releases. Starting in March they use DWR's unimpaired runoff forecasts to identify March through September releases.

East Bay Municipal Utility District: EBMUD's recommendation for minimum instream flows derive from CDFG's 1991 IFIM study, and temperature modeling and fisheries studies conducted by Biosystems. Their recommendation focuses on improving upstream migration and spawning for chinook salmon and steelhead during the fall and winter months, as well as improved juvenile rearing habitat in the spring. Their general strategy recognizes natural variation in stream flow and fish adaptations to these conditions. Critically dry year recommendations allow for intervening trap and haul operations of juvenile salmon downstream to presumed better habitat conditions. EBMUD defines three water-year types, 1) critically dry, 2) dry, and 3) normal and above, that are based solely on predicted and actual end-of-October storage conditions in Pardee and Camanche reservoirs. From May through October a combination of observed streamflow, snowpack, and storage volumes are used to predicts end-of-October storage conditions. November through April releases at Camanche are based on actual reservoir storage at the end of October.

California Department of Fish and Game: CDFG's recommendation for minimum instream flows is based on a combination of WUA and discharge indices from their IFIM study, water temperature modeling, and knowledge of anadromous fish life stage requirements (see their 1991 Management Plan). Their plan places emphasis on using the natural hydrograph to guide flow recommendations by water-year type. Also unique to their recommendation are two blocks of water, in addition to set schedule flows, to be managed adaptively for attraction of fall spawners and spring outmigration of emigrating juveniles. Water-years- dry, normal, and wet are defined solely on the basis of unimpaired runoff above Pardee Reservoir as described for the year in DWR's Bulletin 120 series May 1, report on water conditions. A dry year is considered less than half of the 50-year average for unimpaired runoff, normal is between 50% and 110% of the 50-year average, and wet years exceed 110% of the 50-year runoff. Additional fall attraction flows from October 1 to November 15 are 20 TAF in normal and wet years, and 10 TAF in dry years. Likewise, additional outmigration flows from April 1 to June 30 are 10 TAF for normal and wet years and 5 TAF for dry years. We consider these blocks of water together with the minimum recommended flow during corresponding time periods.

U.S. Fish and Wildlife Service: USFWS's 1993 recommendation allocates water for only two water-year types, dry and critically dry, and normal and wet. Dry and critically dry water years occur when observed inflows into Pardee Reservoir are less than 360 TAF for the water year, or when average annual flows are less than 500 cfs. Normal and wet year flows would be allocated when inflows are in excess of the above cut off. Similar to CDFG's recommendation, the USFWS places high priority on salmonid attraction flows by allocating an additional 15 TAF block of water during the first two weeks in October for normal and wet years. The flow allocation attempts to mimic the natural hyrograph with the allotted water.

AFRP Working Paper: The AFRP Working Paper recommends two sets of minimum instream flows, one set for salmon and steelhead and another for shad. The shad recommendation allocates water in addition to salmon flows during the April through May period for shad attraction, migration and spawning. The salmon recommendation uses three water-year types of wet, normal and dry. The shad recommendation splits normal into above-normal and below-normal, and adds a critical water year. Water-year types for salmon and shad recommendations are based on the San Joaquin Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of acquired water on the Mokelumne River for each of the water-year types for which the existing standards were developed. The guidelines for each of the water-year types are bracketed on the lower end by the 1996 POA for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Ultimately, I expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows. Although these tables use the existing standards as the foundation to which we add acquired water, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in critical water years. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Mokelumne River. The block of water will be managed to maximize benefits to anadromous fish, both in the Mokelumne River and downstream, and in coordination with the Mokelumne River Technical Advisory Committee and downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	3	3	1996 Principle of Agreement (POA) between the East Bay Municipal Utility District (EBMUD), the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG) for minimum flow releases to the lower Mokelumne River for a dry water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
2	Rearing and outmigration (April through May)	13	16	POA minimum releases for a dry water year.
3	Over-summering (June through September)	1	17	POA minimum releases for a dry water year.
4	Spawning and incubation (October through December)	3	20	POA minimum releases for a below-normal water year.
5	Rearing and outmigration (April through June)	15	35	POA minimum releases for a below-normal water year.
6	Incubation and rearing (January through March)	4	39	POA minimum releases for a below-normal water year.
7	Rearing and outmigration (April through June)	12	51	POA minimum releases for above-normal and wet water years.
8	Over-summering (July through September)	1	52	POA minimum releases for above-normal and wet water years.
9	Spawning and incubation (October through December)	7	59	EBMUD's 1993 recommended minimum releases from Camanche Reservoir to the lower Mokelumne River for a dry water year, (as cited in the Lower Mokelumne River Management Plan, prepared by Biosystems Analysis, Inc. 1993).
10	Rearing and outmigration (April through June)	14	73	EBMUD's 1993 recommended minimum releases for normal and wet water years.
11	Incubation and rearing (January through March)	7	80	Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
12	Spawning and incubation (October through December)	16	96	FERC (1993) staff recommended minimum releases for below-normal water years.
13	Over-summering (July through September)	4	100	FERC (1993) staff recommended minimum releases for below-normal water years.
14	Incubation and rearing (January through March)	10	110	CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years.
15	Over-summering (July through September)	3	113	U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993
16	Incubation and rearing (January through March)	3	116	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
17	Over-summering (July through September)	8	124	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
18	Spawning and incubation (October through December)	17	141	FERC (1993) staff recommended minimum releases for above-normal water year.
19	Rearing and outmigration (April through June)	5	146	USFWS (1993) recommended minimum releases for normal and wet water years.
20	Incubation and rearing (January through March)	15	161	USFWS (1993) recommended minimum releases for normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
21	Spawning and incubation (October through December)	15	176	CDFG (1991) recommended minimum releases for normal water years.
22	Rearing and outmigration (April through June)	21	197	CDFG (1991) recommended minimum releases for normal water years.
23	Incubation and rearing (January through March)	3	200	CDFG (1991) recommended minimum releases for normal water years.
24	Over-summering (July through September)	1	201	CDFG (1991) recommended minimum releases for normal water years.
25	Rearing and outmigration (April through June)	36	237	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
26	Incubation and rearing (January through March)	3	240	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
27	Spawning and incubation (October through December)	9	249	CDFG (1991) recommended minimum releases for a wet water year.
28	Incubation and rearing (January through March)	6	255	CDFG (1991) recommended minimum releases for a wet water year.
29	Over-summering (July through September)	34	289	CDFG (1991) recommended minimum releases for a wet water year.
30	Rearing and outmigration (April through June)	54	343	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
31	Incubation and rearing (January through March)	18	361	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.

Table 3. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in dry water years. See the caption for Table 1 for a more complete description of the columns.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	3	3	POA minimum releases for a below normal water year.
2	Rearing and outmigration (April through June)	15	18	POA minimum releases for a below normal water year.
3	Incubation and rearing (January through March)	4	22	POA minimum releases for a below normal water year.
4	Rearing and outmigration (April through June)	12	34	POA minimum releases for above normal and wet water years.
5	Over-summering (July through September)	1	35	POA minimum releases for above normal and wet water years.
6	Spawning and incubation (October through December)	7	42	EBMUD's 1993 recommended minimum releases for a dry water year.
7	Rearing and outmigration (April through June)	14	56	EBMUD's 1993 recommended minimum releases for normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
8	Incubation and rearing (January through March)	7	63	Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years.
9	Spawning and incubation (October through December)	16	79	FERC (1993) staff recommended minimum releases for below-normal water years.
10	Over-summering (July through September)	4	83	FERC (1993) staff recommended minimum releases for below-normal water years.
11	Incubation and rearing (January through March)	10	93	CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years.
12	Over-summering (July through September)	3	96	U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993
13	Incubation and rearing (January through March)	3	99	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
14	Over-summering (July through September)	8	107	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
15	Spawning and incubation (October through December)	17	124	FERC (1993) staff recommended minimum releases for above-normal water year.
16	Rearing and outmigration (April through June)	5	129	USFWS (1993) recommended minimum releases for normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
17	Incubation and rearing (January through March)	15	144	USFWS (1993) recommended minimum releases for normal and wet water years.
18	Spawning and incubation (October through December)	15	159	CDFG (1991) recommended minimum releases for normal water years.
19	Rearing and outmigration (April through June)	21	180	CDFG (1991) recommended minimum releases for normal water years.
20	Incubation and rearing (January through March)	3	183	CDFG (1991) recommended minimum releases for normal water years.
21	Over-summering (July through September)	1	184	CDFG (1991) recommended minimum releases for normal water years.
22	Rearing and outmigration (April through June)	36	220	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
23	Incubation and rearing (January through March)	3	223	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
24	Spawning and incubation (October through December)	9	232	CDFG (1991) recommended minimum releases for a wet water year.
25	Incubation and rearing (January through March)	6	238	CDFG (1991) recommended minimum releases for a wet water year.
26	Over-summering (July through September)	34	272	CDFG (1991) recommended minimum releases for a wet water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
27	Rearing and outmigration (April through June)	54	326	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.
28	Incubation and rearing (January through March)	18	344	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.
29	Rearing and outmigration (April through May)	43	387	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad.

Table 4. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in in below normal water years. See the caption for Table 1 for a more complete description of the columns.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Incubation and rearing (January through March)	12	12	POA minimum releases for above normal and wet water years.
2	Over-summering (July through September)	1	13	POA minimum releases for above normal and wet water years.
3	Spawning and incubation (October through December)	7	20	EBMUD’s 1993 recommended minimum releases for a dry water year.
4	Rearing and outmigration (April through June)	14	34	EBMUD’s 1993 recommended minimum releases for normal and wet water years.
5	Incubation and rearing (January through March)	7	41	Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
6	Spawning and incubation (October through December)	16	57	FERC (1993) staff recommended minimum releases for below-normal water years.
7	Over-summering (July through September)	4	61	FERC (1993) staff recommended minimum releases for below-normal water years.
8	Incubation and rearing (January through March)	10	71	CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years.
9	Over-summering (July through September)	3	74	U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993
10	Incubation and rearing (January through March)	3	77	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
11	Over-summering (July through September)	8	85	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
12	Spawning and incubation (October through December)	17	102	FERC (1993) staff recommended minimum releases for above-normal water year.
13	Rearing and outmigration (April through June)	5	107	USFWS (1993) recommended minimum releases for normal and wet water years.
14	Incubation and rearing (January through March)	15	122	USFWS (1993) recommended minimum releases for normal and wet water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
15	Spawning and incubation (October through December)	15	137	CDFG (1991) recommended minimum releases for normal water years.
16	Rearing and outmigration (April through June)	21	158	CDFG (1991) recommended minimum releases for normal water years.
17	Incubation and rearing (January through March)	3	161	CDFG (1991) recommended minimum releases for normal water years.
18	Over-summering (July through September)	1	162	CDFG (1991) recommended minimum releases for normal water years.
19	Rearing and outmigration (April through June)	36	198	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
20	Incubation and rearing (January through March)	3	201	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
21	Spawning and incubation (October through December)	9	210	CDFG (1991) recommended minimum releases for a wet water year.
22	Incubation and rearing (January through March)	6	216	CDFG (1991) recommended minimum releases for a wet water year.
23	Over-summering (July through September)	34	250	CDFG (1991) recommended minimum releases for a wet water year.
24	Rearing and outmigration (April through June)	54	304	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
25	Incubation and rearing (January through March)	18	322	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.
26	Rearing and outmigration (April through May)	43	365	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad.
27	Rearing and outmigration (April through June)	114	479	AFRP Working Paper (USFWS 1995) minimum releases for a below-normal water year, including releases targeted specifically for American shad.

Table 5. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in in above normal and wetter water years. See the caption for Table 1 for a more complete description of the columns.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
1	Spawning and incubation (October through December)	7	7	EBMUD's 1993 recommended minimum releases for a dry water year.
2	Rearing and outmigration (April through June)	14	21	EBMUD's 1993 recommended minimum releases for normal and wet water years.
3	Incubation and rearing (January through March)	7	28	Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years.
4	Spawning and incubation (October through December)	16	44	FERC (1993) staff recommended minimum releases for below-normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
5	Over-summering (July through September)	4	48	FERC (1993) staff recommended minimum releases for below-normal water years.
6	Incubation and rearing (January through March)	10	58	CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years.
7	Over-summering (July through September)	3	61	U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993
8	Incubation and rearing (January through March)	3	64	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
9	Over-summering (July through September)	8	72	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad.
10	Spawning and incubation (October through December)	17	89	FERC (1993) staff recommended minimum releases for above-normal water year.
11	Rearing and outmigration (April through June)	5	94	USFWS (1993) recommended minimum releases for normal and wet water years.
12	Incubation and rearing (January through March)	15	109	USFWS (1993) recommended minimum releases for normal and wet water years.
13	Spawning and incubation (October through December)	15	124	CDFG (1991) recommended minimum releases for normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
14	Rearing and outmigration (April through June)	21	145	CDFG (1991) recommended minimum releases for normal water years.
15	Incubation and rearing (January through March)	3	148	CDFG (1991) recommended minimum releases for normal water years.
16	Over-summering (July through September)	1	149	CDFG (1991) recommended minimum releases for normal water years.
17	Rearing and outmigration (April through June)	36	185	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
18	Incubation and rearing (January through March)	3	188	AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad.
19	Spawning and incubation (October through December)	9	197	CDFG (1991) recommended minimum releases for a wet water year.
20	Incubation and rearing (January through March)	6	203	CDFG (1991) recommended minimum releases for a wet water year.
21	Over-summering (July through September)	34	237	CDFG (1991) recommended minimum releases for a wet water year.
22	Rearing and outmigration (April through June)	54	291	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.
23	Incubation and rearing (January through March)	18	309	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Support
24	Rearing and outmigration (April through May)	43	352	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad.
25	Rearing and outmigration (April through June)	114	466	AFRP Working Paper (USFWS 1995) minimum releases for a below-normal water year, including releases targeted specifically for American shad.
26	Rearing and outmigration (April through June)	49	515	AFRP Working Paper (USFWS 1995) minimum releases for an above-normal water year, including releases targeted specifically for American shad.
27	Rearing and outmigration (April through June)	123	638	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, including releases targeted specifically for American shad.

Calaveras River

Species and life-history stage priorities

On the Calaveras River, the primary species of concern is winter-run chinook salmon. Table 1 prioritizes life-history stages for winter-run chinook salmon.

Table 2. Draft water allocation priorities for (b)(3) water on the Calaveras River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Adult migration (February through April)	Improve attraction flows for winter-run chinook salmon migrating into the Calaveras River.
2	Spawning and incubation (May through July)	Improve spawning and incubation flows and related habitat conditions for winter-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to Delta outflows.
3	Incubation and rearing (August through October)	Improve incubation and rearing flows and related habitat conditions for winter-run chinook salmon in the Calaveras River; and contribute to improved conditions for survival, and contribution to Delta outflows.
4	Rearing and outmigration (November through January)	Improve rearing habitat and survival of emigrants.

Existing standards

No flow standards exist for the Calaveras River.

Recommendations

The AFRP Working Paper (USFWS 1995) identified flows for three water-year types (critical and dry, below and above normal, and wet) based on results of a preliminary instream flow study conducted by USFWS (Memorandum to the U.S. Bureau of Reclamation re: Stanislaus River basin-Calaveras River conjunctive use water program study: a preliminary evaluation of fish and wildlife impacts with emphasis on water needs of the Calaveras River. 1993) that indicated winter-run chinook salmon require flows of 50 to 225 cfs.

Draft guidelines for allocation of acquired water

Table 2 shows draft guidelines for allocation of acquired water based on flows recommended for three water-year types (critical and dry, below and above normal, and wet) in the AFRP Working Paper (USFWS 1995), and under the assumption that no flows are released at New Hogan Dam.

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Calaveras River. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Calaveras River. The block of water will be managed to maximize benefits to anadromous fish, both in the Calaveras River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Adult migration (February through April)	21	21	AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year.
2	Spawning and incubation (May through July)	22	43	AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year.
3	Incubation and rearing (August through October)	20	63	AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year.
4	Rearing and outmigration (November through January)	9	72	AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year.
5	Adult migration (February through April)	6	78	AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year.
6	Spawning and incubation (May through July)	7	85	AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year.
7	Incubation and rearing (August through October)	4	89	AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
8	Rearing and outmigration (November through January)	4	93	AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year.
9	Adult migration (February through April)	6	99	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
10	Spawning and incubation (May through July)	7	106	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
11	Incubation and rearing (August through October)	3	109	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.

SAN JOAQUIN BASIN

Considerations for management of blocks of water for spawning and incubation

1. Consistent with efforts to address low dissolved oxygen concentrations in the lower San Joaquin River.

2. Consistent with management of (b)(2) water in the Delta and other Delta water operations.

3. In coordination with flow contributions from the San Joaquin, Merced, and Stanislaus rivers to achieve 1 and 2 above.

Considerations for management of blocks of water for rearing and outmigration

1. Consistent with the Vernalis flow requirement for April through May in the Bay-Delta Agreement.

2. Consistent with the Vernalis flow requirement for April through May in the USFWS March 6, 1995 Biological Opinion for Delta smelt.

3. Consistent with management of (b)(2) water in the Delta and other Delta water operations.

4. Consistent with experiments in the Delta, especially those addressing effects of San Joaquin River flows, CVP and SWP exports, and Delta barriers.

5. In coordination with flow contributions from all San Joaquin basin tributaries to achieve 1, 2, 3, and 4 above. (An additional consideration is that we might want to attempt to acquire flows for outmigration from upstream tributaries first to improve conditions in as much of the San Joaquin River as possible.)

Merced River

Merced River stream flows are regulated primarily by New Exchequer and McSwain dams. Both are owned and operated by Merced Irrigation District. Crocker-Hoffman Diversion Dam, located downstream of New Exchequer and McSwain dams, limits anadromous fish to the lower reach of the Merced River. Fall-run chinook salmon is the primary species of concern. Flow standards were established by a FERC licence and Davis-Grunsky contract with Merced Irrigation District. Flow recommendations were provided by the CDFG and USFWS.

Species and life-history stage priorities

On the Merced River, the primary species of concern is fall-run chinook salmon. Steelhead may also be present in the Merced River in some years, but natural production of steelhead in the river is unlikely. Late-fall run chinook salmon may be present, based on observations of adult carcasses in January and recently emerged fry in April (G. Neillands, CDFG Region 4, Fresno, personnel communication). Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Merced River.

Table 1. Draft water allocation priorities for (b)(3) water on the Merced River. The time periods in parentheses in the life history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Merced River.

3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Merced River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows.
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

The Federal Energy Regulatory Commission licenced Merced Irrigation District to operate New Exchequer and McSwain dams in 1964 (Project No. 2179). In 1967, Merced Irrigation District executed Davis-Grunsky Contract No. D-GGR17 with CDWR. Both the FERC licence and Davis-Grunsky contract provide minimum flow standards.

FERC licence: The FERC license establishes two water year types (summarized in Exhibit No. WRINT Merced-3.0, testimony by Ted. C. Selb, Assistant Manager and Engineer, Merced Irrigation District), dry and normal, determined by the April 1 to July 31 forecasted unimpaired runoff into New Exchequer Reservoir. Forecasts are made by the CDWR on May 1. Years in which unimpaired runoff is forecasted to be less than 450,000 af are designated dry water years. Years in which unimpaired runoff is forecasted to be greater than 450,000 af are designated normal water years. Based on water year type, the FERC license requires minimum monthly flows that are measured at Shaffer Bridge, about 20 miles downstream of Crocker-Hoffman Dam. Annual releases are about 33,000 af in dry water years and 44,000 af in normal water years. The licence also stipulates a minimum storage pool in Lake McClure, provides 15,000 af of water to the Merced National Wildlife Refuge, and requires that if the average flow from 1 November to 31 December is greater than 150 cfs, exclusive of flood spills and emergency releases, then flow from 1 January to 31 March would not be less than 100 cfs.

Davis-Grunsky contract: The Davis-Grunsky Contract requires minimum flows of 180-220 cfs for November 1 to March 31, measured at Shaffer Bridge (summarized in Exhibit No. WRINT Merced-3.0, testimony by Ted. C. Selb, Assistant Manager and

Engineer, Merced Irrigation District). Because a range of monthly flows is stipulated in the Davis-Grunsky, we assumed that the minimum of the range would apply in dry water years, as defined in the FERC licence, and the maximum of the range of flows would apply in normal water years. Thus, annual minimum flow standards of the FERC licence and Davis-Grunsky contract are about 67,000 af in dry water years and 84,000 af in normal water years.

Other standards: Pursuant to an adjudicated settlement, Merced Irrigation District is required to release 50 to 250 cfs monthly, contingent upon inflow to Lake McClure during October to February, to supply seven riparian diversions. Because all diversions are located upstream of Shaffer Bridge, the gaging site for the FERC licence and Davis-Grunsky contract, we did not include flows for riparian diversions in the existing standards.

Recommendations

The CDFG and USFWS have provided flow recommendations for the Merced River. Preliminary flow recommendations were made by CDFG in "Restoring Central Valley Streams: A Plan for Action" (CDFG 1993). Recommendations made by the USFWS were developed by the Anadromous Fish Restoration Program in the AFRP Working Paper (USFWS 1995).

California Department of Fish and Game: The CDFG (1993) noted that existing standards in the Merced River are likely inadequate to accommodate migration, spawning, egg incubation, juvenile rearing, and smolt emigration of fall-run chinook salmon, especially during the spring emigration and fall immigration periods. Although instream flow studies have not been completed but are presently underway (W. Loudermilk, CDFG Region 4, Fresno, personnel communication), CDFG (1993) provided interim flow recommendations based on instream flow study and smolt survival data from drainages similar to the Merced River.

Interim recommendations were made for five water-year types according to the San Joaquin River 60-20-20 Index; and recommendations for each year type include volumes of water for spring outmigration (April-May) and fall attraction (October). The recommendations during the spring are consistent with CDFG flow objectives for the San Joaquin River at Vernalis. To determine whether releases are depleted by riparian diversions, the CDFG (1993) also recommended that flows should be measured by CDWR gages at Crocker-Hoffman Diversion Dam and Snelling, and downstream of Snelling. Even though implementing the recommendations would improve conditions beyond the existing standards, CDFG believed that the resulting conditions would not be optimal for chinook salmon spawning, rearing, or emigration, especially in dry years (CDFG 1993).

AFRP Working Paper: The AFRP developed flow recommendations that, in conjunction with other restoration actions, would result in at least doubling natural production of fall-run chinook salmon relative to the average attained during 1967-1991. The recommendations were based on the proportion of unimpaired flow that the Merced River contributes to the San Joaquin River, the historic hydrological regime, and results of an Instream Flow Incremental Methodology (IFIM) study conducted for drainages similar to the Merced River (USFWS 1995). Additional assumptions were that flows greater than historical flows in the lower reach of the river are needed to compensate for elimination of access to upstream habitat, and flows should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles. Recommendations were made for five water-year types according to the San Joaquin River 60-20-20 Index. Recommendations apply to the entire lower Merced River, Crocker-Hoffman Diversion Dam to the confluence of the San Joaquin River.

Draft guidelines for allocation of acquired water

The following tables contain draft guidelines for allocation of acquired water. Table 2 applies to a dry water year, as defined in the FERC licence, using the minimum range of flows in the Davis-Grunsky contract. Table 3 applies to a normal water year using the maximum range of flows in the Davis-Grunsky contract.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Merced River in dry water years pursuant to FERC License No. 2179 and the low range of flows contained in Davis-Grunsky Contract No. D-GGR17. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Merced River. The block of water will be managed to maximize benefits to anadromous fish, both in the Merced River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	6	6	FERC License No. 2179 minimum release for a normal water year and high range of Davis-Grunsky Contract No. D-GGR17.
2	Rearing and outmigration (April through May)	2	8	FERC License No. 2179 minimum release for a normal water year.
3	Incubation and rearing (January through March)	7	15	FERC License No. 2179 minimum release for a normal water year and high range of Davis-Grunsky Contract No. D-GGR17.

4	Over-summering (June through September)	2	17	FERC License No. 2179 minimum release for a normal water year.
5	Spawning and incubation (October through December)	29	46	CDFG (1993) recommended minimum release for a critical water year.
6	Rearing and outmigration (April through May)	30	76	CDFG (1993) recommended minimum release for a critical water year.
7	Over-summering (June through September)	42	118	CDFG (1993) recommended minimum release for a critical water year.
8	Spawning and incubation (October through December)	9	127	CDFG (1993) recommended minimum release for a below normal water year.
9	Rearing and outmigration (April through May)	23	150	CDFG (1993) recommended minimum release for a dry water year.
10	Incubation and rearing (January through March)	15	165	USFWS (1995) minimum releases for a critical water year.
11	Rearing and outmigration (April through May)	35	200	USFWS (1995) minimum releases for a critical water year.
12	Over-summering (June through September)	15	215	USFWS (1995) minimum releases for a critical water year.
13	Rearing and outmigration (April through May)	33	248	USFWS (1995) minimum releases for a dry water year.
14	Incubation and rearing (January through March)	9	257	USFWS (1995) minimum releases for a dry water year.
15	Over-summering (June through September)	12	269	USFWS (1995) minimum releases for a dry water year.
16	Spawning and incubation (October through December)	10	279	USFWS (1995) minimum releases for a wey water year.
17	Rearing and outmigration (April through May)	46	325	USFWS (1995) minimum releases for a below normal water year.
18	Incubation and rearing (January through March)	16	341	USFWS (1995) minimum releases for a below normal water year.

19	Over-summering (June through September)	10	351	CDFG (1993) recommended minimum release for a wet normal water year.
20	Rearing and outmigration (April through May)	46	397	USFWS (1995) minimum releases for an above normal water year.
21	Incubation and rearing (January through March)	76	473	USFWS (1995) minimum releases for an above normal water year.
22	Over-summering (June through September)	29	502	USFWS (1995) minimum releases for a below normal water year.
23	Rearing and outmigration (April through May)	66	568	USFWS (1995) minimum releases for a wet water year.
24	Incubation and rearing (January through March)	81	649	USFWS (1995) minimum releases for a wet water year.
25	Over-summering (June through September)	136	785	USFWS (1995) minimum releases for a wet water year.

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Merced River in normal water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	29	29	CDFG (1993) recommended minimum release for a critical water year.
2	Rearing and outmigration (April through May)	30	59	CDFG (1993) recommended minimum release for a critical water year.
3	Over-summering (June through September)	42	101	CDFG (1993) recommended minimum release for a critical water year.
4	Spawning and incubation (October through December)	9	110	CDFG (1993) recommended minimum release for a below normal water year.

5	Rearing and outmigration (April through May)	23	133	CDFG (1993) recommended minimum release for a dry water year.
6	Incubation and rearing (January through March)	15	148	USFWS (1995) minimum releases for a critical water year.
7	Rearing and outmigration (April through May)	35	183	USFWS (1995) minimum releases for a critical water year.
8	Over-summering (June through September)	15	198	USFWS (1995) minimum releases for a critical water year.
9	Rearing and outmigration (April through May)	33	231	USFWS (1995) minimum releases for a dry water year.
10	Incubation and rearing (January through March)	9	240	USFWS (1995) minimum releases for a dry water year.
11	Over-summering (June through September)	12	252	USFWS (1995) minimum releases for a dry water year.
12	Spawning and incubation (October through December)	10	262	USFWS (1995) minimum releases for a wey water year.
13	Rearing and outmigration (April through May)	46	308	USFWS (1995) minimum releases for a below normal water year.
14	Incubation and rearing (January through March)	16	324	USFWS (1995) minimum releases for a below normal water year.
15	Over-summering (June through September)	10	334	CDFG (1993) recommended minimum release for a wet normal water year.
16	Rearing and outmigration (April through May)	46	380	USFWS (1995) minimum releases for an above normal water year.
17	Incubation and rearing (January through March)	76	456	USFWS (1995) minimum releases for an above normal water year.
18	Over-summering (June through September)	29	485	USFWS (1995) minimum releases for a below normal water year.
19	Rearing and outmigration (April through May)	66	551	USFWS (1995) minimum releases for a wet water year.

20	Incubation and rearing (January through March)	81	632	USFWS (1995) minimum releases for a wet water year.
21	Over-summering (June through September)	136	768	USFWS (1995) minimum releases for a wet water year.

Tuolumne River

The following tables present salmon life history priorities and draft guidelines for allocation of acquired water on the Tuolumne River. The primary species of concern is fall-run chinook salmon. We prioritize salmon life-history stages (Table 1) for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Tuolumne River. Steelhead may also be present in the river in some years, but natural production of steelhead is unlikely. However, given their presence, steelhead should benefit coincidentally from allocated water prioritized for salmon. Although the AFRP Working Paper provided flows for American shad, these flows were less than those needed for chinook salmon.

In 1996 FERC adopted the minimum instream flows for fish presented in the 1995 New Don Pedro Settlement Agreement. We consider this existing standard as the baseline for our prioritized water allocation scheme that follows in Tables 2 through 8. In addition to the standard we consider five additional minimum flow recommendations to assist in incremental allocation of prioritized blocks of water to benefit anadromous fish production; the first four are summarized and presented in the 1996 FERC Final Environmental Impact Statement for the New Don Pedro Project. These recommendations are 1) 1992, Turlock Irrigation District, Modesto Irrigation District and the California Department of Fish and Game(Districts and CDFG), 2) 1993, City and County of San Francisco (CCSF), 3) 1993, U. S. Fish and Wildlife Service (USFWS), 4) 1996 Federal Energy Regulatory Commission (FERC) staff, and 5) 1995, the Anadromous Fish Restoration Program (AFRP) Working Paper. The guidelines for each of the water-year types are bracketed on the lower end by the 1996 standard for the year type and on the upper end by the AFRP Working Paper flows. Although our allocation tables use the designated standards as the foundation to add acquired water to, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

On the Tuolumne River, the primary species of concern is fall-run chinook salmon. Steelhead may also be present in the Tuolumne River in some years, but natural production of steelhead in the river is unlikely. Although the AFRP Working Paper provided flows for American shad, these flows were less than those needed for chinook salmon. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Tuolumne River. This table is an adaptation of the tables the long-term water management planning folks have produced. I generated the priorities and objectives based on Roger Guinee's preliminary draft recommendations for the Tuolumne River and on input from Bill Loudermilk of CDFG.

Table 1. Draft water allocation priorities for (b)(3) water on the Tuolumne River. The time periods in parentheses in the life history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Tuolumne River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Tuolumne River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows.
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

The conditions of the standards are described in the 1995 New Don Pedro Settlement Agreement (Settlement Agreement). The stated focus of the flow agreement is specifically for restoration of fall-run chinook salmon, but generally for the whole anadromous fishery downstream of the project. This standard specifies minimum water releases from New Don Pedro Reservoir, measured at the La Grange bridge. The agreement uses ten water-year types, but in practice there are only seven year types as the last four year types all allocate the same amount of water in normal and wetter conditions. Water allocation by year type ranges from 94 thousand acre-feet (TAF) to 301 TAF. Water-year types are defined using the 60-20-20 San Joaquin Index, a weighted average index that accounts for projected April through July San Joaquin River unimpaired runoff (60%), the current year's estimated October through March runoff in the San Joaquin River (20%), and the previous year's index (20%). The six drier year type standards provide incremental increases in allocated water as the year type classification becomes wetter. In addition to specific flow schedules by year type, the Settlement Agreement provides variable sized blocks of water for smolt outmigration in each year type, and fall attraction pulses in the six wettest water-year types. The Settlement Agreement proposes a flexible adaptive management approach for use of these outmigration and upmigration pulses.

Recommendations

Turlock Irrigation District and Merced Irrigation District and California Department of Fish and Game: The Districts and CDFG recommendation defines specific flow schedules for different times of the year, including spring pulse flows for smolt out-migration for 10 different water-year types. Water allocation by year type ranges from a low of 64 TAF to 374 TAF. Water-year types are calculated based on actual and predicted regulated inflows to New Don Pedro Reservoir. The year type classification is reassessed multiple times during each year incorporating recent inflow and updated inflow predictions. This recommendation results in a general annual unimodal release schedule with a maxima in the spring, and thus is somewhat representative of the natural hydrograph.

City and County of San Francisco: The CCSF recommendation defines 11 different water-year types allocating a minimum of 64 TAF in the driest years to a maximum of 250 TAF in the wettest year types. CCSF water-year types are defined using unimpaired flows at the La Grange gage. Water-year types are calculated and redefined on April 15, May 15, and June 15, and are based on the sum of year-to-date and forecasted unimpaired runoff. This recommendation is bimodal with a two-day fall attraction flow specified for October and increased flows for outmigration in May, summer rearing flows are also provided.

U.S. Fish and Wildlife Service: The USFWS flow recommendation integrates the relationship between temperature and flow, and flow and physical habitat recognizing that habitat components in addition to physical space should be considered in flow allocation. The FWS produced annual flow schedules for four different water-year types, ranging in a minimum annual release of 120 TAF to a maximum of 304 TAF. Water-years are partitioned based on unimpaired flow in the Tuolumne basin; however, the FWS has not identified a specific method to determine how forecasts are to be used to determine unimpaired flow or the dates on which water-year types would be evaluated. Differing from the standard and the two previous recommendations no specific pulse or attraction flows are built into the minimum flow schedules.

Federal Energy Regulatory Commission staff: FERC describes only three water-year types that allocate minimum annual totals of water ranging from 84 TAF to 376 TAF. The year types are defined using unimpaired annual flow at the La Grange gage, similar to the definition of water-year type used by the CCSF and FWS but differing in breakpoint definition resulting in the three water-year types. FERC staff used a water balance model, the Hetch-Hetchy Simulation Model (HHSM), and a salmon production model or the Oak RidgeChinook Model (ORCM) to generate minimum instream flow recommendations that attempt to maximize both fishery and water user benefits and minimize costs to both. The ORCM model uses spawner escapement, daily flow data, water and air temperature and weighted usable area (WUA) data to produce smolt production estimates in this individual based model. For years of normal and wet hydrology FERC staff used an iterative process with HHSM model to generate a minimum instream flow that produced the highest number of salmon smolts. Then they capped the minimum annual flow at 357 TAF, the level where smolt increase per unit flow increased approached zero. From this cap, additional fall attraction flows were added, because this aspect of life history is not well accounted for in the model. Also, additional summer flows were added to provide for other non-salmon objectives. In critical and dry years a similar iterative process was followed but they incorporated a balance between the ORCM model and the ORCM model.

AFRP Working Paper: The AFRP Working Paper presents minimum instream flows for five water-year types and allocates minimum annual totals of water ranging from 411 TAF to 1,544 TAF. Water-year types are based on the San Joaquin Basin 60-20-20 index described above for the existing standard. The Working Paper recommendations produce a unimodal fish allocation that peaks in the spring. Recommended fall and summer flow are derived from Instream Flow Incremental Methodology (IFIM) data. Winter and spring flow recommendations were guided both by historical monthly distribution of total annual unimpaired runoff for the Tuolumne River Basin and Vernalis flow requirements. The intent of the Working Paper flow recommendations was contribute to doubling production of Tuolumne River fall-run chinook salmon and to provide benefit to anadromous fish downstream in the San Joaquin River and Delta.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of acquired water for each of the water-year types for which the existing standards were developed. The guidelines for each of the water-year types are bracketed on the lower end by the standard for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Ultimately, I expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in critical and below water years. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Tuolumne River. The block of water will be managed to maximize benefits to anadromous fish, both in the Tuolumne River and downstream, and in coordination with the Lower Tuolumne River Technical Advisory Committee and downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Rearing and outmigration (April through May)	9	9	New Don Pedro Proceeding Settlement Agreement (Settlement Agreement) minimum releases for a median critical water year.
2	Spawning and incubation (October through December)	1	10	Settlement Agreement minimum releases for an intermediate critical-dry water year.
3	Rearing and outmigration (April through May)	17	27	Settlement Agreement minimum releases for intermediate critical-dry and median dry water years.
4	Over-summering (June through September)	6	33	Settlement Agreement minimum releases for a median dry water year.
5	Spawning and incubation (October through December)	7	40	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
6	Rearing and outmigration (April through May)	2	42	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
7	Incubation and rearing (January through March)	5	47	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
8	Rearing and outmigration (April through May)	24	71	Settlement Agreement minimum releases for a median below normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
9	Spawning and incubation (October through December)	26	97	Settlement Agreement minimum releases for median above normal and wetter water years.
10	Rearing and outmigration (April through May)	45	142	Settlement Agreement minimum releases for median above normal and wetter water years.
11	Incubation and rearing (January through March)	22	164	Settlement Agreement minimum releases for median above normal and wetter water years.
12	Over-summering (June through September)	42	206	Settlement Agreement minimum releases for median above normal and wetter water years.
13	Rearing and outmigration (April through May)	29	235	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
14	Spawning and incubation (October through December)	20	255	USFWS (1993) recommended minimum releases a critical water year.
15	Rearing and outmigration (April through May)	18	273	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
16	Incubation and rearing (January through March)	34	307	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
17	Over-summering (June through September)	27	334	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
18	Rearing and outmigration (April through May)	38	372	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
19	Incubation and rearing (January through March)	11	383	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median critical water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	1	1	Settlement Agreement minimum releases for an intermediate critical-dry water year.
2	Rearing and outmigration (April through May)	17	18	Settlement Agreement minimum releases for intermediate critical-dry and median dry water years.
3	Over-summering (June through September)	6	24	Settlement Agreement minimum releases for a median dry water year.
4	Spawning and incubation (October through December)	7	31	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
5	Rearing and outmigration (April through May)	2	33	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
6	Incubation and rearing (January through March)	5	38	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
7	Rearing and outmigration (April through May)	24	62	Settlement Agreement minimum releases for a median below normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
8	Spawning and incubation (October through December)	26	88	Settlement Agreement minimum releases for median above normal and wetter water years.
9	Rearing and outmigration (April through May)	45	133	Settlement Agreement minimum releases for median above normal and wetter water years.
10	Incubation and rearing (January through March)	22	155	Settlement Agreement minimum releases for median above normal and wetter water years.
11	Over-summering (June through September)	42	197	Settlement Agreement minimum releases for median above normal and wetter water years.
12	Rearing and outmigration (April through May)	29	226	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
13	Spawning and incubation (October through December)	20	246	USFWS (1993) recommended minimum releases a critical water year.
14	Rearing and outmigration (April through May)	18	264	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC’s experience with a salmon production model.
15	Incubation and rearing (January through March)	34	298	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC’s experience with a salmon production model.
16	Over-summering (June through September)	27	325	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC’s experience with a salmon production model.
17	Rearing and outmigration (April through May)	38	363	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
18	Incubation and rearing (January through March)	11	374	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.

Table 4. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in intermediate critical-dry water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Rearing and outmigration (April through May)	2	2	Settlement Agreement minimum releases for a median dry water year.
2	Over-summering (June through September)	6	8	Settlement Agreement minimum releases for a median dry water year.
3	Spawning and incubation (October through December)	7	15	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
4	Rearing and outmigration (April through May)	2	17	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
5	Incubation and rearing (January through March)	5	22	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
6	Rearing and outmigration (April through May)	24	46	Settlement Agreement minimum releases for a median below normal water year.
7	Spawning and incubation (October through December)	26	72	Settlement Agreement minimum releases for median above normal and wetter water years.
8	Rearing and outmigration (April through May)	45	117	Settlement Agreement minimum releases for median above normal and wetter water years.
9	Incubation and rearing (January through March)	22	139	Settlement Agreement minimum releases for median above normal and wetter water years.
10	Over-summering (June through September)	42	181	Settlement Agreement minimum releases for median above normal and wetter water years.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
11	Rearing and outmigration (April through May)	29	210	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
12	Spawning and incubation (October through December)	20	230	USFWS (1993) recommended minimum releases a critical water year.
13	Rearing and outmigration (April through May)	18	248	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
14	Incubation and rearing (January through March)	34	282	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
15	Over-summering (June through September)	27	309	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
16	Rearing and outmigration (April through May)	38	347	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.
17	Incubation and rearing (January through March)	11	358	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
18	Rearing and outmigration (April through May)	56	414	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
19	Incubation and rearing (January through March)	26	440	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
20	Over-summering (June through September)	32	472	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.

Table 5. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median dry water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	7	7	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
2	Rearing and outmigration (April through May)	2	9	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
3	Incubation and rearing (January through March)	5	14	Settlement Agreement minimum releases for an intermediate dry-below normal water year.
4	Rearing and outmigration (April through May)	24	38	Settlement Agreement minimum releases for a median below normal water year.
5	Spawning and incubation (October through December)	26	64	Settlement Agreement minimum releases for median above normal and wetter water years.
6	Rearing and outmigration (April through May)	45	109	Settlement Agreement minimum releases for median above normal and wetter water years.
7	Incubation and rearing (January through March)	22	131	Settlement Agreement minimum releases for median above normal and wetter water years.
8	Over-summering (June through September)	42	173	Settlement Agreement minimum releases for median above normal and wetter water years.
9	Rearing and outmigration (April through May)	29	202	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
10	Spawning and incubation (October through December)	20	222	USFWS (1993) recommended minimum releases a critical water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
11	Rearing and outmigration (April through May)	18	240	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
12	Incubation and rearing (January through March)	34	274	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
13	Over-summering (June through September)	27	301	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
14	Rearing and outmigration (April through May)	38	339	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.
15	Incubation and rearing (January through March)	11	350	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
16	Rearing and outmigration (April through May)	56	406	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
17	Incubation and rearing (January through March)	26	432	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
18	Over-summering (June through September)	32	464	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.

Table 6. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in intermediate dry-below normal water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Rearing and outmigration (April through May)	24	24	Settlement Agreement minimum releases for a median below normal water year.
2	Spawning and incubation (October through December)	26	50	Settlement Agreement minimum releases for median above normal and wetter water years.
3	Rearing and outmigration (April through May)	45	95	Settlement Agreement minimum releases for median above normal and wetter water years.
4	Incubation and rearing (January through March)	22	117	Settlement Agreement minimum releases for median above normal and wetter water years.
5	Over-summering (June through September)	42	159	Settlement Agreement minimum releases for median above normal and wetter water years.
6	Rearing and outmigration (April through May)	29	188	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
7	Spawning and incubation (October through December)	20	208	USFWS (1993) recommended minimum releases a critical water year.
8	Rearing and outmigration (April through May)	18	226	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
9	Incubation and rearing (January through March)	34	260	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
10	Over-summering (June through September)	27	287	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
11	Rearing and outmigration (April through May)	38	325	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.
12	Incubation and rearing (January through March)	11	336	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
13	Rearing and outmigration (April through May)	56	392	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
14	Incubation and rearing (January through March)	26	418	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
15	Over-summering (June through September)	32	450	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
16	Rearing and outmigration (April through May)	79	529	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
17	Incubation and rearing (January through March)	39	568	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
18	Over-summering (June through September)	90	658	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.

Table 7. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median below normal water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	26	26	Settlement Agreement minimum releases for median above normal and wetter water years.
2	Rearing and outmigration (April through May)	45	71	Settlement Agreement minimum releases for median above normal and wetter water years.
3	Incubation and rearing (January through March)	22	93	Settlement Agreement minimum releases for median above normal and wetter water years.
4	Over-summering (June through September)	42	135	Settlement Agreement minimum releases for median above normal and wetter water years.
5	Rearing and outmigration (April through May)	29	164	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.
6	Spawning and incubation (October through December)	20	184	USFWS (1993) recommended minimum releases a critical water year.
7	Rearing and outmigration (April through May)	18	202	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
8	Incubation and rearing (January through March)	34	236	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
9	Over-summering (June through September)	27	263	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
10	Rearing and outmigration (April through May)	38	301	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
11	Incubation and rearing (January through March)	11	312	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
12	Rearing and outmigration (April through May)	56	368	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
13	Incubation and rearing (January through March)	26	394	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
14	Over-summering (June through September)	32	426	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
15	Rearing and outmigration (April through May)	79	505	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
16	Incubation and rearing (January through March)	39	544	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
17	Over-summering (June through September)	90	634	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.

Table 8. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in above normal water years (including intermediate below normal-above normal, median above normal, intermediate above normal-wet, and median wet/maximum water years). See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Rearing and outmigration (April through May)	29	29	TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
2	Spawning and incubation (October through December)	20	49	USFWS (1993) recommended minimum releases a critical water year.
3	Rearing and outmigration (April through May)	18	67	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
4	Incubation and rearing (January through March)	34	101	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
5	Over-summering (June through September)	27	128	FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model.
6	Rearing and outmigration (April through May)	38	166	TID and MID (1992) recommended minimum releases for a median wet/maximum water year.
7	Incubation and rearing (January through March)	11	177	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
8	Rearing and outmigration (April through May)	56	233	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
9	Incubation and rearing (January through March)	26	259	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
10	Over-summering (June through September)	32	291	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
11	Rearing and outmigration (April through May)	79	370	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
12	Incubation and rearing (January through March)	39	409	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
13	Over-summering (June through September)	90	499	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
14	Spawning and incubation (October through December)	50	549	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
15	Rearing and outmigration (April through May)	58	607	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
16	Incubation and rearing (January through March)	106	713	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
17	Over-summering (June through September)	60	773	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
18	Spawning and incubation (October through December)	76	849	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
19	Rearing and outmigration (April through May)	88	937	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
20	Incubation and rearing (January through March)	93	1030	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
21	Over-summering (June through September)	209	1239	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.

Stanislaus River

Stanislaus River stream flows are regulated primarily by water released from New Melones Dam, which is operated by the USBR. Flows are also regulated farther downstream by Tulloch and Goodwin dams, but their storage is relatively small compared to storage in New Melones Reservoir. Goodwin Dam forms the upstream limit of anadromous fish in the Stanislaus River. Fall-run chinook salmon and possibly late-fall-run chinook salmon and steelhead are found in the river. Flow standards were established by an agreement between the CDFG and USBR, and also by a SWRCB decision. Flow recommendations were provided by the CDFG and USFWS, both in 1993. The USFWS later identified additional flow needs.

Species and life-history stage priorities

The primary species of concern in the Stanislaus River is fall-run chinook salmon. Late-fall-run chinook salmon and steelhead may also be present. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Stanislaus River.

Table 1. Draft water allocation priorities for water on the Stanislaus River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

Priority	Life-history stage	Objective
1	Spawning and incubation (October through December)	Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Stanislaus River.
3	Incubation and rearing (January through March)	Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows.
2	Rearing and outmigration (April through May)	Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Stanislaus River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows.

Priority	Life-history stage	Objective
4	Over-summering (June through September)	Improve rearing habitat for over-summering juvenile chinook salmon and steelhead.

Existing standards

The existing standards are specified in a 1987 study agreement between the CDFG and USBR (CDFG and USBR 1987). The agreement specifies interim annual water allocations of 98,300-302,000 af depending on New Melones Reservoir carryover storage and inflow. Annual flow schedules are determined by the CDFG.

In addition to flows for fish, a SWRCB decision (SWRCB D-1422, April 1973) estimated that at least 70,000 af of water is available annually for release to meet water quality requirements in the lower Stanislaus River and at Vernalis on the San Joaquin River. The SWRCB decision also stated water quality goals for dissolved oxygen in the Stanislaus River. Because water quality requirements are often not met with 70,000 af of water, the USBR commonly releases additional water in an attempt to meet the SWRCB D-1422 standards on the lower San Joaquin River.

To estimate existing standards, we used USBR estimates that 98,300 af of water would be allocated to fish in critical to above normal water years of the San Joaquin River basin 60-20-20 index and 302,000 af would be allocated during wet water years (Jeff Sandberg, USBR, personal communication, September 1996). Because flows for water quality and dissolved oxygen requirements benefit fish, we assumed that 220-250 cfs would be released from June through September for these requirements in critical to above normal water years. Although lower summer flows can occur when water quality and dissolved oxygen standards are satisfied (Jeff Sandberg, USBR, personal communication, September 1996). Therefore, we have used 157,816 af pattern for the exiting standard in critical to above normal water years and 302,000 in wet water years.

Because monthly flow allocations for the two existing standards vary annually, we used mean monthly flows provided by CDFG to CH2MHill (letter dated 23 August 1996) to allocate 98,300 af for critical to above normal water years, and added the summer flows to meet water quality requirements (Table 1). Monthly allocations for wet water years were based on the flow schedule CDFG submitted to the USBR for allocation of the 302,000 af in 1996-1997 (17 April 1996 letter from CDFG to USBR).

Table 2. Estimated existing standards for the Stanislaus River in critical to above normal and wet water-year types.

Month	Flow in critical to above normal year for fish (cfs)	Minimum estimated flow for water quality (cfs)[a]	Flow in wet year for fish (cfs)
October	111	0	300
November	200	0	300
December	200	0	300
January	125	0	300
February	125	0	300
March	189	0	300
April	500	0	700
May	250	0	800
June	0	220	800
July	0	230	300
August	0	250	300
September	0	220	300

[a]Assumed minimum flow for water quality and dissolved oxygen for modeling purposes.

Recommendations

Flow recommendations have been made by the CDFG and USFWS. The USFWS made flow recommendations based on an instream flow study and subsequently identified additional flow needs in the AFRP Working Paper..

California Department of Fish and Game: The CDFG (1993) provides interim flow recommendations for the Stanislaus River. Recommendations are intended to improve conditions for fall-run chinook salmon. Recommendations are based on results of an instream flow study conducted by the USFWS (Aceituno 1993) for October through March and smolt survival studies conducted by CDFG for April through May. Recommendations are provided for five water-year types in the 60-20-20 index of the San Joaquin

River basin, ranging from 185,280 to 381,498 af. The recommendations also include blocks of water to be used for spawner attraction in October and outmigration in April and May.

USFWS instream flow study: The USFWS has provided recommendations based on an instream flow study using the Instream Flow Incremental Methodology (IFIM; Aceituno 1993). Flows were to provide adequate spawning, incubation, and rearing habitats for fall-run chinook salmon. A total of about 155,000 af is recommended, irrespective of water-year type. The study noted that to protect and preserve chinook salmon in the Stanislaus River, a comprehensive instream flow regime would need to consider factors that were not included in the IFIM study, such as water quality, temperature, attraction flows, and flow for juvenile emigrations.

AFRP Working Paper: The AFRP identified flow needs that, in conjunction with other restoration actions, would result in at least doubling natural production of fall-run chinook salmon relative to the average attained during 1967-1991. The needs were based on an IFIM study (Aceituno 1993), the proportion of unimpaired flow that the Stanislaus River contributes to the San Joaquin River, and the historic hydrological regime. Assumptions were that flows greater than historical flows in the lower reach of the river are needed to compensate for elimination of access to upstream habitat, and flows should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles. Recommendations were made for five water-year types, according to the San Joaquin River 60-20-20 Index. The identified that flows ranged from 290,000 to 943,000 af.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of water managed under sections 3406(b)(1), (b)(2), and (b)(3) of the CVPIA. Allocations were developed relative to two water-year types established by the existing standards. A process to determine sources of water allocated in excess of the existing standards (i.e., from sections 3406(b)(1), (b)(2), and (b)(3) of the CVPIA) is being developed.

Table 2. Draft guidelines for allocation of water for use on Stanislaus River in critical to above normal water years. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Stanislaus River. The block of water will be managed to maximize benefits to anadromous fish, both in the Stanislaus River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	21	21	USFWS (Aceituno 1993) recommended minimum releases for spawning and incubation.
2	Incubation and rearing (January through March)	9	30	USFWS (Aceituno 1993) recommended minimum releases for incubation and rearing.
3	Spawning and incubation (October through December)	7	37	CDFG (1993) recommended minimum releases for a critical water year.
4	Incubation and rearing (January through March)	4	41	CDFG (1993) recommended minimum releases for a critical water year.
5	Spawning and incubation (October through December)	5	46	CDFG (1993) recommended minimum releases for a dry water year.
6	Rearing and outmigration (April through May)	24	70	CDFG (1993) recommended minimum releases for a dry water year.
7	Incubation and rearing (January through March)	5	75	CDFG (1993) recommended minimum releases for a dry water year.
8	Spawning and incubation (October through December)	4	79	CDFG (1993) recommended minimum releases for a below normal water year.
9	Rearing and outmigration (April through May)	27	106	CDFG (1993) recommended minimum releases for a below normal water year.
10	Incubation and rearing (January through March)	4	110	CDFG (1993) recommended minimum releases for a below normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
11	Over-summering (June through September)	5	115	CDFG (1993) recommended minimum releases for a below normal water year.
12	Rearing and outmigration (April through May)	16	131	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
13	Incubation and rearing (January through March)	22	153	AFRP Working Paper (USFWS 1995) minimum releases for a critical water year.
14	Over-summering (June through September)	42	195	Existing standard for a wet water year.
15	Spawning and incubation (October through December)	8	203	CDFG (1993) recommended minimum releases for an above normal water year.
16	Rearing and outmigration (April through May)	48	251	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
17	Incubation and rearing (January through March)	17	268	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
18	Spawning and incubation (October through December)	9	277	CDFG (1993) recommended minimum releases for a wet water year.
19	Rearing and outmigration (April through May)	70	347	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
20	Incubation and rearing (January through March)	26	373	AFRP Working Paper (USFWS 1995) releases for a below normal water year.
21	Over-summering (June through September)	26	399	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
22	Rearing and outmigration (April through May)	46	445	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
23	Incubation and rearing (January through March)	74	519	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
24	Over-summering (June through September)	27	543	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
25	Spawning and incubation (October through December)	13	556	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
26	Rearing and outmigration (April through May)	64	607	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
27	Incubation and rearing (January through March)	62	669	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
28	Over-summering (June through September)	100	769	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.

Table 3. Draft guidelines for allocation of water for use on Stanislaus River in wet water years. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Stanislaus River. The block of water will be managed to maximize benefits to anadromous fish, both in the Stanislaus River and downstream, and in coordination with downstream water managers.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
1	Spawning and incubation (October through December)	21	21	CDFG (1993) recommended minimum releases for an above normal water year.
2	Rearing and outmigration (April through May)	70	91	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.
3	Incubation and rearing (January through March)	30	121	AFRP Working Paper (USFWS 1995) minimum releases for a dry water year.

Priority	Targeted life-history stage	Block of water (taf)	Cumulative total (taf)	Source
4	Spawning and incubation (October through December)	9	130	CDFG (1993) recommended minimum releases for a wet water year.
5	Rearing and outmigration (April through May)	69	199	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
6	Incubation and rearing (January through March)	26	225	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
7	Over-summering (June through September)	27	252	AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year.
8	Rearing and outmigration (April through May)	46	298	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
9	Incubation and rearing (January through March)	74	372	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
10	Over-summering (June through September)	27	399	AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year.
11	Spawning and incubation (October through December)	13	412	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
12	Rearing and outmigration (April through May)	64	476	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
13	Incubation and rearing (January through March)	64	540	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.
14	Over-summering (June through September)	99	639	AFRP Working Paper (USFWS 1995) minimum releases for a wet water year.

Attachment G5

U.S. Fish And Wildlife Service
Draft Justification of 1997 Delta Flow And Habitat Objectives Using CVPIA Tools Pursuant To Section 3406(b)(1), (b)(2), And (b)(3) of The CVPIA
(Memorandum of October 25, 1996)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento-San Joaquin Estuary Fishery Resource Office
4001 North Wilson Way, Stockton, CA 95205-2486
209-946-6400 (Voice) 209-946-6355 (Fax)

October 25, 1996

Dear Interested Party:

In my letter of October 10 and its attached workshop “flyer”, I announced a technical workshop on Wednesday, October 30, 1996 at 3310 El Camino Avenue, Sacramento in the Fish and Wildlife Services’ basement conference rooms A and B.

As noted, the focus of this workshop will be to review the Anadromous Fish Restoration Programs’ proposed fish flow and habitat objectives for those Central Valley rivers and the Delta upon which the Central Valley Project has direct influence due to their operational facilities. Our goal is to develop a final set of flow and habitat objectives that make the most effective use of the water resource “tools” of the CVPIA to benefit anadromous fish.

The attached enclosure describes our proposed (draft) fish flow and habitat objectives for your review prior to the workshop. We also supplement this list of objectives with a brief package of background information describing the objectives in more detail, the fish species and life stages targeted for benefit, a concise summary of the information supporting the objective and a evaluation/monitoring approach. Due to time constraints, background information on some objectives may not be available until the workshop.

We would appreciate your suggestions and recommendations from a biological perspective regarding the objectives themselves (i.e., Are they appropriate?, Need they be modified?) and their priority order (i.e., relative their magnitude of benefit, certainty of result, level of need, etc.).

We hope to have comprehensive input from fishery biologists with expertise on the diversity of anadromous fish and habitats represented in this effort. While our time on October 30th will be limited, we encourage your follow-up input via phone calls, E-mail, letter or, as time and staff resources allow, individual meetings and additional workshops.

Broad, technical input from the interested parties is important in designing the appropriate list of flow and habitat objectives. The final fish flow and habitat objectives will be used by the CVP in coordination with the SWP to develop the operations forecast for the 1997 water year. The final list of objectives will reflect the relative desirability of all biological priorities (both in Delta and upstream actions). As noted in my letter of October 10th, the next CVPIA workshop on November 13th will present the process and initial results of developing the CVP’s 1997 operational forecast. This process includes a variety of modeling efforts that are underway to estimate the water supply costs of implementing these actions.

We look forward to your participation on the 30th and your continued assistance in developing the 1997 operational forecast.

Sincerely,

Martin A. Kjelson, Program Manager
Anadromous Fish Restoration Program

Anadromous Fish Restoration Program
Draft Justification of 1997 Delta Flow and Habitat Objectives
using CVPIA tools [Section 3406(b)(1)(B), (b)(2), (b)(3)]

INTRODUCTION

The goal of the Anadromous Fish Restoration Program (AFRP) is to make all reasonable efforts to at least double natural production of anadromous fish in Central Valley rivers and streams. Presently the Delta is governed by the 1995 Water Quality Control Plan (WQCP; SWRCB, 1995) whose basis was the Delta Accord (1994). A portion of the Central Valley Project Improvement Act (CVPIA) water resources are being used to meet conditions of the Delta Accord and WQCP and the remaining portion is proposed for use to increase production of anadromous fish in the Delta in addition to that provided by the Delta Accord. This document describes proposed flow and habitat objectives for the 1997 water year in addition to those occurring as a result of the Accord, using resources provided by the CVPIA.

Most of the proposed AFRP actions in the Delta would result in extending the time period for protective measures contained within the Delta Accord. These include limiting exports to 35% of inflow, moving the X_2 position downstream, and closing the cross channel gates. The Delta Accord targets protective measures during the late winter and spring period when the majority of anadromous fish are present.

Extending the time period of Delta Accord protective measures would increase the protection of anadromous fish in the fall, winter and summer months. For instance, protecting both the early and late outmigrants of the various salmon races would provide greater life history diversity relative to outmigration timing. Providing life history diversity would decrease the risk of artificially selecting a segment of the population based on outmigration timing, a trait possibly under genetic control. Extending Delta export limitations through the month of July would likewise extend protection to juvenile striped bass and other fish populations, which are vulnerable to entrainment in the summer.

We have selected actions in the Delta to increase the natural production of anadromous fish, but other resident species would likely benefit as well. We believe that the Delta Accord provides some protection to anadromous fish. Given the additional water resources available through the CVPIA, we believe the proposed actions will further improve the natural production of anadromous fish migrating or residing in the Delta, and contribute to the goal of the AFRP to make all reasonable efforts to at least double the natural production of anadromous fish in the Central Valley.

Each action is described in a template that provides a description of the action, including background information, the species and life history stages benefitted, selected key supporting data, monitoring and evaluation needs, and sources of information.

Biological justification for the protective measures contained within the Delta Accord are available in a variety of documents, such as EPA's "Review of State of California Water Quality

Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Under Section 303 of the Federal Clean Water Act" (EPA, 1995), the USFWS's "Measures to Improve the protection of chinook salmon in the Sacramento/San Joaquin River Delta" (USFWS, 1992), California Department of Fish and Game's exhibits to the 1992 SWRCB hearings, and a variety of reports by the Interagency Ecological Program (IEP).

The AFRP is requesting that the interested parties review the actions and relative priorities and make comments to facilitate the most effective use of our water resources in increasing the natural production of anadromous fish in the Delta.

Citations

Delta Accord, 1994. Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government. December 15, 1994.

EPA, 1995. Technical Support Memorandum: Review of State of California Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Under Section 303 of the Federal Clean Water Act.

SWRCB, 1995. Environmental Report. Appendix 1 to Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.

USFWS, 1992 . Measures to Improve the Protection of Chinook Salmon in the Sacramento/San Joaquin River Delta. Expert Testimony of U.S. Fish and Wildlife Service on Chinook Salmon Technical Information for State Water Resources Control Board Water Rights Phase of the Bay/Delta Estuary Proceedings. July 6, 1992 WRINT-USFWS-7.

PROPOSED DELTA ANADROMOUS FISH RESTORATION PROGRAM ACTIONS FOR THE 1997 WATER YEAR REQUIRING WATER ABOVE THE BAY/DELTA ACCORD AND 1995 WQCP.

Priority

1. Limit the combined SWP and CVP exports so as to maintain a San Joaquin River at Vernalis inflow total export ratio during the 30 day, April through May pulse flow period (4/15 to 5/15) by water year type as follows: 5:1 wet, 4:1 above normal, 3:1 below normal, 3:1 dry/critical.

   Note: The Service and Bureau of Reclamation are working in conjunction with the Interagency Ecological Program (IEP) agencies, the San Joaquin Tributary group and the California Urban Water Association (CUWA) to determine how best to evaluate the benefits of the proposal action and if the action should be modified to some degree.

2. Continue to evaluate a temporary rock barrier at the head of Old River to improve conditions for chinook salmon migration and survival during the April 15- May 15, or other 30 day pulse period, consistent with the Corps of Engineers Permit to the Department of Water Resources and Fish and Wildlife Services' Biological Opinion on Delta smelt.

3. Increase the level of protection targeted by the May and June X_2 requirements to a 1962 level of development. This represents an increase in numbers of days when X_2 is required at Chipps Island in Table A of the 1995 WQCP as described below. PMI is previous months index.

	1962 LOD		IN WQCP	
PMI	MAY	JUNE	MAY	JUNE
500	0	0	0	0
750	0	0	0	0
1000	0	0	0	0
1250	0	0	0	0
1500	0	0	0	0
1750	1	0	0	0
2000	4	0	1	0
2250	13	1	3	0
2500	24	3	11	1
2750	29	7	20	2
3000	30	12	27	4
3250	31	18	29	8
3500	31	23	30	13
4000	31	28	31	18
4250	31	29	31	25
4500	31	29	31	27
4750	31	30	31	28

List of Delta actions

4. Maintain at least 13,000 cfs daily flow in the Sacramento River at the I street Bridge during May to improve transport of eggs and larval and striped bass and other young anadromous fish and to reduce egg settling and mortality at low flows. Provide 9000 cfs daily flow minimum at Knights Landing during May.

   Note: The 9,000 cfs is requested at Knights Landing since striped bass spawn above the mouth of the Feather and flow is needed there initially.

5. Ramp (linearly) the total CVP/SWP export level from whatever it is on 5/15 to meet Action 1 to those export levels proposed by projects to meet the 1995 WQCP on June 1, when salmon are present.

   Note: This is a new action and meant to prevent a quick rise in exports after May 15 when salmon and other anadromous fishes could be vulnerable to such an operational change.

6. Close the Delta Cross Channel (DCC) starting on November 1.

   Note: This action is meant to supplement that in the Accord and 1995 WQCP where it asks for a closure of up to 45 days based on the NMFS draft guidelines.

7. Limit the average CVP/SWP exports to no greater than 35% of Delta inflow in July. Sub priorities: 1) July 1- July 15, 2) July 16 - July 31.

8. Establish conditions for a CWT late fall run smolt survival experiment in Dec '97/Jan '98 at exports of 65 and 35% of DOF, respectfully.

9. Limit the average CVP/SWP exports to no greater than 35% of Delta inflow in the November-January period. Sub priorities: 1) January, 2) December, 3) November.

Delta Action 1: Limit the combined SWP and CVP exports so as to maintain a San Joaquin River at Vernalis inflow total export ratio during the 30 day, April through May pulse flow period (4/15 to 5/15) by water year type as follows : 5:1 wet, 4:1 above normal, 3:1 below normal, 3:1 dry/critical.

Description: The proposed action establishes ratios of Vernalis flow to combined SWP and CVP exports (VFER) from mid-April to mid-May. Three values of VFER are proposed and vary with water-year type. Attaining the ratios will depend on coordination among SWP and CVP operators that control exports and the USBR and private reservoir operators that regulate dam releases influencing flow at Vernalis. Three tools provided by Section 3406 of the Central Valley Project Improvement Act (CVPIA), that is reoperation 3406(b)(1)(B), 800,000 af of dedicated water 3406(b)(2), and acquired water 3406(b)(3), will be used to implement the action. We acknowledge there is some uncertainty to using a ratio of variables to describe protective criteria. However, it is our intent to increase flows and decrease exports to levels that will benefit the fish. The ratio is a convenient method of identifying conditions to benefit fish even though evidence suggests that the difference between inflow and exports may be a more useful variable.

Background: Recommendations for VFER were addressed in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP; SWRCB 1995) and a formal consultation, pursuant to section 7(a)(2) of the federal Endangered Species Act, between the USFWS and USBR concerning delta smelt (USFWS 1995a). The 1995 WQCP water quality objectives for fish and wildlife beneficial uses include limiting export rate to 1,500 cfs or 100% of San Joaquin River flow at Vernalis, whichever is greater. The objective applies to the period 15 April to 15 May, but the time period can be varied depending on real-time monitoring and the operations group. A recommendation from the consultation for delta smelt was to institute a 1.5:1 VFER. A higher VFER than in the 1995 WQCP was intended to reduce entrainment of delta smelt into the CVP and SWP facilities pumps.

The San Joaquin River Tributaries Association (SJTA) filed suit challenging the 1995 WQCP, and proposed a settlement together with other water interests (SJTA et al. 1996). The U.S. Environmental Protection Agency (EPA) and others are developing studies to reduce uncertainty noted in the proposed settlement.

The proposed action is intended to provide greater protection to fish than afforded by the regulatory documents noted above.

Fish species and life stages benefited:

- juvenile fall-run chinook salmon
- juvenile steelhead
- juvenile striped bass
- juvenile American shad
- adult white and green sturgeon
- juvenile delta smelt and other resident fishes

Supporting data: We present data to support the proposed action from various sources. Three categories of data are present here: 1) survival indices of juvenile chinook salmon derived from studies using smolts marked with coded-wire-tags (CWT), 2) stock and recruitment relationships relative to environmental conditions, and 3) timing of smolt emigration from the San Joaquin River tributaries and through the Delta.

Survival indices--The USFWS has calculated survival indices of CWT juvenile chinook salmon in the San Joaquin Delta since early in the last decade (Table 1; see USFWS 1987, 1992; and SSJEFRO data files). The studies have investigated survival of fish released from various locations to Chipps Island, effects of a barrier at the head of Old River on fish survival, and differential survival of fish from the Merced Fish Facility and Feather River Hatchery. Data from the studies were also used to develop a San Joaquin salmon smolt survival model (Brandes 1994).

Most data generated by the studies have been highly variable and open to multiple interpretations. We believe some of the data provide sufficient information for biologists to develop management recommendations for improving protection of aquatic resources. All recommendations are considered in the context of adaptive management.

Flow at Stockton has generally been correlated to survival indices of CWT smolts released at Dos Reis between 1982, 1985 to 1991 (USFWS, 1992), although in recent years that relationship has appeared to break-down (Figure 1). We believe the relationship is still present based on other evidence, but is masked by combining smolts of Feather River stock with those from Merced River stock. The groups released since 1990 have been from Feather River stock, whereas those released prior to 1989 were all from Merced River stock.

In 1995, under very high flows (20,000 - 25,000 cfs), the average survival index for smolts released at Dos Reis was 0.23, much less than would have been estimated using our previous relationship between survival and flow. Experiments performed in 1996 indicated that smolts released at Dos Reis from Merced River stock survived 5 times greater (0.10 versus 0.02) than those released at the same time and place using Feather River smolts. If we assume that this is a true difference in survival and had Merced River smolts been released in 1995, their expected survival index would have been over 100 percent. The relation between survival of fish released at Dos Reis and flow at Stockton data differed for fish from the Feather and Merced rivers (Figures 2 and 3). Survival was 9 times greater in 1995 at flows of 20,000 - 25,000 cfs than in 1996 when flows ranged between 6,000 and 12,000 for smolts originating from Feather River (Fall 1996 IEP Newsletter, in press).

Stock and recruitment relationships--Annual escapement estimates for chinook salmon (i.e., the number of 2- and 3-year-old fish that return to spawn) have been made by the CDFG for San Joaquin River tributaries. The CDFG used these data and spring flows of tributaries and the San Joaquin River at Vernalis when three-year-old fish were emigrating as smolts, to perform regression analyses (CDFG 1987, 1992). The analyses indicated significant ($p<0.05$) positive correlations between spring flow in the tributaries and at Vernalis and escapement of fish 2.5 years later (Figures 4, 5, and 6). Moreover, analyses conducted before state and federal water projects began operation resulted in regression equations for the Stanislaus and Tuolumne rivers with greater slopes and intercepts than equations calculated for the periods after operations, indicating negative effects of water export on salmon survival.

The ratio of Vernalis flow to water export has been suggested as a factor influencing salmon escapement in the San Joaquin River basin, primarily by affecting smolt survival during the peak emigration period, e.g., the AFRP Working Paper (USFWS 1995b). The USFWS performed a regression analysis to describe the relation between adult escapement (3-year-old fish) and VFER during 15 April to 15 May the year fish were smolts (Figure 7). The resulting regression equation was significant ($p<0.01$) and VFER accounted for 40% of the variance in escapement.

To better understand factors affecting chinook salmon in the San Joaquin River basin, Carl Mesick Consultants (CMC 1994, 1995, 1996) performed correlation analyses on existing data to investigate relations among streamflow, exports, VFER, water temperature, stock size (escapement of 3-year-old fish), ocean harvest, water quality, ocean conditions, and recruitment of chinook salmon cohorts (combined number of 2- and 3-year-old fish returning in 1.5 and 2.5 years).

Each report offered further refinements to the analyses, especially concerning discrimination between cohorts. All reports analyzed data from the Stanislaus and Tuolumne rivers separately, and differed from earlier analyses conducted by the CDFG (CDFG 1987, 1992) by accounting for differences in age structure of fish in escapement estimates. Data were analyzed for various time periods within the years 1951-1989, depending on data availability, and the latter two reports (CMC 1995, 1996) developed stock and recruitment relationships, and presented time-series population models to predict recruitment relative to potential restoration activities.

Overall, the analyses indicated that three variable accounted for most of the variance in recruitment of chinook salmon in the Stanislaus and Tuolumne rivers. The variables were VFER, extremely low tributary flows during smolt emigration, and stock levels below 1,000 fish. For example, VFER was typically most closely associated with recruitment. for April, May, and June of all years of record (1951-1989; CMC 1994), VFER alone accounted for >70% of the variance in recruitment for the San Joaquin River, and >50% of the variance in the Stanislaus and Tuolumne rivers. The later reports analyzed data sets truncated at 1960 and reaffirmed associations indicated earlier. Over 80% of the variance in recruitment was explained by VFER when stock ranged from 1,000 to 9,000 fish for the Stanislaus River and 1,000 to 7,000 fish for the Tuolumne river. Furthermore, recruitment appeared to be a nonlinear function of spring VFER, and can be illustrated by holding stock constant (Figures 8 and 9).

Because the proposed action applies only to a 30-day period in April and May and the predictive equations developed by CMC (1994, 1995, 1996) were derived for April through June, we expect that, if the equations are correct, implementing the action would result in recruitment lower than predicted. However, because the 30-d period encompasses the period of peak smolt emigration (see below), we believe that the action would improve smolt survival and recruitment. The action would also provide an opportunity to evaluate the response of chinook salmon to habitat conditions and project operations, and can be integrated with proposed investigations.

Migration timing--The 30-day period between 15 April and 15 May was identified in the Framework Agreement as the time period for export curtailments to allow juvenile salmon to benefit from a pulse flow. Since 1988, the CDFG has observed an annual peak migration of smolts into the Delta between 23 April and 7 May, based on sampling with Kodiak trawls during early April to late June (Figure 10; W. Loudermilk, CDFG, personal communication). In most years between 1988 to 1993, 75% of all juvenile salmon were collected by 15 May (for details, see CDFG 1988, 1989, 1990, 1991, 1992).

Monitoring and evaluation needs: The USFWS and U.S. Bureau of Reclamation are working in conjunction with IEP agencies, the San Joaquin Tributary group and the California Urban Water Association to determine whether the proposed action should be modified and how best to evaluate the action. Also, the IEP real-time monitoring program and sampling conducted in the spring at Mossdale will provide information to assist in evaluating the proposed action. Additional data from CWT fish harvested in the ocean will be used.

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Table 1. Chinook Salmon smolt survival indices and associated Delta hydrology features for two different stocks of fish, Feather and Merced rivers, for different years within the time period 1982 through 1996.

Date	Origin	Flow (cfs) at Stockton	Flow (cfs) at Vernalis	Exports (cfs)	Vernalis flow to export ratio	Survival Index
April 2, 1989	Feather	112	2,274	10,297	0.22	0.14
April 16, 1990	Feather	0	1,290	9,549	0.14	0.04
May 2, 1990	Feather	490	1,665	2,461	0.68	0.04
April 5, 1991	Feather	60	676	5,153	0.13	0.16
April 17, 1995	Feather	7,345	18,479	3,743	4.94	0.15
May 5, 1995	Feather	8,940	22,353	3,911	5.72	0.39
May 17, 1995	Feather	9,253	23,262	4,525	5.14	0.16
May 1, 1996	Feather	2,375	6,269	1,500	4.18	0.02
May 9, 1996	Feather	2,715	7,206	2,200	3.28	0
May 16, 1996	Feather	3,702	10,443	7,000	1.49	0
April 23, 1982	Merced	7,861	19,233	5,598	3.44	0.7
April 30, 1985	Merced	513	2,597	6,311	0.41	0.59
May 29, 1986	Merced	2,514	7,215	5,386	1.34	0.34
April 27, 1987	Merced	471	2,386	6,093	0.39	0.38
May 2, 1989	Merced	790	2,289	2,470	0.93	0.14
May 1, 1996	Merced	2,375	6,269	1,500	4.18	0.1

Figure 1 through 10 not available electronically.

Delta Action 2: Continue to evaluate a temporary rock barrier at the head of Old River to improve conditions for chinook salmon migration and survival during the April 15-May 15, or other 30 day pulse period, consistent with the Corps of Engineers Permit to the Department of Water Resources and Fish and Wildlife Service's Biological Opinion on delta smelt.

Description: The proposed action consists of constructing a temporary rock barrier at the head of Old River and operating the barrier during the spring when juvenile chinook salmon are emigrating from the San Joaquin River.

Background: As the San Joaquin River enters the Delta, its flow bifurcates at the head of Old River. When CVP and SWP export facilities, which are located in Old River, are not operating, about 60% of the total San Joaquin River flow at Vernalis enters the Old River channel (Morhardt et al. 1995). However, during export operations, flow in Old River can exceed total flow in the San Joaquin River at Vernalis and cause reverse flows in the San Joaquin River and other channels in the south Delta. Fish entering Old River, which have been assumed to be proportional to flow at the bifurcation, are exposed to possible entrainment at the facilities and incur potentially high mortality due to high water temperature and predators inhabiting the area near the facilities, Clifton Court Forebay, and other south Delta channels. To reduce the number of juvenile chinook salmon that enter Old River during emigration, a barrier at the head of Old River has been proposed. The barrier has been identified as a potential management tool in the SWRCB 1995 Water Quality Control Plan (WQCP; SWRCB 1995), the Environmental Protection Agency's (EPA) review of the 1995 Water Quality Control Plan (WQCP), and the Central Valley Project Improvement Act. The barrier has also been investigated by the California Department of Fish and Game (CDFG) as possible mitigation for the South Delta Temporary Barriers Project's agricultural flow control barriers and is a proposed permanent structure in the Interim South Delta Project.

Fish species and life stages benefited:

- juvenile chinook salmon in the San Joaquin River
- juvenile steelhead in the San Joaquin River

Supporting data: We present data to support the proposed action primarily from studies conducted by the Sacramento-San Joaquin Estuary Fishery Resource Office (SSJEFRO) since 1985 (see USFWS 1987, 1989, 1990, 1991, 1992, 1993, 1994; and SSJEFRO data files). The data are also summarized in draft issue papers by the California Department of Fish and Game (CDFG 1995) and the U.S. Fish and Wildlife Service (USFWS 1995). The categories of data presented are: 1) comparisons of survival indices between juvenile chinook salmon released in Old River and the San Joaquin River at Dos Reis, just downstream from the Old River bifurcation; 2) comparisons of survival indices between juvenile chinook salmon released when the barrier was and was not in operation; and 3) number of marked juvenile chinook salmon recovered at CVP and SWP fish salvage facilities when the barrier was and was not in operation.
Comparisons of survival indices between Old River and San Joaquin River--From 1985 to 1990, the U.S. Fish and Wildlife Service (USFWS) calculated survival indices for juvenile chinook salmon released in Old River and in the San Joaquin River at Dos Reis, downstream of the Old

River bifurcation. All fish were marked with coded-wire-tags (CWT) and released at each location, generally both groups within a two day period. The number of CWT fish collected at Chipps Island was used to calculate survival indices from the release location to Chipps Island.

The survival index for fish released at Dos Reis was greater than the index of fish released in Old River for six of the seven studies (Table 1). For the seven studies, the mean survival index for fish released at Dos Reis was 0.24 (range 0.04-0.59) and the mean survival index for fish released in Old River was 0.16 (range 0.01-0.62). Thus, the mean survival index from Dos Reis to Chipps Island was almost 50% greater than the mean survival index from Old River to Chipps Island.

The difference in the mean survival indices of fish released at both locations may actually be greater because indices for fish released at Dos Reis may be underestimated. Some fish released at Dos Reis apparently moved upstream of the Old River split, and were collected at Mossdale (W. Loudermilk, CDFG, personal communication). Fish moving upstream may have then entered Old River as they moved downstream.

It should also be noted that the survival indices likely overestimate the benefits of a barrier at any one export rate. This is due to increased movement of water toward the CVP and SWP facilities from the lower Old and Middle rivers and other south Delta channels that occurs when a barrier is operated. When the barrier is not operated, fish released at Dos Reis are exposed to differ flow dynamics. Thus, we assume that improvements in fish survival due to a barrier at Old River will be dependent on export levels and flow in the San Joaquin River. See discussion of data for action 1 concerning the relation between chinook salmon survival and escapement relative to flow and exports.

Comparisons of survival indices between juvenile chinook salmon released when the barrier was and was not in operation--Studies to compare survival indices between juvenile chinook salmon released when the a barrier at Old River was and was not in operation were made in 1992 and 1994. In both years, CWT fish were released at Mossdale, upstream of the Old River bifurcation, and collected at Chipps Island. Fish were released before and after a barrier at Old River was constructed.

Five groups of fish were released in 1993, two before the barrier was constructed and three after the barrier was operational. The mean survival index was 0.15 for the period before the barrier was constructed and 0.04 after the barrier was constructed (Table 2). These values were contrary to the expected relation between fish survival and barrier operation. We believe that fish survival may have been influenced by water temperature. Water temperature was 63 and 64°F during the first two studies before the barrier was constructed and increased to 69-72°F during the studies after the barrier was constructed.

To adjust for the effects of water temperature, a correction factor developed for fish released in the Sacramento River (Kjelson and Brandes 1989, USFWS 1991) was applied to the data. The mean survival indices of the adjusted data were 0.10 for fish released before the barrier was constructed and 0.28 for fish released after the barrier was constructed. Conclusions based on these results should be considered tentative because we are uncertain whether the adjustment is appropriate.

In 1994, CWT fish were released at Mossdale on four dates, one before the barrier was constructed and three after the barrier was operational. Survival indices were low for all fish, 0 for those released before the barrier was constructed and 0-0.04 for those released after the barrier was constructed (Table 3). Although survival indices were generally greater for fish released after the barrier was operational than the single value for fish released before the barrier was constructed, we believe these data are inconclusive concerning the effect of the barrier on survival indices. It should be noted that survival indices calculated for fish released at other locations in the San Joaquin River basin and the Sacramento River were relatively low in 1994 (Table 4) and that survival indices of fish released in the San Joaquin River basin have been relatively low in recent years (see tables 1 through 4, Table 5).

Number of marked juvenile chinook salmon recovered at CVP and SWP fish salvage facilities--Numbers of CWT juvenile chinook salmon that were released at Mossdale and recovered at the CVP and SWP fish salvage facilities in 1992 and 1994 were greater for studies conducted before the barrier was constructed than those conducted after the barrier was operational (Table 5). Recoveries before and after the barrier was constructed differed by at least two orders of magnitude in 1992 and at least one order of magnitude in 1994.

Relative to the low survival indices observed for CWT juvenile salmon released in recent years (1992-1996), the number of marked fish recovered at the salvage facilities have similarly declined (Table 5). The decline does not appear to be related to whether the barrier was or was not constructed. The recent low survival indices and recovery of fish at salvage facilities suggest that environmental quality in the lower San Joaquin River and southern Delta has declined relative to conditions in the earlier years of this decade.

Monitoring and evaluation needs: The variable results obtained from studies investigating the relation between survival indices of juvenile chinook salmon and the barrier at the head of Old River indicate that the barrier may improve salmon survival. However, the high variability implies that other factors may be important, or that problems in controlling experimental conditions limit our ability to understand the effects of the barrier on smolt survival.

The variable results may be influenced by differential mortality of study fish from the Merced River Fish Facility and Feather River Hatchery. Studies in 1995 and 1996 indicated that survival indices for Feather River fish were consistently lower than indices for Merced River fish. Existing data are being used to investigate the influence study fish source on survival indices. See Action 1 for details.

Because survival indices can be relatively high when a barrier in not constructed and extremely low when the barrier is operational, we assume that factors such as river flow, exports, and water temperature, potentially influence the efficacy of the barrier. The proposed action will evaluate the relation among these factors and the efficacy of the barrier in improving survival indices.

Delta Action 2

With a barrier at the head of Old River, flow toward the CVP and SWP export facilities may increase in south Delta channels, depending on export levels. The change in flow dynamics in these channels is likely to affect other species, such as delta smelt, winter-run chinook salmon, and striped bass. Improvements afforded by the barrier to survival of chinook salmon emigrating from the San Joaquin River needs to be evaluated relative to the effects on other species and races, and relative to expected export levels.

Some biologists believe that increase in net upstream flows in the central and south Delta can result in fish being drawn toward the export facilities, thus making the fish susceptible to indirect losses such as high temperatures, agricultural diversions, and predation. Losses due to these factors can be exacerbated by an increase in export levels. This may explain the results of our studies in which few CWT fish were captured at Chipps Island or salvage facilities when the barrier was operational. Other biologist believe that a benefit of the barrier is that it reduces direct entrainment of juvenile chinook salmon emigrating from San Joaquin River by preventing fish from entering Old River. The proposed action will assist in reconciling these views.

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Delta Action 2

Table 1. Results of studies comparing survival indices of CWT juvenile chinook salmon from Dos Reis and Old River to Chipps Island.

Release at Dos Reis		Release at Old River	
Date	survival index	date	survival index
30 April 1985	0.59	29 April 1985	0.62
29 May 1986	0.34	30 May 1986	0.20
27 April 1987	0.38[a]	27 April 1987	0.16
20 April 1989	0.14	21 April 1989	0.09
2 May 1989	0.14	3 May 1989	0.05
16 April 1990	0.04	17 April 1990	0.02
2 May 1990	0.04	13 May 1990	0.01
Mean	0.24		0.16

[a]Original survival estimate (0.82) was modified based on the ratio of ocean recovery rates between the Dos Reis and Old River releases.

Table 2. Results of studies comparing survival indices of CWT juvenile chinook salmon from Mossdale to Chipps Island before and after the barrier at Old River was constructed in 1992.

Date	water temperature (°F)	survival	adjusted survival[a]
	before barrier was constructed		
7 April 1992	64	0.17	0.13
13 April 1992	63	0.12	0.07
Mean	--	0.15	0.10
	after barrier was constructed		
24 April 1992	69	0.08	0.25
4 May 1992	71	0.01	0.28
12 May 1992	72	0.02	0.32
Mean	--	0.04	0.28

[a]Values were adjusted by a correction factor developed for fish released in the Sacramento River.

Delta Action 2

Table 3. Results of studies comparing survival indices of CWT juvenile chinook salmon from Mossdale to Chipps Island before and after the barrier at Old River was constructed in 1994.

Date	water temperature (°F)	survival
	before barrier was constructed	
11 April 1994	63	0
	after barrier was constructed	
26 April 1994	60	0.04
2 May 1994	66	0
9 May 1994	68	0.02
Mean	--	0.02

Table 4. 1994 chinook salmon smolt survival indices for fish released at sited other than Mossdale. No values for survival indices indicates that no fish were recovered.

Release Location	Release Date	Water Temperature (°F)	Survival Index	Combined Fish Recoveries at the CVP and SWP
Ryde	April 12	62.5	0.20	0
Georgian Slough	April 12	62	0.06	0
Jersy Point	April 13	64	0.19	16
Ryde	April 25	62	0.18	0
Georgian Slough	April 25	62	0.11	0
Jersy Point	April 27	63	0.28	0
Miller Park	May 3	67	0.07	0
Miller Park	May 24	67		
Lower Old River	April 11	62		94
Lower Old River	April 26	62		84
Mossdale	April 11	63		752
Mossdale	April 26	60	0.04	0
Mossdale	May 2	66		36
Mossdale	May 9	68	0.02	13
New Hope Landing	May 23	67	0.16	0
New Hope Landing	May 23	67	0.18	0
combined group survival			0.17	
New Hope Landing	May 10	68	0.09	12
New Hope Landing	May 10	68	0.12	31
combined group survival			0.11	
Merced Hatchery	April 22	not available	0.04	27
Merced Hatchery	April 22	not available	0.04	49
Merced Hatchery	April 22	not available	0.08	28
Merced Hatchery	April 22	not available	0.04	24
combined group survival			0.05	
Lower Merced	April 22	not available		26
Lower Merced	April 22	not available	0.07	54
Lower Merced	April 22	not available		80
combined group survival			0.07	
Upper Tuolumne	April 23	not available	0.07	19
Upper Tuolumne	April 23	not available	0.03	24
Upper Tuolumne	April 23	not available		4
combined group survival			0.03	
Lower Tuolumne	April 24	not available	0.37	48
Lower Tuolomne	April 24	not available	0.37	38
combined group survival			0.37	

Table 5. Water temperature, survival index from Mossdale to Chipps Island, and recovery of CWT fish at CVP and SWP facilities during 1992-1996. Survival indices adjusted for

temperature are given in parentheses (see text for explanation). Each release group consisted of about 50,000 fish.

Date	Water Temperature (°F)	Survival	Recovery at CVP and SWP Facilities[a]
7 April 1992[b]	64	0.17 (0.13)	5,451
13 April 1992[b]	63	0.12(0.07)	3,491
24 April 1992	69	0.08(0.25)	56
4 May 1992	71	0.01(0.28)	36
12 May 1992	72	0.02(0.32)	6
6 April 1993	63	0.04	1,332
28 April 1993	64	0.07	1,106
4 May 1993	61	0.07	1,033
12 May 1993	65	0.07	1,445
11 April 1994[b]	63	0	752
26 April 1994	60	0.04	0
2 May 1994	66	0	36
9 May 1994	68	0.02	0
17 April 1995[c]	57	0.22	2,768
5 May 1995[c]	62	0.12	1,933
17 May 1995[c]	63	0.07	1,580
15 April 1996[c]	60	0.02	99
30 April 1996[c]	64	0.01	134

[a] All recoveries are expanded values except those for 1996.
[b] Barrier operational.
[c] Data are from two release groups, survival index is a mean and salvage recovery is a total of the two groups.

Delta Action 3: This action was not ready for inclusion here at the time of printing, but will be provided separately when available.

Delta Action 4: Maintain at least 13,000 cubic feet per second (cfs) in the Sacramento River at the I Street Bridge during May to improve transport of eggs and larval striped bass and other anadromous fish, and to reduce egg settling and mortality at low flows. Provide 9,000 cfs at Knights Landing during May.

Description: This action calls for daily minimum flows in the Sacramento River of 13,000 cfs and 9,000 cfs at the I Street Bridge and Knights Landing, respectively, to improve survival of striped bass eggs and larvae and to improve downstream transport of all anadromous fish.

Background: Key involved parties include state and federal resource regulatory agencies, affected water interests, and environmental interests. This proposed action has its foundation in results from long-term monitoring of young striped bass in the Sacramento River. The relationship between an index of survival of Sacramento River spawning cohorts and Sacramento River flow at Sacramento indicates that survival between the egg and 6mm larvae stage is low in the Sacramento River when Sacramento River flows are low, whereas at higher flows (>13,000 cfs) the survival index has been demonstrated to increase in some years. Greater transport flow associated with this standard will also benefit other downstream migrating anadromous fishes. The following is a summary of some of the pertinent biological information to support the daily minimum flow criteria for the Sacramento River of 13,000 cfs at Sacramento, and 9,000 cfs at Knights Landing above the Feather River confluence.

Fish species and life stages benefited: Striped bass, American shad, white and green sturgeon egg and larval life stages, and spring and fall chinook salmon, and steelhead juveniles are the primary beneficiaries of these minimum flow requirements in the Sacramento River during May.

Supporting data:

Historical striped bass population trend--A persistent decline in the juvenile striped bass abundance since the mid to late 1960's and adult striped bass abundance since the early 1970's has been documented by the Department of Fish and Game (CDFG 1987; Exhibit 25). The adult striped bass population has declined from about 1.8 million to about 600,000. The juvenile striped bass index decreased even more, from indices in excess of 100 in the mid-late 1960's to indices averaging less than 20 since the late 1970's (Figure 1). Much of the supporting information for the proposed action that follows is derived from the ongoing annual striped bass monitoring program and subsequent analyses and modeling efforts that have been reported. For more information the reader should refer to the following summary documents: CDFG 1987; Exhibit 2, A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin Estuary, and IEP Technical Report 20 1987, CDFG Exhibit 25, Factors affecting striped bass abundance in the Sacramento-San Joaquin River system, and the USFWS Working Paper, 1995 (also see reference section).

Striped bass spawning--Striped bass primarily spawn in two areas: in the Sacramento River mainly from the city of Sacramento to Colusa, and in the western Delta between Antioch and Venice Island (CDFG 1987, Exhibit 25). About one-half to two-thirds of the bass spawn in the Sacramento River from late April into June (CDFG 1992, Exhibit 2). Survival of eggs and larvae spawned in the Sacramento River is partially influenced by flows in the river (CDFG 1987, Exhibit 25).

Delta Action 4

Limitations to juvenile striped bass production and its relation to the proposed action--It has been demonstrated that when abundance of early larval life-history stages is low, abundance of the 38mm life stage is also low (Figure 2, and CDFG 1987, Exhibit 25). Thus survival of early larvae partially establishes year class strength in mid-summer, which in turn affects adult recruitment (CDFG 1992, Exhibits 2 and 3). Setting a minimum daily flow requirement in the Sacramento River will benefit egg and larvae survival. Other factors affecting system productivity, such as toxicity and factors affecting increased adult striped bass mortality also may warrant investigation and remediation. However, this proposal specifically focuses on improving river habitat conditions to increase juvenile striped bass survival with the May minimum flow criterium and is consistent with the tools of the CVPIA and its goals for natural fish production.

Relationship between the proposed action and survival of larval striped bass--Information from the early 1970's to the early 1990's documenting the relationship between an index of survival of eggs and larvae in the Sacramento River and flow at Sacramento indicates that survival between the egg and 6mm larva stage is low in the Sacramento River when Sacramento River flows are low (Figure 3). Thus given a minimum daily flow requirement of 13,000 cfs at Sacramento, and a concurrent minimum of 9,000 cfs at Knights Landing, a potential for greater egg and larva survival exists for fish in the Sacramento system during some years. There are four possible mechanisms that may contribute to this relationship.

- At lower flows, eggs and larvae may settle to the river bottom and die when they encounter near zero velocity during periods of flood tides in tidally influenced reaches (CDFG 1992, Exhibit 2).
- Slower transport at low flows may result in lower survival because larvae are delayed in reaching downstream nursery areas where feeding conditions are generally considered to be more favorable (CDFG 1992, Exhibit 2; Figure 4).
- When flows are low, more larvae may die due to longer exposures to higher concentrations of toxic substances that may enter the river (CDFG 1992, Exhibit 2).
- More eggs and larvae would be diverted from the Sacramento River through the Delta Cross Channel and Georgiana Slough (Figure 5 and CDFG 1992, Exhibit 2). While this may not cause immediate mortality, fish will be transported more rapidly to the south Delta where there is a greater risk of entrainment via export operations at the CVP and the SWP pumps (CDFG 992, Exhibit 2).

The relative contribution of these potential mechanisms cannot be sorted out with the existing data, but all are likely to be detrimental (CDFG 1992, Exhibit 2). Thus based on these data, and data summarized for Action 7 relative to juvenile entrainment losses, a reasonable and prudent biological approach would be to establish the 13,000 cfs Sacramento flow standard for the month of May.

American shad, sturgeon and chinook salmon production considerations--Juvenile American shad abundance is positively correlated with flow during the primary spawning months, April through June (USFWS, Working Paper, Volume 2, 1995; Figure 6). While this documented relationship is based on Delta outflows, outflow is influenced by, and will sometimes positively co-vary with, Sacramento River inflow; so to some extent outflow is likely a surrogate for inflow. Flow associated factors that may influence juvenile shad survival are likely similar to those influencing juvenile striped bass eggs and larvae. Thus the potential negative effects of lower flows include: reduced survival due to egg and larva settling, greater exposure times to toxins, poor feeding conditions, and greater numbers of juveniles moving to the central and south Delta (USFWS, Working Paper, Volume 2).

Kohlhorst et al. (1991 as cited in the USFWS, Working Paper, Volume 2) found a significant positive correlation between year-class strength of white sturgeon and Sacramento River outflow from April to July. During years with high April to July flow (1982 and 1983), white sturgeon year-class strength was greater than in years between 1975 and 1985 with lower outflows (Figure 7). Mechanisms responsible for increased recruitment are not well defined but are possibly similar to those mentioned above for striped bass and shad.

For chinook salmon, correlation between Sacramento River flows during the smolt emigration period and the number of adults returning to Sacramento River tributaries indicate that flow, or factors related to flow, affect chinook salmon survival and abundance (Dettman et al. 1987). Likewise, mark-recapture studies of fall-run chinook salmon smolts demonstrated that smolt survival through the Delta is positively correlated with Sacramento River temperatures and negatively correlated with the fraction of Sacramento River flow diverted in to the Delta Cross Channel and Georgiana Slough during the April through June emigration period (USFWS 1987). Though no significant relationship between chinook salmon smolt survival and Sacramento River flow has been documented, increases in river flows should contribute to beneficial water temperatures for migrating salmon and possibly reduce the magnitude of negative effects associated with fish migration through the central and south Delta (USFWS 1992). Thus the potential greater flows in May associated with the proposed May daily minimum flows should be beneficial to chinook salmon smolts emigrating through the Sacramento River system during this time. Accrued benefits should also be similar for migrating juvenile steelhead based on life-history similarities between the two species.

Predicted fish benefits: This flow related habitat improvement measure, combined with reductions in juvenile striped bass entrainment, and improvements in water quality will enhance the ability of the striped bass population to recover in future years. The magnitude of striped bass production increase relative to the proposed action is currently unknown and will vary depending on the magnitude of flows that would otherwise be in the river. The information reviewed also suggests that this proposed minimum May flow target should afford survival benefits to sturgeon, American shad, and salmon.

Monitoring and evaluation needs: The current striped bass monitoring program implemented through the Interagency Ecological Program (IEP) will yield information that will allow analysis of the effects of the proposed action, but absolute verification may require more future egg larva monitoring than currently planned by the IEP. IEP monitoring also addresses benefits to the other anadromous species.

Citations

California Department of Fish and Game. 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Exhibit 25, entered by the California Department of

Fish and Game for the State Water Resources Control Board 1987 water rights proceeding on the San Francisco and Sacramento-San Joaquin Delta.

California Department of Fish and Game. 1992. A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin Estuary. WRINT-DFG-Exhibit 2, entered by the California Department of Fish and Game for the State Water Resources Control Board, 1992, water rights phase of the Bay-Delta estuary proceedings.

California Department of Fish and Game. 1992. A model for evaluating the impacts of freshwater outflow and export on striped bass in the Sacramento-San Joaquin estuary. WRINT-DFG-Exhibit 3, entered by the California Department of Fish and Game for the State Water Resources Control Board, 1992, water rights phase of the Bay-Delta estuary proceedings.

Dettman, D.H., D.W. Kelly, and W.T. Mitchell. 1987. The influence of flow on Central Valley salmon. D.W. Kelly and Associates. Newcastle, CA. Prepared for California Department of Water Resources, Sacramento, CA.

Kohlhorst D.W., L.W. Botsford, J.S. Brennan, and G.M. Cailliet. 1991. Aspects of the structure and dynamics of an exploited central California population of white sturgeon (*Acipenser transmontanus*) 1991. Pages 277-293 *in:* Proceedings of the First International Symposium on the Sturgeon, P. Williot, editor. CEMAGREF. Bordeaux, France.

USFWS. 1987. The needs of chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin estuary. (USFWS Exhibit No. 31, State Water Resources Control Board 1987 water quality/water rights proceeding for the San Francisco Bay/Sacramento-San Joaquin Delta, Sacramento, CA.) U.S. Fish and Wildlife Service, Sacramento, CA.

USFWS. 1992. Measures to improve the protection of chinook salmon in the Sacramento/San Joaquin River Delta. WRINT-USFWS-7, Testimony to the State Water Resources Control Board, Water Rights phase of the Bay/Delta Estuary Proceedings, July 6, 1992.

USFWS. 1995. Anadromous Fish Restoration Program, working paper on restoration needs, habitat restoration actions to double natural production of anadromous fish in the Central Valley of California, Volume 2.

Figure 1 through 7 not available electronically.

Delta Action 5: Ramp (linearly) the total CVP/SWP export level from whatever it is on 5/15 to meet Action 1 to those export levels proposed by projects to meet the 1995 WQCP on June 1, when juvenile salmon are present.

Description: This action is meant to overcome a quick rise in exports in late May when juvenile salmon and other anadromous fish would continue to be vulnerable to a low inflow/export ratio. If temperatures are high and juvenile salmon do not appear to be migrating into the Delta from the San Joaquin basin the action would be suspended. If flow levels and permits allow a barrier at the head of Old River to be used (Action 2), it would continue to be in place with its respective benefits during the proposed ramping.

Background: Between April 15 and May 15, the San Joaquin inflow to CVP/SWP export ratio per the AFRP proposed Delta action 1 can range from 5:1 to 3:1, depending on the water year type. Between May 15 and May 31, exports can increase to levels greater than during the first half of May but still meet the monthly average of 35% of Delta inflow. For example in 1996, the 1995 WQCP allowed export rates to increase from approximately 1500 cfs on May 15 to over 10,000 cfs in less than two weeks time. The extreme change and high absolute level of exports would be detrimental to a variety of anadromous fish that are present in the central and southern delta. Reducing export levels and increasing gradually would provide additional protection for these by allowing a greater fraction of the fall run smolt outmigrants and possible other species to move downstream out of the influence of the pumps.

Fish species and life stages benefited: Juvenile San Joaquin salmon are expected to benefit from the reduction in exports between 5/15 and 5/31. Juveniles of other species such as Striped Bass, steelhead, White and Green Sturgeon and American Shad and other resident species may also benefit.

Supporting data: It is believed that decreasing exports for the later half of May by ramping will benefit the San Joaquin chinook population. The exact benefit for San Joaquin smolts will be contingent on the number of smolts migrating through the Delta and the flow and export levels during the latter half of May.

In some years, at least part of the juvenile salmon population from the San Joaquin basin migrate through the Delta between May 16 and May 31 (figure 1 and 2). Reductions in exports at any one flow level are expected to increase survival of smolts migrating through the Delta (see action 1). This added protection would provide better outmigration conditions for that portion of the population migrating through the Delta during that time. Protecting a greater proportion of the total population would help meet the goals of the AFRP and assure greater genetic diversity within the stock.

Monitoring and evaluation needs: Interagency Ecological Program (IEP) real time monitoring (kodiak trawling) will occur at Mossdale between March 15 and June 30, seven days/week. Daily rotary screw trapping also is proposed for the at the mouth of the Stanislaus. Both sites will provide data to determine if Action 5 is necessary and for how long. See discussions of actions 1 and 2 for additional evaluations.

Citations

California Department of Fish and Game (DFG), 1995. Annual Performance Report, Federal Aid in Sport Fish Restoration Act. Grant Agreement No: F-51-R-6, Project No. 38, Job No. 4: Index and Estimate San Joaquin Drainage Salmon Smolt Production.

Figure 1 through 2 not available electronically.

Delta Action 6: Close the Delta Cross Channel (DCC) starting on November 1.

Description: The AFRP action is intended to augment the Accord by providing gate closures for an additional three month period (November 1- January 31).

Background: The cross channel gates have been closed between February 1 and April 30 as a winter run protection measure since 1993. The Delta accord further extended closure of the Delta cross channel until May 20, with provisions for potential closures between November and January and after May 20 until June 14. The Delta Accord and 1995 WQCP call for the closure of the Delta cross channel gates for up to a maximum of 45 days between November 1 and January 31, to be decided by the CALFED operations group. NMFS has provided draft guidelines on triggers for gate closures during this period. Closures are needed for flood control when flows at Freeport are above 25,000 cfs and also have been made in the fall when water quality impacts were negligible (fall of 1995). This action has a potential impact of lessening water quality in the Delta below that required under the 1995 WQCP unless increases in Delta outflow are provided.

Fish species and life stages benefited: Fall, late fall and tributary spring yearling and winter run fry chinook salmon may all benefit from closing the cross channel starting on November 1. Figure 1 and 2 document the abundance of juvenile salmon between November and January entering the Delta and within the Delta.

Supporting data: Several pieces of data based on results of mark and recapture work using juvenile chinook salmon indicate a benefit associated with closing the cross channel gates at a variety of lifestages. Specific data for the various lifestages follows:

Fry: Coded wire half tagged (CW1/2T) fall run salmon fry released between 1981 and 1986, indicate that smolts released into the Central Delta in low flow years survive at a lower rate than those released on the mainstem Sacramento River (table 1).

Smolts: Through mark and recapture experiments, it has been found that fall run chinook salmon smolts released above the cross channel gates on average survive to the western Delta at a greater rate than those released below the cross channel gates. Survival is increased by about 50% by closing the cross channel gates using two independent estimates of survival (table 2). Although critics of this result believe the data is biased from results of one group released above the opened cross channel gates (Courtland) at high temperatures, similar high temperatures were present for the paired, below cross channel gate, release making relative comparisons generally valid. Furthermore a release into Steamboat Slough on the same day at the same high temperature survived at a much greater rate than those released at Courtland (USFWS, 1996).

Poor relative survival in the Central Delta versus that in the mainstem river is further confirmed from marked smolt releases made at Courtland, Ryde and in the North and South Forks of the Mokelumne river in 1983-1986 (USFWS, 1992) and paired releases made at Ryde and into Georgiana Slough between 1992-1994 (table 3 and table 4).

Yearlings: Additional experiments using marked late fall yearlings in December and January, indicate that survival also is less for late fall juveniles released into Georgiana Slough versus those released at Ryde. There is no indication that the larger late fall released at low temperatures survive at a better rate in the central delta than fall run (table 3). Experiments conducted in December of 1996, also showed high survival for yearlings released at Courtland and Ryde with the gates closed compared to those released into Georgiana Slough (table 5).

Monitoring and evaluation needs: Kodiak or midwater trawl sampling will be conducted on the Sacramento River near Sacramento between October and June to index juvenile salmon immigration into the Delta. Additional monitoring using a rotary screw trap may be done on the Sacramento River near Knights Landing. This combined monitoring can be used to determine if the timing of such action regarding the cross channel gate closure is warranted. Additional mark and recapture work would be necessary to further document the benefits. It has been suggested that the benefit of the closing the cross channel be further tested using CWT late fall or fall run hatchery smolts released at Coleman National Fish Hatchery. Two groups would be released, one with the gate open and one with the gate closed and the survival index to the western Delta (Chipps Island) compared. Both marked late fall and fall run juveniles will be released at Sacramento to index survival through the Delta under conditions of the Delta accord, including closure of the cross channel gates.

Citations

USFWS, 1992 . Measures to Improve the Protection of Chinook Salmon in the Sacramento/San Joaquin River Delta. Expert Testimony of U.S. Fish and Wildlife Service on Chinook Salmon Technical Information for State Water Resources Control Board Water Rights Phase of the Bay/Delta Estuary Proceedings. July 6, 1992 WRINT-USFWS-7.

USFWS, 1996. U.S. Government Memorandum to Lisa Holsinger (NMFS) from Pat Brandes (USFWS) regarding Benefit of closing the cross channel gates dated July 8, 1996.

Table 1: Ocean recovery rates of coded wire half tag (CW1/2T) fry released in the Delta at Ryde or Isleton on the Sacramento River and in the Central Delta (Lower, North Fork or South Fork Mokelumne River). The ratio (Ryde/Mokelumne) reflects the relative difference in survival between the two areas of the Delta.

Year	Release Site	Recovery Rate	North and South Fork Mean	Ratio
1981	Isleton	0.001013		2.0
	Lower Mokelumne River	0.000506		
1982	Isleton	0.000657		1.2
	Lower Mokelumne River	0.000539		
1983	Isleton	0.000482		0.9
	Lower Mokelumne River	0.000557		
1984	Ryde	0.002440		2.1
	North Fork Mokelumne River	0.001447	.001156	
	South Fork Mokelumne River	0.000866		
1985	Ryde	0.001815		1.2
	North Fork Mokelumne River	0.001506	.001503	
	South Fork Mokelumne River	0.001500		
				$\bar{x}$ ratio 1.5

Table 2: Indices of survival to Chipps Island and ocean recovery rates for CWT fall run smolts released above and below the Cross Channel gates with the gates open and closed between 1984 and 1989. When the below to above ratios (B/A) are compared with the gates open versus closed, an estimate of the benefit associated with closing the Cross Channel gates is obtained.

Smolt Survival Estimates

	Year	**Above**	**Below**	**B/A**
Cross Channel Open	1984	0.70	0.73	1.0
	1985	0.34	0.77	2.3
	1986	0.37	0.68	1.8
	1987	0.41	0.88	2.1
	1988	0.73	1.27	1.7
	1988	0.02	0.34	17.0
	1989	0.84	1.20	1.4
	1989	0.35	0.48	1.4
	1989	0.22	0.16	0.7
				Average = 3.3
Cross Channel Closed	1983	1.22	1.39	1.1
	1987	0.66	0.84	1.3
	1988	0.68	0.93	1.4
	1988	0.17	0.40	2.4
				Average = 1.6

Ocean Recovery Rates

	Year	**Above**	**Below**	**B/A**
Cross Channel Open	1984	.0064	.0045	0.7
	1985	.0038	.0086	2.3
	1986	.0171	.0195	1.1
	1987	.0142	.0203	1.4
	1988	.0091	.0248	2.7
	1988	.0007	.0053	7.6
	1989	.0048	.0082	1.7
	1989	.0008	.0016	2.0
	1989	.0009	.0002	0.2
				Average = 2.2
Cross Channel Closed	1983	.0044	.0040	0.9
	1987	.0198	.0315	1.6
	1988	.0111	.0204	1.8
	1988	.0097	.0046	0.5
				Average = 1.2

Table 3: Survival indices for smolts released at Ryde and Georgiana Slough in 1994, 1993, and 1992 and the ratio of survival between the two paired groups. Numbers in parentheses are raw recovery numbers at Chipps Island.

Date	Ryde	Georgiana Slough	Ryde/Georgiana Slough Ratio
FALL RUN			
4/12/94	0.198 (11)	0.054 (3)	3.7
4/25/94	0.183 (11)	0.117 (6)	1.5
4/14/93	0.41 (23)	0.13 (7)	3.2
5/10/93	0.86 (43)	0.29 (15)	3.0
4/06/92	1.36 (78)	0.41 (23)	3.3
4/14/92	2.15 (97)	0.71 (41)	3.0
4/27/92	1.67 (93)	0.20 (11)	8.4
LATE FALL RUN			
12/2/93	1.91 (37)*	0.28 (5)	6.8
12/5/94	0.57 (15)*	0.16 (4)	3.6
1/4/95	0.33 (11)	0.12 (4)	2.8
1/10/96	0.66 (21)	0.17 (5)	3.9

*Actual release made at Isleton, about 5 miles downstream of Ryde.

Table 4: Ocean recovery rates of the Ryde and Georgiana Slough release groups of 1992 and 1993 and the ratios (Ryde: Georgiana Slough) of these ocean recovery rates.

Release Date	Ryde	Georgiana Slough	Ryde/Georgiana Slough Ratio
4/6/92	0.0066	0.0028	2.38
4/14/92	0.0116*	0.0045	2.26
4/27/92	0.0040	0.0006	6.67*
4/14/93	0.0092	0.0033	2.78
5/10/93	0.0204	0.0056	3.64

*The Ocean recovery rate for the 1992 release made at Ryde is underestimated due to the fact that some (10,500) of the fish were inadvertently released at Georgiana Slough by mistake. The resulting ratio, therefore, is also biased low.

Table 5: Survival indices to Chipps Island for late fall run CWT yearlings released in January 1996.

Release Site	Survival Index
Courtland	.78
Ryde	.66
Georgiana Slough	.17

Delta Action 7: CVP/SWP export limitation of 35% or less of Delta inflow during July Action sub-priority: a) July 1 to July 15 and b) July 15 to July 31

Description: This action calls for State and Federal water contractors to limit Delta exports to not more than 35% of total Delta inflow during July, extending juvenile anadromous fish protection from potential entrainment losses at the pumps. This is a continuation of the protective Delta export:inflow ratio of 35% already in place for February through June according to State Water Resources Control Board (SWRCB) water quality standards and operational constraints.

Background: Key involved parties include state and federal resource regulatory agencies, agriculture and urban water interests, and environmental interests. The Delta habitat objective of a 35% limitation on export:inflow ratio in July was preceded by a similar February through June limitation that was established by the 1994 Bay-Delta Accord, and incorporated in the May, 1995 SWRCB Water Quality Control Plan. A goal of these water quality standards is to provide interim comprehensive ecosystem protection for the Bay/Delta system. The export:inflow limitation proposed for the month of July is in addition to the conditions established by the Bay-Delta Accord, with its main objective the maintenance of more favorable Delta hydrology in an effort to reduce juvenile anadromous fish mortality associated with water exports. This habitat objective will further contribute to the goals of the Accord, as well as contribute to the goals of the Anadromous Fish Restoration Program (AFRP).

The following is a summary of some of the pertinent biological information and justification that has led to the development of the July export:inflow ratio limitation to support increased survival of juvenile striped bass and other anadromous fish.

Fish species and life stages benefited: Striped bass, American shad, and white and green sturgeon juveniles are the primary beneficiaries of maintaining the Delta export:inflow ratio at 35% through July.

Supporting data:

Historical striped bass population trend--Persistent declines in the juvenile striped bass index (38 mm index) since the late 1960's and in adult abundance since the early 1970's have been documented by the Department of Fish and Game (CDFG 1987; Exhibit 25). The adult striped bass population declined by two thirds in that time, to a present population of about 600,000. The juvenile striped bass index decreased even more, from indices in excess of 100 in the mid to late 1960's to indices averaging less than 20 since the late 1970's. (Figure 1). During this period, combined Delta exports at State Water Project (SWP) and Federal Water Project (CVP) pumps have continually increased (Figure 2). Much of the supporting information for the proposed action that follows is derived from the ongoing annual striped bass monitoring program and subsequent analyses and modeling efforts that have been reported. For more information, see the following summary documents: CDFG 1992; Exhibit 2, A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin Estuary, and IEP Technical Report 20 1987, CDFG Exhibit 25, Factors affecting striped bass abundance in the Sacramento-San Joaquin River system.

Delta Action 7

Striped bass spawning--Striped bass spawn in two areas: in the Sacramento River spawning occurs mainly from the city of Sacramento to Colusa; the San Joaquin population generally spawns in the western Delta between Antioch and Venice Island (CDFG 1987, Exhibit 25). Most spawning in the Delta occurs from April through May, with ambient salinity conditions playing an important role in specific location (CDFG 1992, Exhibit 2). After spawning, young striped bass rear in the Delta and Suisun Bay. The distribution of young striped bass in their first few months of life is largely influenced by the magnitude of outflow and Delta water exports. Young striped bass residing in the central and south Delta are vulnerable to being entrained by SWP and CVP pumping operations (CDFG 1987, Exhibit 2).

Production limitations--For fish abundance to decline, productivity must decrease or mortality must increase. The thesis that we predicate our July export:inflow ratio on is that recruitment of 3-year-old striped bass has continued to decline based on an increase in mortality, predominately during the first year of life, and caused largely by increased losses of juvenile fish entrained in water exports by the State and Federal Water Projects (CDFG 1992, Exhibit 2). Other factors affecting system productivity, such as toxicity and increased adult striped bass mortality also may warrant investigation and remediation. However, we propose to create improved Delta habitat conditions in July using the tools of the CVPIA in an attempt to reduce juvenile striped bass entrainment at the SWP and CVP pumps.

Limitations to juvenile striped bass production and its relation to the proposed action--To support the hypothesis that entrainment losses of larval and juvenile striped bass can partially be mitigated by the July export:inflow limitation, we primarily rely on information summarized and presented by the CDFG in their exhibits presented to the State Water Resources Control Board, 1992.

- Losses of young bass entrained in the water project diversions constitute a significant portion of the population. Since 1970 annual total estimated losses of juvenile striped bass (21mm to 150mm) have been conservatively estimated to constitute 14% to 58% of the estimated abundance of young bass in the Estuary depending on assumptions related to sampling efficiencies (CDFG 1992, Exhibit 2, Page 35). The magnitude and annual trend in estimates of juvenile striped bass losses at SWP and CVP Delta pumping facilities from 1957 to 1989 is presented in Figure 3. In terms of yearling equivalents, peak losses occur in July. Large losses also occur in May, June and August, and a secondary peak occurs later in the year from November through January (Brown 1992; Figure 4).

- Prior to 1970, juvenile striped abundance was closely related to the percentage inflow diverted (Figure 5). As percent of effective inflow diverted increased striped bass abundance decreased. This relationship explained nearly 80% of the dependent variable (juvenile striped bass index) response. As export:inflow ratios increased above 35% the YOY index declined. While these percentages include internal Delta use, this relationship indicates that juvenile striped bass entrainment losses would be reduced if water exports were reduced.

- After the SWP began pumping large amounts of water in about 1970, the abundance of striped bass began to decline (Figure 1). This decline has persisted through the early 1990's and has been most distinct in the Delta, the area most affected by diversions, compared to downstream habitats such as Suisun Bay (CDFG 1992, Exhibit 2, page 19 and Figure 6).

- Regression analysis suggests that during the period of 1959-1990, April through July and May through July, outflow and water exports account for 65% and 73%, respectively, of the variability in the fraction of the young striped bass population residing in the Delta (CDFG 1992, Exhibit 2, Table 4). Delta outflow and water export rates interact to affect the distribution of juvenile striped bass residing in the Estuary and entrainment losses. Over a range of flows, similar export reductions will have a greater relative benefit in drier years, when greater proportions of juvenile striped bass reside in the Delta (Figure 7).

- The magnitude of estimated percentage reductions in abundance due to losses of striped bass eggs and larvae entrained in water projects is substantial. Such losses have been estimated (CDFG 1987, Exhibit 25, pages 70 to 78) to cause from 31% to 99% reductions in the population before young bass reach the 20 mm stage (also see CDFG 1992, Exhibit 2, page 34). This is significant as it has been demonstrated that mid-summer juvenile striped bass abundance, as described by the 38mm index, is at least partially determined by the abundance of larvae. This juvenile index, and subsequent entrainment losses, in turn largely determines subsequent recruitment of adults (CDFG 1992, Exhibits 2 and 3).

Based on these data, water exports reduce abundance of young striped bass, and if a year class gets off to a poor start it reduces adult recruitment. These results are consistent with a conclusion that more restricted July exports will provide additional protection to juvenile striped bass which in turn will benefit adult recruitment.

American shad and sturgeon production considerations--Juvenile American shad are the third most common fish species salvaged at the CVP and SWP pumping facilities with thousands of fish salvaged annually and thousands more lost to other diversions (USFWS, Working Paper, Volume 2, 1995). The bulk of the juvenile American shad entrainment at these facilities occurs from July through December. However, Evaluations of screening efficiencies comparable to studies for striped bass have not been conducted, consequently the proportion of entrained juveniles has not been quantified. It has been estimated that salvaged American shad suffer mortality rates in excess of 50% in the summer months and the proposed July export limitation would help reduce this value (USFWS, Working Paper, Volume 2, 1995).

Larval and juvenile sturgeon are transported downstream primarily by river currents and are susceptible to entrainment associated with water export pumping. Magnitude of these entrainment losses and effects on population abundance are currently unknown (USFWS, Working Paper, Volume 2, 1995).

Benefits: The magnitude of striped bass production increase relative to the proposed action is currently unknown but could be addressed through modeling simulations using estimates of juvenile entrainment for various water year scenarios. Sturgeon and American shad will also likely benefit from reduced export pumping in July. Changes in flow patterns associated with reduced export pumping also may result in fewer young fish being transported to the south Delta where entrainment and associated losses are great.

Delta Action 7

Monitoring and evaluation needs: Current fisheries monitoring implemented through the Interagency Ecological Program (IEP) will document effects of the proposed action. Currently, the striped bass monitoring efforts assess both juvenile and adult population attributes and provide valuable long-term population trend information relative to Delta and estuarine conditions.

Summary: The loss of juvenile striped bass to July export pumping in the Delta is well documented. This information suggests that providing additional protection to juvenile striped bass from entrainment losses in July by limiting the export:inflow ratio at 35% will provide increased survival during their first year of life. This is turn will contribute to increased adult abundance which along with other coordinated improvements to Delta operations for the benefit of anadromous fish, will likely allow fishery production benefits to accrue more rapidly.

Citations

Brown, R.L. 1992. Bay/Delta fish resources. WRINT DWR-30, State Water Resources Control Board, 1992 Proceedings, Sacramento, CA.

California Department of Fish and Game. 1987. Factors affecting striped bass abundance in the Sacramento-San Joaquin River system. Exhibit 25, entered by the California Department of Fish and Game for the State Water Resources Control Board 1987 water rights proceeding on the San Francisco and Sacramento-San Joaquin Delta.

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Kohlhorst, D.W., D.E. Stevens, and L.W. Miller. 1992. A model for evaluating the impacts of freshwater outflow and export on striped bass in the Sacramento-San Joaquin estuary. WRINT-DFG-Exhibit 3, entered by the California Department of Fish and Game for the State Water Resources Control Board, 1992, water rights phase of the Bay-Delta estuary proceedings.

USFWS. 1995. Anadromous Fish Restoration Program, working paper on restoration needs, habitat restoration actions to double natural production of anadromous fish in the Central Valley of California, Volume 2.

Figure 1 through 7 not available electronically.

Delta Action 8: Establish conditions for a CWT late fall run juvenile survival experiment in Dec'97/Jan '98 at cxports of 65 and 35% of Delta inflow, respectively.

Description: This action would entail manipulating CVP and SWP exports and potentially flow at Sacramento to meet the desired export/inflow ratios for testing. This action was proposed to estimate the value of the lower export/inflow (E/I) ratio (35%) to survival of juvenile salmon migrating through the Delta between November and January.

Background: The experiment planned for the winter of 97-98 would be the second of three annual experiments designed to determine if survival to Chipps Island is greater for CWT late fall yearlings released at Sacramento during the low export/inflow ratio period than for those released during the higher export/inflow ratio period. To broaden the objectives of the study, releases made as part of this experiment will be timed, if possible to coincide with late fall production releases made at Coleman National Fish Hatchery. The production also is tagged so estimates of survival between Battle Creek and Sacramento can also be made. Estimates of survival are generated from recoveries of marked fish recaptured at Chipps Island. An additional release will be made at Port Chicago/Benecia to allow survival to be estimated from differential recoveries of adults in the ocean fishery from the two groups released at Sacramento. Unfortunately, release group sizes are relatively small and sample variation could influence our ability to detect small differences in survival should they exist. Replication of the experiment in 1998/1999 will provide additional results to test the hypothesis.

Since flows may be variable between the December and January releases, exports will be modified to meet the proposed ratios. The higher ratio was selected for the December period, since inflows will likely be less in December than January, thereby making the ratio more attainable using export modification. The fish may be slightly larger for the later release increasing their survival irrespective of the export/inflow ratio. This is somewhat problematic. The cross channel gates would be closed during both test periods, to minimize the effect of other factors between groups.

The specific proposal has been out for review since June 11, 1996. Specific comments on the proposal included the suggestion of redefining the hypothesis and using a particle tracking model to determine test conditions that are a better reflection of flow movement to the south delta project export facilities than that of the E/I ratio (USFWS, 1996b and 1996c).

Fish species and life stages benefited: If the lower export/inflow ratio increases survival through the Delta for yearling chinook salmon it would suggest that a lower E/I ratio of 35% would benefit outmigrant juvenile salmon during the November - January period and add justification for implementation of Action 9.

Supporting data: There is some evidence that indicates that marked late-fall chinook salmon released at Ryde (or Isleton) and into Georgiana Slough survive more similarly when the export/inflow ratio is lower, both when the cross channel gates are open and when they are closed (table 1). This analyses assumes the Ryde groups are a good index of survival through the Delta without impacts associated with the pumps. Although some recoveries are made at the fish facilities from fish released at Ryde, indicating they are still influenced to some degree by project pumping they are much less influenced than the releases made into Georgiana Slough.

Delta Action 8

The experiment proposed is designed to index survival through the Delta with late fall yearlings released at Sacramento with the gates closed at the two ratios. It is uncertain how much decreasing the export/inflow ratio from 65% to 35% would increase survival for juvenile salmon migrating through the Delta.

Monitoring and evaluation needs: Evaluation of the effectiveness of this action will be determined from the results of the experiment. Confirmation of the Chipps Island survival indices will be provided by recovering marked fish in the ocean fishery as adults.

Citations

USFWS, 1996a. Proposal to compare survival indices of coded-wire tagged (CWT) late-fall released in the Delta in December, 1996 and January, 1997 under two levels of Delta export/inflow ratio. Draft 11 June 1996.

USFWS, 1996b. Letter from William J. (BJ) Miller, Consulting Engineer to Marty Kjelson (USFWS), regarding comments on June 11 draft proposal to index juvenile late fall survival at two different export/inflow ratios. Dated July 2, 1996.

USFWS, 1996c. Response from USFWS (Marty Kjelson) to BJ Miller regarding comments on the June 11 late fall proposal. Dated July 23, 1996.

Table I: Survival indices for late fall yearlings released at Ryde and into Georgiana Slough in 1993-1996 and mean Qwest, CVP, and SWP exports and flow at Vernalis for 17 days after release. The cross channel gate status, export/inflow ratio and the Ryde/Georgiana Slough survival index ratio are also included.

Date	Ryde Survival Index	Georgiana Slough Survival Index	Ryde/ Georgiana Slough	Qwest	Exports	Vernalis Flow	Cross Channel Gate Status	Export/ Inflow Ratio	Sacramento Flow at Freeport
12/2/93	1.91	0.28	6.8	1054	10,660	1,618	Open	50%	21,440
12/5/94	0.57	0.16	3.6	-165	7,075	1,297	Open	37%	19,133
1/4/95	0.33	0.12	2.8	10024	11,763	3,444	Closed	18%	62,900
1/10/96	0.66	0.17	3.9	37	11,370	2,665	Closed	32%	33,881

*Actual release made at Isleton, about 5 miles downstream of Ryde.

Delta Action 9: Limit the average CVP/SWP exports to no greater than 35% of Delta inflow in the November- January period. Sub priorities: 1) January, 2)December, 3)November.

Description: This action is designed to protect a variety of anadromous fish that migrate through the Delta between November and January by reducing the export/inflow ratio from 65% per the Delta accord to 35%. The action would require reduction in exports by the CVP and SWP or an increase in delta inflow or both.

Background: Reducing the export levels to no greater than 35% is designed to reduce the direct and indirect entrainment affects of export pumping. January is given the highest sub-priority because more juvenile salmon are in the system during that month (figure 1) with December of next priority and November being of lowest priority. Fewer fish were observed in November than in December or January.

There is considerable uncertainty as to the quantitative benefits of this action. Based on the late fall experiment conducted in December 1996 and January 1997 and experience with make up pumping, the justification for this action should be better understood. A problem occurs in implementing sub priorities because if one does not take action in November the chance is lost. However, water conditions in early fall may enable operators to determine if November or December reductions are a possibility.

Fish species and life stages benefited: Fall, late fall and spring run yearling chinook migrate through the Delta during these months. Winter and fall run fry may also enter the Delta during this time and rear in the Delta for up to several months. Actions to protect late fall, tributary spring and winter run are of high priority since these races are at extremely low population levels. Other species that could benefit would include juvenile striped bass, steelhead, American shad, white and green sturgeon and adult San Joaquin basin fall-run chinook salmon.

Supporting data: Annual expanded recoveries at the CVP and SWP fish facilities of late fall run yearlings released at Coleman National Fish Hatchery have ranged between 0.09 and 0.26 percent between 1994 and 1996 (table 1). Although, these numbers are relatively low, the fact that they reach the fish facilities is of concern. Assuming that the indirect losses in the Delta associated with being diverted off their main migration path towards the pumps are much greater than the direct losses (estimates have ranged between 4 and 7 times greater) the total impact associated with exports could range as high as 1 to 2 percent of the release.

Modeling based on fall run smolts indicate that after the variability due to temperature is removed, 17% of the variability in central delta survival was due to combined CVP/SWP exports (Kjelson, et al., 1989).

Depending on the length of curtailment benefits would vary. It is expected that indirect and direct losses (salvage) of all anadromous fish would decrease during the months of reduction in the export/inflow ratio. Decreases in exports relative to Delta inflow, with the cross channel gates closed would increase QWEST. Increases in QWEST during the November - January period could help juvenile anadromous fish diverted into the Central Delta via Georgiana Slough find their way to the ocean. Limited data has affected our ability to understand the importance of reverse flows in the western San Joaquin River on smolt survival in the central Delta

Monitoring and evaluation needs: Sampling for late fall CWT tags will occur at the fish facilities and at Chipps Island to assess entrainment and survival under the various export/flow conditions between November and January. Salvage also occurs for the other species and races of anadromous fish. Additional work using juvenile salmon with radio tags may assist in understanding the influence of QWEST flow levels on smolt migration in the Delta.

Citations

Kjelson, M.A., Greene, S. and P. Brandes, 1989. A Model for Estimating Mortality and Survival of Fall-Run Salmon Smolts in the Sacramento River Delta Between Sacramento and Chipps Island.

Table 1: Expanded recoveries at the CVP and SWP fish facilities, total number released and the total percent recovered of late - fall run juveniles released in the upper Sacramento River in 1994-1996.

Year	Total Number Released	Expanded SWP	Expanded CVP	Total Number Salvaged Expanded	Percent Recovered at SWP & CVP
1995	497,129	868	246	1,114	0.224
1994	613,565	99	433	532	0.087
1996	797,243	1,602	468	2,070	0.259

Stanislaus River Action 1: Implement an interim river regulation plan that meets the following flow schedule (Table 1) by supplementing the 1987 agreement between USBR and CDFG, through reoperation of New Melones Dam, use of (b)(2) water, and acquisition of water from willing sellers as needed.

Description: The implementation of AFRP flow objectives on the Stanislaus River continues to require balancing among improving river flows for the aquatic ecosystem in the basin, meeting temperature criteria, and providing adequate carryover storage in New Melones Reservoir. We recommend that releases from Goodwin Dam be maintained at not less than the flows identified by the AFRP (Table 1) to help the declining salmon and steelhead populations in the Stanislaus River continue to recover from the adverse effects of the recent drought. We are participating in the ongoing process to evaluate the "sustainable" CVP yield in the Stanislaus River basin available for helping to meet the AFRP flow objectives, as well as the potential of acquiring water from willing sellers.

Our flow objectives include the release of increased springtime flows (April to June 1997) to the Stanislaus River below Goodwin Dam. The springtime releases from Goodwin Dam should result in an increase in Stanislaus River flows, lower San Joaquin River flows, and Delta outflow. Combined with the Merced River and Tuolumne River flows; our intention is that these springtime flows will contribute to meeting the Vernalis flow standard for April and May consistent with the Bay-Delta Agreement and the Fish and Wildlife Service's March 6, 1995 biological opinion for delta smelt (USFWS 1995a).

In addition to the springtime flows, the objectives for the Stanislaus River include: 1) flows below Goodwin Dam during October through March to provide spawning and rearing habitat for salmon and steelhead; and 2) minimum base flow in the summer. A fall attraction pulse flow using approximately 15,000 to 30,000 af is being considered for release during October 1997 to facilitate upstream migration of adult fall-run chinook salmon. If we wish to pursue this measure or use the water in another fashion, as indicated by the results of real-time monitoring, we will advise the agencies, stakeholders, and the public at a later date.

Background: Although New Melones Reservoir is the largest impoundment (2.4 maf) in the Stanislaus River basin, Goodwin Dam is located downstream of New Melones Dam and is the upstream barrier for salmon migration (Reynolds et al. 1993, USFWS 1995b). Existing releases to meet needs of chinook salmon in the lower Stanislaus River are specified in a 1987 study agreement between CDFG and USBR (CDFG and USBR 1987, USFWS 1995b). This agreement specifies interim annual flow allocations of 98,300 af to 302,100 af, depending on New Melones Reservoir carryover storage and inflow. Since the agreement was signed, water shortages have limited the quantity of water allocated to meeting fish needs to 98,300 af in all years except 1996. This quantity has proven to be inadequate for survival of all life stages of chinook salmon (Loudermilk 1994, USFWS 1995b).

The 1987 agreement provides for a 7-year study with seven study elements that are in various stages of completion. To date, results of smolt survival studies by CDFG and a 1992 instream flow study by USFWS (Aceituno 1993) has yielded sufficient data to allow formulation of minimum stream flow schedules with increased allotments for fish. In August 1992, CDFG submitted revised flow schedules to USBR and CDWR. The revised flows range from 185,280 af to 381,498 af (Reynolds et al. 1993). CDFG has indicated that these are minimum flows that are subject to revision upon completion of the remaining studies (Reynolds et al. 1993). The purpose of establishing minimum flows is to maintain the current population or prevent further decline as water demands increase (Reynolds et al. 1993). Therefore, a key assumption of the AFRP was that increasing natural production of chinook salmon in the Stanislaus River would require flows higher than the specified minimum flows.

Fish species and life stages benefited:

- spawning adult chinook salmon
- rearing and outmigrating juvenile chinook salmon
- spawning adult steelhead
- juvenile striped bass
- juvenile American shad
- juvenile delta smelt and other estuarine species

Supporting data: Escapement of adult chinook salmon into the Stanislaus River is associated with spring outflow in both the San Joaquin River at Vernalis and the Stanislaus River at Ripon (CDFG 1987, USFWS 1995b). Annual escapement estimates for chinook salmon (i.e., the number of 2 and 3-year old fish that return to spawn) have been made by the CDFG for San Joaquin River tributaries. The CDFG used these data and spring flows of tributaries and the San Joaquin River at Vernalis when three year old fish were emigrating as smolts, to perform regression analyses (CDFG 1987, 1992). The analyses indicated significant ($p<0.05$) positive correlations between spring flow in the tributaries and at Vernalis and escapement of fish 2.5 years later (Figures 1 and 2). An additional concern is that low flows in the fall may delay adult migration and spawning (CDFG 1992, USFWS 1995b).

The ratio of Vernalis flow to water export has been suggested as a factor influencing salmon escapement in the San Joaquin River basin, primarily by affecting smolt survival during the peak emigration period, e.g., the AFRP Working Paper (USFWS 1995). The USFWS performed a regression analysis to describe the relation between adult escapement (3 year old fish) and the Vernalis flow to combined SWP and CVP exports (VFER) during 15 April 15 May the year ,fish were smolts (Figure 3). The resulting regression equation was significant (p▸0.01) and VFER accounted for 40% of the variance in escapement.

To better understand factors affecting chinook salmon in the San Joaquin River basin, Carl Mesick Consultants (CMC 1994, 1995, 1996) performed correlation analyses on existing data to investigate relations among streamflow, exports, VFER, water temperature, stock size (escapement of 3 year old fish), ocean harvest, water quality, ocean conditions, and recruitment of chinook salmon cohorts (combined number of 2 and 3 year old fish returning in 1.5 and 2.5 years).

Each report offered further refinements to the analyses, especially concerning discrimination between cohorts. All reports analyzed data from the Stanislaus and Tuolumne rivers separately, and differed from earlier analyses conducted by the CDFG (CDFG 1987, 1992) by accounting for differences in age structure of fish in escapement estimates. Data were analyzed for various time periods within the years (1951-1989, depending on data availability, and the latter two reports (CMC 1995, 1996) developed stock and recruitment relationships, and presented time-series population models to predict recruitment relative to potential restoration activities. Overall, the analyses indicated that three variables accounted for most of the variance in recruitment of chinook salmon in the Stanislaus and Tuolumne rivers. The variables were VFER, low tributary flows during smolt emigration, and stock levels below 1,000 fish.

The CDFG (Reynolds et al. 1993) provided interim flow recommendations for the Stanislaus River (Table 2). Recommendations were intended to improve conditions for fall-run chinook salmon, and were based on results of an instream flow study conducted by the USFWS (Aceituno 1993) for October through March and smolt survival studies conducted by CDFG for April through May (CDFG 1992). Recommendations are provided for five water-year types in the San Joaquin 60-20-20 index, ranging from 185,280 to 381,498 af. The recommendations also include blocks of water to be used for spawner attraction in October and outmigration in April and May.

Recommendations from the instream flow study were thought to provide adequate spawning, incubation, and rearing habitats for fall-run chinook salmon. A total of about 155,000 af was recommended, irrespective of water-year type. However, the study noted that to protect and preserve chinook salmon in the Stanislaus River, a comprehensive instream flow regime would need to consider factors that were not included in the study, such as water quality, temperature, attraction flows, and flow for juvenile emigration.

The AFRP identified flow needs that, in conjunction with other restoration actions, would result in at least doubling natural production of fall-run chinook salmon relative to the average attained during 1967-1991 (USFWS 1995b). The needs were based on Aceituno (1993), the proportion of unimpaired flow that the Stanislaus River contributes to the San Joaquin River, and the historic hydrological regime. Assumptions were that flows greater than historical flows in the lower reach of the river are needed to compensate for elimination of access to upstream habitat, and flows should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles. Needs were then identified for five water-year types, according to the San Joaquin 60-20-20 index. The identified flows ranged from 290,000 to 943,000 af per year.

The AFRP flow objectives were derived from comments and additional information received on the flow needs identified in the Working Paper (USFWS 1995b). The resulting flow objectives are consistently higher than the CDFG recommendations, especially in the spring, but overall, they are similar at other times.

Monitoring and evaluation needs: The monitoring and assessment of these proposed AFRP flow objectives for the Stanislaus River is essential to obtain data on anadromous fish production and to facilitate an evaluation of the effects of this restoration action. The AFRP recommends that CDFG continue its existing monitoring programs, such as escapement surveys. The AFRP also encourages the water districts to continue monitoring juvenile salmon emigration using the rotary screw traps in partnership with the AFRP. Finally, the AFRP recommends the completion of the study elements identified in the 1987 agreement between CDFG and USBR, including CWT smolt survival studies and linking the existing USBR temperature model (Rowell 1993) with the USFWS instream flow model (Aceituno 1993). These proposed monitoring and study efforts can be coordinated with other monitoring and assessment programs in the San Joaquin basin and integrated through the Comprehensive Assessment and Monitoring Program (Section 3406(b)(16) of the CVPIA) with all CVPIA restoration actions and evaluations.

Citations

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Stanislaus River

Table 1. Flow objectives for the Stanislaus River downstream of Goodwin Dam during 1 April 1997 through 31 March 1998. Water year type is based on the San Joaquin 60-20-20 index.

Month	Stanislaus River flow objectives (cfs) by water year type				
	Wet	Above normal	Below normal	Dry	Critical
October	350[a]	350[a]	250[a]	250[a]	200[a]
November-December	400[a]	350[a]	300[a]	275[a]	250[a]
January-March	400[b]	350[b]	300[b]	275[b]	250[b]
April 1-15	1500[c]	1500[c]	1500[c]	300	300
April 16-30	1500[c]	1500[c]	1500[c]	1500[c]	1500[c]
May 1-15	1500[c]	1500[c]	1500[c]	1500[c]	1500[c]
May 16-31	1500[c]	1500[c]	300	300	300
June	1500[d]	800[d]	250	200	200
July-September	300	300	250	200	200
Total (taf)	467	410	313	257	247

[a]Flow based on IFIM recommendations and the assumption that greater than historic flows are needed to compensate for elimination of access to upstream habitat. A pulse flow using approximately 15,000 to 30,000 af is being considered during October to attract adult chinook salmon.

[b]Flow based on the recommendation that flow should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles.

[c]Recommended springtime flows to improve survival of emigrating chinook salmon smolts in the Stanislaus River and San Joaquin River basin, benefit delta smelt and other estuarine species, and aid in the downstream transport of striped bass eggs and larvae. The timing, magnitude, and duration of the April-May and October flows must be flexible and responsive to changing hydrologic conditions and coordinated with flows on the Toulumne and Merced rivers.

[d]The June releases may be adjusted in cooperation with CDFG and USBR, depending on “real-time” chinook salmon monitoring, water temperatures in the Stanislaus and San Joaquin rivers, and concurrent flow releases in the Merced and Tuolumne rivers.

Table 2. Flow recommendations for the Stanislaus River downstream of Goodwin Dam (after Reynolds et al. 1993). Water year type is based on the San Joaquin 60-20-20 index.

	Stanislaus River flow objectives (cfs) by water year type				
Month	Wet	Above normal	Below normal	Dry	Critical
October 1-14	300	300	250	250	200
October 15-December 31	400	350	300	275	250
January-March	350	300	250	225	200
April-May	500	450	400	350	300
June-September	350	300	250	200	200
April-May pulse[a] (af)	89,100	68,310	47,520	26,730	5,940
October pulse (af)	15,000	15,000	15,000	15,000	15,000
Total (af)	381,498	325,959	269,034	221,811	185,280

[a]Based on 30 day flow of 400 cfs (100 cfs for 30 days in addition to spring base flow f 300 cfs) for critical year. Stanislaus River flow contribution at Vernalis = 20 percent.
Based on 30 day flow of 800 cfs (450 cfs additional flow for 30 days from base spring flow of 350 cfs) for dry year.
Based on 30 day flow of 1,200 cfs (800 cfs for 30 days in addition to spring base flow of 400 cfs) for below normal year.
Based on 30 day flow of 1,600 cfs (1,150 cfs for 30 days in addition to spring base flow of 450 cfs) for above normal year.
Based on 30 day flow of 2,000 cfs (1,500 cfs for 30 days in addition to spring base flow of 500 cfs) for wet year.

Figure 1 through 3 not available electronically.

American River Action 1: Develop and implement a river regulation plan that meets the flow objectives in Table 1 by modifying CVP operations, using (b)(2) water, and acquiring water from willing sellers as needed.

Description: To improve immigration, spawning, incubation, rearing, and emigration conditions for chinook salmon and steelhead in the lower American River, develop and implement a river regulation plan that meets the following flow objectives below Nimbus Dam.

Table 1. Flow Objectives (cfs)[1] for the American River for April 1, 1997 through March 31, 1998.

	Year type				
Month	Wet	Above normal	Below normal	Dry	Critical dry
April-June	4500[a]	3000	3000	2000	2000
July	2500[b]	2500	2500	1500	1500
August	2500[b]	2000	2000	1000	1000
September	2500[b]	1500	1500	500	500
October-December[2]	2500[c]	2000	2000	1750	1750
January-February	2500[c]	2000	2000	1750	1750
March	4500[a]	3000	3000	2000	2000

[1]A multi-agency and interested party management team should be formed to review and develop flow objectives in consideration of reservoir carryover storage and hydrologic conditions as needed to provide for the long-term needs of anadromous fish.

[a]Recommended flows to provide appropriate juvenile rearing habitat availability and out migration flows, and temperature control during May and June (i.e., maintain mean monthly river water temperatures below 65ºF at H-Street).

[b]Recommended flows to provide some thermal protection (i.e., maintain mean monthly river temperatures at or below 70ºF) for steelhead juveniles.

[2]Minimum flows for October 1 through December 31, 1997 will be based on the water year type for 1997 and reservoir storage conditions as of September 30, 1997. To be responsive to changing hydrologic conditions, flows may be ramped up or down in cooperation with CDFG and USBR in January 1997 and 1998.

[c]Flows needed for chinook salmon spawning. The 2500 cfs flow recommendation approaches the maximum release rate that can be sustained throughout this and subsequent months without exceeding water availability.

We understand that operating primarily to meet new water quality standards pursuant to the Bay-Delta Agreement and water supply demands south of the Delta will determine flows in the American River from April through September 1997. This will depend on reservoir inflow, storage, flow in the Sacramento River and other hydrologic conditions. In any event, American River flows (i.e., Nimbus releases) should be maintained at no less than the schedule in Table 1.

American River

Depending on hydrologic conditions, a carryover storage of not less than 600,000 AF at the end of September 1997 should be retained in Folsom Reservoir. This would provide for releases below Nimbus Dam of not less than 2,500 cfs from October 1997 through February 1998, and not less than 4,500 cfs in March 1998. Carryover storage greater than 600,000 AF will help supply the water to meet these instream flow objective, and to meet fall water temperature objectives. We are continuing to work on the relationship among October 1997 through March 1998 flow objectives and the 1997 reservoir storage, inflow and hydrologic conditions. We will coordinate with the agencies, stakeholders, and the public regarding the flow objective in the event Folsom Reservoir is less than 600,000 AF at the end of September. To be responsive to changing hydrologic conditions, flows may be ramped up or down in cooperation with CDFG and Reclamation in January 1997 and 1998. These flow objectives will provide spawning and rearing habitat for salmon and steelhead, improve survival of downstream migrating late fall-run, winter-run, and spring-run chinook salmon through the Delta; and assist in meeting the needs of estuarine species consistent with the Bay-Delta Agreement.

To the extent possible, flow fluctuations should be eliminated during this period. Interim criteria on significant flow thresholds and ramping rates are being prepared by CDFG and the Service in cooperation with Reclamation to assist Reclamation staff in minimizing adverse fishery impacts due to flow fluctuations. We will continue to work together to develop ramping criteria for the long-term.

Fish species and life stages benefited:

- Spawning adult fall-run chinook salmon
- Incubating, rearing and outmigrating juvenile fall-run chinook salmon
- Spawning adult steelhead
- Incubating, rearing and outmigrating juvenile steelhead
- Spawning adult American shad
- Juvenile American shad
- Adult and juvenile striped bass
- Other anadromous and resident fishes (including splittail)

Background: Efforts to implement the American River flow objectives are consistent with the objectives of the Water Forum, a broad-based regional planning effort that includes business and agricultural leaders, environmental groups, citizens groups, regional water managers, and local governments (letter of comment on the draft Anadromous Fish Restoration Plan dated March 1, 1996 and signed by Melvin Johnson, Executive Director of the Sacramento City-County Office of Metropolitan Water Planning).

The American River flow objectives and models for implementation of the objectives were developed and refined by teams of biologists and hydrologists with representation from Save the American River Association, the Water Forum's Surface Water Negotiation Team, the California Department of Fish and Game, the East Bay Municipal Utility District (EBMUD), business interests in the Water Forum, State Water Resources Control Board, Service, Reclamation, and others. The objectives and models for implementation where generally supported by the participants, although concerns were raised about potential effects on over-summering steelhead and late-fall-run chinook salmon.

Prior to development of the American River flow objectives (in 1972), the Environmental Defense Fund (EDF) filed suit against EBMUD challenging a proposed diversion of water from Nimbus Dam through the Folsom South Canal, bypassing the lower American River. A 1990 court decision resulting from this case (known as the Hodge decision) ordered the following flows for the protection of salmonid resources in the lower American River: 2,000 cfs between 15 October and 28 February; 3,000 cfs between 1 March and 30 June; and 1,750 cfs between 1 July and 14 October.

The Hodge flows prescribe conditions that must be met prior to diversion of American River water by EBMUD. In most dry and critical years, those flow conditions could not be met and therefore EBMUD could not divert water. We recommend higher flow objectives to provide greater benefits than the Hodge flows in wet, above, and below normal years and lower flow objectives in drier years, such that flows could reasonably be met in almost all years. In addition, the Hodge flows were to protect all public trust resources and therefore the summertime flows included consideration of recreational activities, including wading, swimming and rafting.

Supporting data: The Hodge flows were established after extensive review of available scientific data concerning the relationship between lower American River flows and salmonid production. Additional information addressing optimal instream flows for salmonid spawning and incubation, rearing, outmigration, and temperature control has been developed subsequent to the Hodge decision, either as part of the retained jurisdiction associated with *EDF et al. v. EBMUD* (Williams 1995), as part of AFRP Technical Team efforts to develop the AFRP Working Paper (USFWS 1995), or as part of the Water Forums regional planning efforts (Bratovich et al. 1995). Bratovich et al. (1995) listed over thirty studies of fish and related hydrology on the lower American River and Williams (1995) summarized and discussed many of these studies, focusing on evidence and analysis bearing on the flows and water temperatures needed to protect chinook salmon in the lower American River. This additional information was used to develop the instream flow recommendations for the lower American River that appear in Table 1.

Monitoring and evaluation needs: Monitoring the effectiveness of the American River flow objectives is essential to obtain data on anadromous fish production and to facilitate an evaluation of the effects of this restoration action. We recommend that existing monitoring programs continue, including escapement surveys, redd surveys, emigrant trapping, and seine surveys. Refinement of existing methods should continue and additional studies should be conducted (see Williams [1995] for a discussion of potential additional studies). In a letter of comment on the draft Anadromous Fish Restoration Plan dated January 12, 1996, John Williams identified several assumptions he felt should be the focus of an adaptive management approach to the American River flow objectives. The monitoring and study efforts should be coordinated with other monitoring and study programs in the Central Valley and integrated through CAMP with all CVPIA restoration actions and evaluations.

Citations

Bratovich, P.M., S.L. Taylor, and D.B. Christophel. 1995. Sacramento Area Water Plan Forum: Final Fish Biologists Working Session Summary. Prepared for the Sacramento City-County Office of Metropolitan Water Planning, Sacramento, California.

U.S. Fish and Wildlife Service. 1995. Working paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 3. May 9, 1995. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, California.

Williams, J.G. 1995. Report of the Special Master, Environmental Defense Fund v. East Bay Municipal Utility District, Alameda County (California) Superior Court Action No. 425955.

Sacramento River Action 1: Minimum Keswick releases of 5,300 from April 1, 1997 through September 30, 1997 and between 3,250 and 5,300 from October 1, 1997 to March 30, 1998 based on October 1, 1997 Shasta Reservoir carryover storage.

Description: During April, 1997, we recommend that releases from Keswick Dam be maintained at not less than 5,300 with such flows to remain in the river below Red Bluff Diversion Dam. Flows from May to September should be determined by operations required to meet temperature control criteria for winter-run chinook salmon. In any event, Sacramento River flows (i.e. Keswick releases) should be maintained at not less than 5,300 through September 30. Flows from October, 1997 through the following March should be based on October 1, 1997 Shasta reservoir carryover storage according to the following table.

Carryover storage (maf) (October 1, 1997)	Keswick Release (cfs)	Carryover storage (maf) (October 1, 1997)	Keswick Release (cfs)
less than 1.9[1]	3250	2.6	4,500
1.9 to 2.1	3,250	2.7	4,750
2.2	3,500	2.8	5,000
2.3	3,700	2.9	5,250
2.4	4,000	3.0 or greater	5,300
2.5	4,250		

Background:
The flow schedule recommended addresses fluctuations by limiting flow reductions and fluctuations to less than have previously occurred. During the fall, prior to passage of CVPIA, it was not uncommon to have flows running at 5-6 k cfs during October-November primarily for cross-delta deliveries (e.g. to refill San Luis Reservoir). When fall rainfall and natural accretions increased sufficiently to satisfy cross-delta needs, the flows from Shasta were dropped to minimums (3k cfs) regardless of the storage conditions in Shasta (i.e. maximizes storage for next summer's releases). The flow reduction would usually occur over a very short time period and strand many eggs and juveniles. This would occur even flood control operations in January-March required flows to be greatly increased. However, it also makes no sense to drain the reservoir during the winter with increased in-stream releases and not have enough cold water to provide for winter run spawning during the following summer. The recommended flow schedule is a balance between needs for storage and instream flows is realized.

[1] In the event forecasted carryover storage drops below 1.9 maf, USBR must reinitiate consultation with NMFS.

Sacramento River

Fish species and life stages benefited:

- Spawning adult chinook samon
- Rearing and outmigrating juvenile chinook salmon
- Spawning adult steelhead
- Rearing and outmigrating juvenile steelhead

Supporting data: The proposed flow schedule provides the most productive and stable environment that can be attained under the reservoir storage, runoff, and project operation conditions during the water year. Specifically this flow recommendation will provide for improved spawning and rearing of chinook salmon and steelhead, and improved survival of downstream migrating late-fall run, winter-run, and spring-run chinook salmon.

The algorithm for flow is built on the minimum flow and carryover requirements established in the Biological Opinion (BO) for CVP and State Water Project (SWP) effects on Sacramento River winter-run chinook salmon (NMFS 1993, CVPIA Working Paper, Vol. 3) and Water Rights Order 90-5 stipulating minimum instream flows. The BO also requires a minimum instream flow of 3,250 cfs from October 1 to April 30 and temperature control operation from May 1 to September 30 (NMFS 1993).

Clear Creek Action 1: Release a minimum flow into Clear Creek from Whiskeytown Dam of:
150 cfs from April 1, 1997 through May 30, 1997;
50 cfs from June 1, 1997 through September 30, 1997;
150-200 from Oct 1, 1997 through May 30, 1998; and
Release a spring pulse flow in May 1997.

Description: The recommended releases from Whiskeytown Dam to Clear Creek are 150-200 cfs from October to April and 50 cfs for the remainder of the year with variable spring-time releases depending on water year type.

The recommended flows provide habitat and temperature requirements for fall-run and late fall-run chinook salmon and steelhead and, to a lesser extent, for spring-run chinook salmon, which are presently extirpated from the stream. If the spring-run chinook salmon population becomes successfully reintroduced, it may require an even lower summer water temperature regime, necessitating increased flows. The releases are measured at Whiskeytown Dam to provide more precise temperature regulation and prevent harmful flow fluctuations.

A springtime flushing flow recommendation will be developed empirically to accomplish sediment removal, prevent riparian vegetation encroachment, maintain the proper channel configuration, distribute new spawning gravel, facilitate timely juvenile outmigration, and attract adult spring-run salmon and steelhead into the stream. The schedule and amount of flow would be determined by a series of experiments designed to intensify and augment a storm flow at strategic times. The flushing flow releases would not exceed the natural inflow into Whiskeytown Reservoir during the storm.

Background: The cumulative effects of water diversion, gold mining, gravel mining, logging, road building, residential development, and the construction of Whiskeytown Dam have contributed to the decline of the Clear Creek anadromous fishery habitat.

Existing Clear Creek habitat supports an estimated 2% of the Sacramento River's salmon population. Restoration of habitat and increased flow releases from Whiskeytown Reservoir could triple the present production of salmon in Clear Creek. Steelhead populations would similarly benefit.

McCormick Saeltzer (Saeltzer)Dam is located six miles upstream from the Sacramento River on Clear Creek. Whiskeytown Dam is ten miles upstream from Saeltzer Dam. Because the fish ladder on Saeltzer Dam doesn't function very well, the upper ten miles of Clear Creek is currently inaccessible to most if not all salmon and steelhead.

Increased flows were provided in Clear Creek from October 1, 1995 to April 28, 1996, with benefits to the fishery including: 1) improved fish passage into Clear Creek; 2) improved Clear Creek water temperatures in October; 3) increased the amount of spawning and rearing habitat in Clear Creek; and 4) record numbers of fall-run chinook salmon spawning in Clear Creek. The

Clear Creek

Service distributed a report (Brown 1996) in the summer of 1996 on the fishery impacts of the flow release, based on field studies conducted by FWS, CDFG and DWR. The FWS and CDFG and again requested similar flows in 96-97 and flows were again increased in October, 1996 and are expected to continue through May, 1997.

Fish species and life stages benefited:

- Spawning adult chinook salmon
- Rearing and outmigrating juvenile chinook salmon
- Spawning adult steelhead
- Rearing and outmigrating juvenile steelhead

Supporting data: The recommended flow releases can nearly double available fall-run and late fall-run chinook salmon habitat over that provided by the present minimum releases of 50 cfs. By increasing the flows below Whiskeytown Dam, it is possible to add back approximately five miles of spring-run habitat and 10 miles of steelhead habitat and to possibly reintroduce spring-run chinook salmon. If successful, another distinct and genetically viable population of spring-run chinook salmon and steelhead could become established in the Central Valley, which would reduce the probability of these species going extinct. In addition, Clear Creek is one of two tributaries in the upper Sacramento River that can provide habitat for three races of salmon and steelhead.

These recommendations (CDFG correspondence report 1993, Working Paper, Vol. 3) are based on attainable temperature objectives and habitat requirements that were determined by an instream flow study (DWR 1986, Working Paper, Vol. 3) and the Clear Creek hydrologic data at Whiskeytown Dam for 1923 to 1994 (USBR Central Valley Project Operations Hydrologic Data, Working Paper, Vol. 3).

Attachment G6

Minimum Instream Fishery Releases For Trinity River

Attachment G6

MINIMUM INSTREAM FISHERY RELEASES FOR TRINITY RIVER

The following release schedule for Trinity River was developed by the Service for use in the Draft PEIS alternatives on April 26, 1995.

Flow alternative assumes a restored channel configuration, channel morphology (maintenance), riparian innundation and dessication (and seed dispersion), sediment transport, rearing, overwintering, and redd separation.

Water Year Exceedence> TRD INFLOW	Wet 0.25 1,600,000		Above Normal 0.50 1,050,000		Below Normal 0.70 860,000		Dry 0.90 600,000		Critical <0.90 <600,000	
Week										
01 Oct	275		225		200		200		200	
09 Oct	300		250		225		225		225	
16 Oct	350		275		250		250		250	
23 Oct	400		300		300		300		300	
30 Oct	450	337	325	265	325	248	325	248	325	248
06 Nov	450		350		350		350		350	
13 Nov	500		375		350		350		350	
20 Nov	500		400		400		400		400	
27 Nov	500	480	425	373	499	364	400	364	400	364
04 Dec	500		450		400		400		400	
11 Dec	500		475		450		450		400	
18 Dec	500		500		450		450		400	
25 Dec	500	500	500	476	450	434	450	434	400	400
01 Jan	600		500		450		450		450	
08 Jan	600		500		450		450		450	
15 Jan	600		500		450		450		450	
22 Jan	600		500		450		450		450	
29 Jan	600	600	500	500	450	450	450	450	450	450
05 Feb	600		500		450		450		450	
12 Feb	600		500		450		450		450	
19 Feb	600		500		450		450		450	
26 Feb	600	600	500	500	450	450	450	450	450	
05 Mar	600		600		500		500		500	
12 Mar	650		600		500		500		500	
19 Mar	700		600		500		500		500	
26 Mar	750	663	600	587	500	494	500	494	500	494
02 Apr	800		800		700		600		600	
09 Apr	850		800		700		600		600	
16 Apr	900		800		700		600		600	
23 Apr	1,000		800		800		600		600	
30 Apr	1,500	903	1,000	800	1,000	727	800	603	800	603
07 May	2,000		2,000		1,500		1,000		2,000	
14 May	4,000		5,200		2,000		1,500		2,000	
21 May	8,500		5,200		4,500		4,500		2,000	
28 May	3,750	4,048	3,000	3,381	2,000	2,258	1,750	1,961	2,000	1,768
04 Jun	3,500		2,500		1,500		1,500		2,000	
11 Jun	3,000		1,500		1,200		1,000		750	
18 Jun	2,500		1,000		1,000		850		600	
25 Jun	2,000	2,875	900	1,647	750	1,213	650	1,087	500	1,082
02 Jul	1,500		650		550		450		450	
09 Jul	1,000		500		400		300		300	
16 Jul	700		400		300		275		250	
23 Jul	500		350		300		250		250	
30 Jul	400	926	300	477	250	390	200	322	200	311
06 Aug	350		300		250		200		200	
13 Aug	300		300		250		200		200	
20 Aug	275		275		225		200		200	
27 Aug	250	314	250	286	200	236	175	196	175	196
03 Sep	225		225		200		175		175	

Water Year	Wet		Above Normal		Below Normal		Dry		Critical	
Exceedence>	**0.25**		**0.50**		**0.70**		**0.90**		**<0.90**	
TRD INFLOW	**1,600,000**		**1,050,000**		**860,000**		**600,000**		**<600,000**	
Week										
10 Sep	200		200		175		150		150	
17 Sep	200		200		200		150		150	
24 Sep	250	221	200	209	200	194	175	163	175	163
Total	752,252		573,804		449,757		408,177		393,278	

Attachment G7

U.S. Department of the Interior Final Administration Proposal on Management of Section 3406(b)(2) Water (November 20, 1997)

United States Department of the Interior

November 20, 1997

U.S. Fish and Wildlife Service
Region 1
911 N.E. 11th Avenue
Portland OR 97232-4181

U.S. Bureau of Reclamation
Mid-Pacific Region
2800 Cottage Way
Sacramento CA 95825-1898

Dear CVP Stakeholders, CALFED Participants, and Interested Parties:

Attached is the Department of the Interior's (Interior) Final Administrative Proposal on the Management of Section 3406(b)(2) Water. This paper presents Interior's conclusions as to how it intends to comply with the statutory mandate to dedicate and manage the water dedicated pursuant to Section 3406(b)(2) of the Central Valley Project Improvement Act.

The release of the Administrative Proposal reflects substantial agency and stakeholder dialogue. The active participation of interested parties and the public has been instrumental in helping Interior determine the approach for managing the 3406 (b)(2) issues. Interior urges the continued involvement and participation of stakeholders and others as it implements, in the coming 5 years, the set of near-term fish and wildlife measures described in the Administrative Proposal.

Copies of the Administrative Proposal can be accessed on the Bureau of Reclamation Mid-Pacific Region's homepage at http:/www.mp.usbr.gov or can be obtained by calling Ms. Lynnette Wirth at 916/978-5100 (TDD 916/978-5608).

Sincerely,

Michael J. Spear
Regional Director
U.S. Fish and Wildlife Service
Region 1

Roger K. Patterson
Regional Director
U.S. Bureau of Reclamation
Mid-Pacific Region

Attachment

INTRODUCTION

The Central Valley Project Improvement Act (CVPIA) amended the purposes of the Central Valley Project (CVP) to make fish and wildlife mitigation, protection, and restoration purposes equal to use of water for irrigation and domestic purposes of the CVP. To assist in meeting these newly-added goals, the Secretary is authorized and directed to modify CVP operations to provide flows "from the quantity of water dedicated to fish and wildlife and habitat restoration purposes" under Section 3406(b)(2), from acquired water supplies and from "other sources which do not conflict with fulfillment of the Secretary's remaining contractual obligations to provide CVP water for other authorized purposes."

Section 3406(b)(2) of the CVPIA directs the Secretary to "dedicate and manage annually eight hundred thousand acre-feet of Central Valley Project yield [hereinafter "(b)(2) water"] for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help to meet such obligations as may be legally imposed upon the CVP under State or Federal law following the date of enactment of this title, including but not limited to additional obligations under the Federal Endangered Species Act." Subsection (B) of section 3406(b)(2) further provides that the (b)(2) water "be managed pursuant to conditions specified by the United States Fish and Wildlife Service after consultation with the Bureau of Reclamation and the California Department of Water Resources and in cooperation with the California Department of Fish and Game."

There has been considerable debate over the interpretation of this language, primarily regarding the issues of how the 800,000 acre-feet may be used and how it should be accounted. As discussed below, resolving these issues has been the goal of a substantial and lengthy agency, stakeholder, and public dialogue. This paper presents the Department of the Interior's (Interior's) conclusions as to how it intends to comply with the statutory mandate to dedicate and manage each year the water dedicated pursuant to 3406(b)(2).

BACKGROUND

(A) Development of the (b)(2) Guidelines and Draft CVPIA Administrative Proposals

In December 1994, Interior, acting through the U.S. Fish and Wildlife Service (Service) and the U.S. Bureau of Reclamation (Reclamation), issued draft guidelines ("(b)(2) guidelines") on the management of the (b)(2) water (also known as the "White Paper"). Comments were received from many sources, including environmental, urban, and agricultural stakeholders. Several meetings were held with stakeholders to discuss the concept of the paper. The draft (b)(2) guidelines were revised and reissued as a draft on September 12, 1995, and were transmitted as a final recommendation from the authors to the Regional Directors of Reclamation and the Service in May 1996. A copy of that recommendation was included with the first public draft of the CVPIA Administrative Proposal on Management of Section 3406(b)(2) Water (800,000 Acre-Feet) on July 1, 1996 (first Draft Administrative Proposal).

Further discussions of the issues involving the (b)(2) water began in late 1995 when a large stakeholder work team began meeting. These stakeholders identified a lengthy list of issues surrounding the management of the (b)(2) water. A summary of the stakeholder discussions and Interior's initial proposals for addressing the issues were included in the first Draft Administrative Proposal. A copy of that draft is available from Reclamation or may be accessed at Reclamation's home page on the Internet.

As noted in the first Draft Administrative Proposal, two additional issues raised by the stakeholders -- the operation of New Melones Dam and area of origin priorities -- have been reviewed in other forums in the CVPIA Forum process, and the results of those reviews are included in the final CVPIA Stanislaus Administrative Proposal, dated June 23, 1997, and a draft paper titled, "Applicability of Area of Origin Statutes Federal Central Valley Project," dated March 13, 1996. That draft was released for comment and will be released to the public when finalized.

(B) June 24 and October 31 Draft Administrative Proposals

On June 24, 1997, Interior released a substantially revised Draft Administrative Proposal (June 24 Draft Administrative Proposal). In this June 24 Draft Administrative Proposal, Interior suggested that it would be more productive and more in keeping with the intent of the statute to focus less on a formal "accounting system" for the dedication of 800,000 acre-feet and instead decide how it intends to manage the tools in 3406(b)(1), (b)(2), and (b)(3) for the benefit of the fish and wildlife resources in the Central Valley and in the Bay-Delta estuary. Consistent with this approach, Interior released a list of environmental measures it proposed meeting annually during the next 3 to 5 years. It also released preliminary model results showing the effects of implementing those measures on CVP water deliveries.

At the same time that it released the June 24 Draft Administrative Proposal, Interior initiated a series of public outreach efforts to solicit comment on its approach from affected interests and agencies. The public outreach effort involved three different focuses:

~ A "Fish Group" met to discuss the list of proposed environmental measures in the Bay and Delta. This group analyzed the existing list of measures and proposals for how the measures might be improved to be more effective biologically, more useful for resolving biological questions in the Delta, and/or more water-efficient.

~ A "Modeling Group" met to discuss how the proposed or revised environmental measures should best be modeled to show the probable impacts of implementation on CVP and State Water Project deliveries across a broad range of potential hydrological conditions.

~ A "Toolbox Group" met to consider whether there were actions that can be taken now and in the future to minimize the adverse effects to water users of implementing the environmental measures under the CVPIA. This Toolbox Group did not limit its work to the tools provided by the CVPIA; it operated under the premise that water policy in California was undergoing a fundamental review in the CALFED Bay-Delta Program, a component of which includes the environmental resources provided by the CVPIA. For this reason, a broader range of tools, resources, and objectives needed to be considered and included in order for all interest groups to move forward in the larger forum.

These three public forums met frequently during July, August, and September, and provided significant comment that was extremely useful in refining Interior's proposal for implementing Section 3406(b). Interior released another revised Administrative Proposal on October 31, which incorporated many of the refinements suggested by the public forums. Interior believes that the individual concerns and comments raised by the respective stakeholder participants have led to a substantially improved set of environmental measures for the next few years and to a better understanding of how these measures may affect water supplies.

In addition to specific comments that may be reflected elsewhere in this revised Administrative Proposal, participants in the public forums made two broad suggestions. First, that Interior should develop and support a long-term scientific evaluation process to evaluate the effectiveness of the CVPIA environmental measures, based on a sound monitoring program. Second, that Interior should consider forming an interagency-stakeholder group to assist in the "fast-track" implementation of appropriate measures identified in the "Toolbox" effort, using a broad array of CVPIA, CALFED, and other resources. Interior agrees that these ideas have merit, and will work with stakeholders to implement them in the coming months.

(C) Public Comment on Draft Administrative Proposal

Interior provided opportunity for public comment on the June 24 and October 31 draft Administrative Proposals and has incorporated in this final Administrative Proposal many of the comments and suggestions that it received on its Draft Administrative Proposals. A full summary of the comments received on Interior's various draft Administrative Proposals, as well as Interior's responses to those comments, is available from the Sacramento Office of Reclamation.

RESOLUTION OF THE MAJOR ISSUES

This revised Administrative Proposal describes Interior's resolution of three major issues: (A) dedicating and managing the (b)(2) water; (B) role of the "Toolbox"; and (C) crediting (b)(2) water towards the Water Quality Control Plan (WQCP). In addition, the paper describes the resolution of six additional issues, which have been largely subsumed within Interior's approach to the three major issues. Those six additional issues are: (1) defining the (b)(2) baseline; (2) using (b)(2) in the Delta; (3) reoperation/reuse of (b)(2) water; (4) shortage provisions for (b)(2) water; (5) prioritizing use for (b)(2) water; and (6) status of the "(b)(2) Guidelines." This discussion reflects Interior's conclusions after considering the substantial comments developed in the three public forums discussed above, as well as other comments submitted to Interior on these issues.

(A) Dedicating and Managing the (b)(2) Water

The CVPIA represented a significant change in the way water resources are to be used and managed in the CVP. For the first time, the "mitigation, protection, and restoration of fish and wildlife" has been placed on an equal footing with other major CVP purposes. In addition, the CVPIA, in the (b)(2) water provisions, placed affirmative obligations on the Service to specify conditions for the management of the CVP water for fish, wildlife and habitat restoration purposes. The CVPIA also requires the Service to consult with Reclamation and others in determining those conditions.

When combined with the directives on water management included in CVPIA Section 3406(b)(1)(B)(generally referred to as "(b)(1)" or "reoperation" of the project) and Section 3406(b)(3)(water acquisition), the (b)(2) water provision requires a coordinated approach to the management of CVP water. Reclamation has had to refine, and will continue to refine, its decisionmaking process to account for the multiple and frequently competing objectives for the project as now defined in the CVPIA. At the same time, the Service is developing a better understanding of Reclamation's operations process, so that it can be more effective in carrying out its obligations under the CVPIA.

Section 3406(b)(2) provides that the Secretary "shall dedicate and manage annually 800,000 acre-feet of CVP yield" for the primary purpose of implementing the CVPIA's fish and wildlife habitat restoration purposes. The statute further defines the CVP yield as "the delivery capability of the CVP during the 1928-1934 drought period" after factoring in the conditions of the applicable permits, licenses, and agreements in place at the time the CVPIA was enacted. That water is to be managed "pursuant to conditions specified by the Fish and Wildlife Service" after consultation with Reclamation and the California Departments of Fish and Game and Water Resources.

Interior continues to believe that a significant part of the disagreement over the (b)(2) provision is caused by attempting to separate (b)(2) "measurement" (an aspect of dedication) from (b)(2) "actions" (how the water is managed to accomplish the purposes of the Act). Interior believes that (b)(2) water measurement definitions cannot take place in a vacuum isolated from the process of defining the actual environmental restoration actions that will be accomplished through the use of (b)(2) water. Further, Interior believes that (b)(2) must also be implemented in concert with the remainder of the statute. In particular, Interior's water management process for the CVP must focus on using the many tools in the CVPIA (including (b)(2) water, reoperation possibilities, acquired water, and others) in a coordinated and flexible manner. Recent cooperative efforts in California, such as the Bay-Delta Accord and the CALFED Operations Group, have shown the advantages of flexible, real-time water management for both environmental and water supply goals. Interior intends to apply this same flexible approach to the management of CVP water. Interior also believes that much of the controversy over the (b)(2) water arises from concern over the potential impact of a method of dedication that is based on a given "accounting" system. Stakeholders have also expressed a desire for certainty, and a desire to understand clearly how the water will be managed and what the impact will be to each use.

In recognition of the interrelationship between the accounting and the management of the water and the interrelationship of (b)(2) with the remainder of the statute, and in an attempt to provide certainty to the broad range of stakeholders, Interior proposed in the June 24 Draft Administrative Proposal (and reiterated in the October 31 Draft Administrative Proposal) the following approach to resolution of the (b)(2) issues:

> "First, Interior has developed a set of environmental measures that it will commit to implement during the next 3 to 5 years. [Footnote omitted.]These measures will be accomplished through a combination of project reoperation ((b)(1)) and dedication of (b)(2) water. Interior believes that, within the reasonable range of uncertainty inherent in managing water for environmental purposes, implementation of these measures will comply with the Act's mandate to dedicate a quantity of water under section 3406(b)(2). Further, by coordinating actions under (b)(2) with the operational flexibility authorized under section 3406(b)(1), the expected benefit to the environment should exceed the benefit solely attributable to 3406(b)(2). Also, where appropriate, additional capabilities and benefits may be obtained, under certain circumstances, through the acquisition of water from willing sellers, using the authority provided in section 3406(b)(3). A matrix summarizing the environmental measures is attached to this administrative proposal as Appendix A. Note that most of these measures vary in some way according to hydrological and operational conditions."

In addition, Interior proposed modeling the expected effects of implementing the proposed environmental measures on CVP water deliveries. In doing so, it modeled its best approximation of those measures over a 70-year hydrological record and quantified the impacts to CVP water deliveries during that modeled period. While impacts to water deliveries are neither the stated goal nor the stated measure of the 800,000 acre-feet of (b)(2) water, the model results provided the best data available on the effect that implementation of the environmental measures would have on existing contractors. In addition to showing overall averages, the model summary provided maximum, minimum, and average CVP water supply impacts for each of the standard hydrologic water year type categories (wet, above-normal, etc.). This modeling process was similar to the modeling effort carried out in developing the Bay Delta Accord.

After considering the comments that arose from the three public forums described above, as well as other comments submitted to Interior, Interior prepared a revised list of environmental measures and released that revised list on October 31 for public comment. The list, as revised in response to all comments received, is attached as Appendix A. After considering the comments, Interior has determined that it will implement the measures in Appendix A beginning in the 1998 water year (which began October 1, 1997), in cooperation with the CALFED Ops Group and with the State Water Project. Interior will implement these Appendix A measures for 5 years, in accordance with the hydrologic triggers and conditions described for each measure, at which time it will review the environmental effects of the measures and make any necessary revisions or refinements to the measures for implementation in subsequent years[1]. These revisions or refinements may either increase or decrease the impacts to water deliveries of implementing the measures, and may involve either reducing or increasing the number of measures themselves.

Stated broadly, the major change in Appendix A as compared to the June 24 Draft Administrative Proposal has been to better define the objective and implementation of each measure so that the measure's design and operation could be adjusted to meet that objective. As shown in the detailed description included in Appendix A, many of these measures have been restated as "protective experiments" -- measures that are intended to provide additional useful information about the biological processes at work within the ecosystem, while at the same time providing a level of protection of the resources that is consistent with the goals of the Revised Draft Anadromous Fish Restoration Plan (AFRP), and sufficient to meet, for the term they are effective, the purposes set out in the CVPIA. In addition, many of the measures have been revised to include better "triggers" or other responses to hydrological and/or biological conditions. The use of these real-time response mechanisms is intended to provide better biological results while minimizing unnecessary adverse impacts to water supplies. Interior will incorporate the measures described in Appendix A into a supplement to the 1992 Central Valley Project Operation Criteria and Plan (CVP-OCAP), with sufficient detail to allow project operators to plan and conduct CVP operations so as to attain all of the measures.

[1] Some of the measures included in Appendix A, notably those associated with the Vernalis Adaptive Management Program or VAMP, by their own terms, will last longer than 5 years. Interior intends to implement these measures for the longer timeframes explicitly included in the definition of the measures.

As part of its commitment to implement the measures outlined in Appendix A, Interior will ensure that the monitoring and evaluation process described for the particular measures is carried out during this 5-year period. Interior believes that this information and analysis will be critical in evaluating the effectiveness of Appendix A measures when these measures are reviewed at the end of the 5-year period. At that time, Interior anticipates that the measures will be revised as appropriate in response to the information made available through the scientific review process. Further, Interior commits to conducting its review of these measures at the end of the 5-year period through a public process similar to the process used in arriving at these Appendix A measures. Finally, Interior will coordinate its analysis of the effectiveness of the Appendix A measures with the triennial review process to be conducted by the State Board.

Interior is also providing a revised set of model results in Appendix B that portray the potential effects of implementing the environmental measures on water deliveries across a broad range of hydrologies. As noted in both the June 24 and October 31 Draft Administrative Proposals, impacts to water deliveries is neither the goal nor the measure of the (b)(2) water. These modeling data, however, provide the best available information on the water supply impacts of implementing the environmental measures. The revised model results are attached as Appendix B. Given the difficulty of portraying "triggers" or similar refinements in the existing hydrological models, these model results are necessarily only a rough approximation. Interior believes that although particular results may vary, on balance the use of the "triggers" will somewhat reduce the actual impacts to water deliveries as compared to the revised modeled results. Note that these models show average water delivery impacts of approximately 800,000 acre-feet in dry years and approximately 600,000 acre-feet in critically dry years. The level of impacts in critically dry years is consistent with Interior's decision to invoke the shortage provision of section 3406(b)(2)(C), as discussed below.

The information provided in the revised Appendix A and Appendix B reflects a number of important conclusions, including the following:

- The environmental measures included in revised Appendix A are generally consistent with the proposals for upstream and in-Delta measures included in the Revised Draft Anadromous Fish Restoration Plan. In addition, the measures in Appendix A reflect the discussions that have been taking place between agencies and stakeholders over the proper implementation of environmental measures on the lower San Joaquin River. These discussions, which have resulted in the development of the Vernalis Adaptive Management Plan or VAMP, bear directly on the nature of environmental measures 1, 2 and 5 in Appendix A.

- By designating a set of fish, wildlife and habitat restoration measures that will be implemented over the course of a set period of time, Interior is providing greater certainty for the environment, for project operators, and for water users. These measures will be incorporated into the annual operations of the CVP beginning in the 1997-98 water year, and will not be changed until Interior conducts a public process of revising those measures at the end of 5 years. Aside from the flexibility built into the measures themselves, "real time" flexibility to implement different or additional environmental measures in the system will come primarily through project reoperation, through management of a water reserve account, or through water purchases.

~ Interior believes that the Act provides for the use of up to 800,000 acre feet of (b)(2) water every year. At the same time, it is reasonable to expect that the entire 800,000 acre-feet may not be necessary in the wetter hydrologies. As noted in the first Draft Administrative Proposal, CVPIA Section 3406(b)(2)(D) provides a relief provision from the mandate to dedicate (b)(2) water: "If the quantity of water dedicated under [(b)(2)] 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." The matrix of measures in Appendix A reflects Interior's finding of how best to accomplish the purposes of the statute for the next 5 years. Thus, Interior believes by meeting the environmental measures set out in Appendix A, it is fully using the (b)(2) water. However, to the extent others question this conclusion, Interior relies on Section 3406(b)(2)(D) of the Act. To the extent that the measures in Appendix A do not use all the dedicated water, this document constitutes the Secretary's finding that such unused quantity, if any, is not needed for the purposes of Section 3406 of the Act, and such quantity is available for other project purposes. This finding is based on the entire record supporting this Administrative Proposal, and on the "protective experimental" nature of the measures. This finding will be reassessed in the context of the review and possible revision of these environmental measures at the end of the 5-year period.

(B) Role of the "Toolbox"

Discussions between Interior and the public (including the "Toolbox Group") over the past several months have highlighted the significant changes occurring in California water management. Notably, the CALFED Bay-Delta Program has been moving quickly towards developing and finalizing a preferred alternative for a broader resolution to the many competing interests in California water. Related to this planning effort was the passage of Proposition 204 by the California voters in November 1996, which provided almost $500 million for ecosystem restoration in the Bay and Delta, as well as almost another $500 million for related water management projects and activities. In addition, the U.S. Congress authorized up to $430 million over the next 3 years for Bay and Delta ecosystem restoration, and Congress has appropriated $85 million of this amount for fiscal year 1998.

Given these changes in the policy background of California water issues, Interior agrees that it should look beyond the CVPIA as it considers ways to mitigate potential adverse effects, if any, on CVP contractors. The Toolbox Group discussions developed a number of ideas for enhancing water supplies in the near term and in the longer term.

In Appendix C, Interior has described a number of specific "tools" that it is committing to implement. These "tools" are based in large part on the discussions that took place in the Toolbox Group, although Interior has continued to evaluate and refine them to identify those tools that promise real water supply benefits in the near term. Some of the tools are primarily at the discretion of Interior, and Interior will move forward with implementing these tools immediately. Other tools require the cooperation and/or regulatory approval of other entities. As to these latter tools, Interior is committing to initiate the appropriate regulatory applications immediately.

Interior's discussions with various stakeholder groups have identified concerns about Interior's ability and commitment to move forward quickly on the development and implementation of these tools. To address these concerns, Interior has included in Appendix C a proposed schedule of tasks necessary to implement the toolbox measures. This schedule was developed in cooperation with many of the stakeholders and the State of California after reviewing the institutional needs and regulatory requirements that must be resolved to implement the tools. Interior is committing to apply the necessary technical and policy staff at all levels to achieve the schedule outlined in Appendix C.

A primary component of toolbox implementation is identifying necessary funding. In Appendix C, Interior has included a rough estimate of the potential costs of implementing the toolbox, and has listed potential sources for these funds. Given the recent changes in the policy background of California water issues discussed above, and the clear interconnection between toolbox implementation and the broader resolution of California water issues being developed in the CALFED Bay-Delta process, Interior believes it should pursue a broad approach of using all possible funding sources (CVPIA, CALFED, etc.) to implement appropriate measures. In reviewing funding opportunities, Interior believes one fundamental principle should have substantial weight, and that principle is that the beneficiary or beneficiaries of a toolbox measure should pay for that measure. This concept of "beneficiary pays" is a cornerstone of the CALFED program and is equally applicable in this broad toolbox implementation effort.

One concern that has been raised in Interior's many discussions with stakeholders is about the relationship of the environmental measures in Appendix A and the toolbox measures in Appendix C. As discussed above, Interior is committed to implementing both the environmental measures and the toolbox measures expeditiously and with equal effort. Beyond that commitment, however, there is no linkage between the two sets of measures. Interior is not attempting to maintain any particular notion of proportional implementation or temporally linked implementation.

One measure suggested in the June 24 and discussed further in the October 31 Draft Administrative Proposal -- the water reserve account -- reflects a different approach to managing CVP water. Under this approach, water derived from a number of potential sources would be stored in designated storage locations as a "reserve account." This reserve account could then be flexibly used by Interior to respond to new information or opportunities during the course of the year. After reviewing comments on the different possible forms of a water reserve account, Interior has concluded that it is best viewed and used as an adjunct of the toolbox measures. A description of the form and operation of the water reserve account is included in Appendix C.

(C) Crediting of Bay/Delta Requirements Towards the WQCP

The December 15, 1994, Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government ("Accord") provide that, for the term of the Accord, "All CVP water provided pursuant to these principles shall be credited toward the CVP obligation under Section 3406(b)(2) of the CVPIA to provide 800,000 acre feet of project yield for specified purposes." Stakeholders appear to agree that this crediting arrangement should remain in place for the life of the Accord. There is not consensus, however, as to whether the credit should be extended beyond the 3-year life of the Accord.

Sections 3406(b)(1)(C) states that Interior shall cooperate with the State "to the greatest degree practicable" to ensure that the water dedicated under (b)(2) is credited against additional obligations of the CVP arising after the enactment of the CVPIA, and that "to the greatest degree practicable" the programs required by the Act "avoid[ ] inconsistent or duplicative obligations from being imposed" on CVP water and power contractors. Section 3406(b)(2) states that one of the purposes of the (b)(2) water is to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Many of the anadromous fish habitat restoration measures and management of the (b)(2) water, as provided in Appendix A, will have conjunctive benefits to other aquatic resources in the CVP streams and Delta ecosystem. Interior, therefore, believes that there is both legal and policy rationale supporting the use and extension of the credit, and intend to continue crediting water provided for meeting the CVP's share of the State's water quality standards towards the dedication of (b)(2) water.

Interior's conclusion on this issue is based in part on the assumed equal sharing of the burden of the Bay-Delta Accord between the State and Federal water projects. The two projects are moving towards a review and revision of the sharing formula in the Coordinated Operations Agreement (COA) governing joint operations of the projects. If the current formula for sharing the burdens of meeting current Endangered Species Act and Delta water quality requirements changes substantially, Interior will reevaluate this policy of crediting water provided under the Accord towards the (b)(2) water.

In addition to the three major issues discussed above, Interior's Draft Proposals also discussed six additional issues that had been raised by stakeholders at various times. Many of those issues were important in the context of evaluating various approaches to the (b)(2) water. Interior's resolution of those issues, however, has largely been subsumed by dedication and management of the water for fish and wildlife restoration as discussed above. The additional six issues and their resolution are discussed below.

(1) Defining the (b)(2) Baseline

One issue that has generated many comments involves the question of the proper "baseline" against which to measure the dedicated water. That question is largely subsumed by Interior's approach to accounting for the (b)(2) water by meeting certain environmental measures. It remains relevant, however, for purposes of modeling the impacts to water deliveries. As explained in the Draft Administrative Proposal, some stakeholders believe that the proper baseline conditions should include only those requirements that were formally in place at the time of the CVPIA's passage (October 1992), including the D-1485 Bay-Delta standards along with the 1992 Biological Opinion's winter-run salmon temperature requirements. The fundamental issue is whether any of the 1993 winter-run Biological Opinion's requirements are appropriate for inclusion in the baseline.

Interior continues to believe that the proper baseline includes not only the literal language of the 1992 Biological Opinion, but also those requirements from the 1993 Biological Opinion (as well as the related State Water Resources Control Board requirements to meet temperature targets) that were inherently part of the 1992 Biological Opinion. The 1992 Biological Opinion was a 1-year opinion only and did not have to consider issues such as long-term temperature objectives. The 1993 Biological Opinion is intended to be a long-term, multiyear opinion. As such, it was necessary in the 1993 Opinion to explicitly articulate the related conditions that would lead to compliance with the 1992 Biological Opinion temperature requirements over a broader range of hydrological conditions.

Interior believes that including the Shasta Reservoir storage requirements from the 1993 Biological Opinion is the best way to reflect how the temperature requirements of the 1992 Biological Opinion would affect CVP operations into the future. Accordingly, Interior is including those requirements in its baseline for purposes of modeling the impact of using the dedicated (b)(2) water. Similarly, Interior is using this same baseline in its analysis of the CVPIA in the Programmatic Environmental Impact Statement.

Interior notes that other measures included in the 1993 Biological Opinion, such as the "Q-West" requirements, are not being included in the baseline. This is because, consistent with the reasoning above, these requirements were additional to, rather than explanatory of, the measures in the 1992 Biological Opinion.

(2) Appropriateness of Delta Uses for (b)(2) Water

During the Spring 1996 water allocation process, a dispute arose about the appropriateness of using (b)(2) water to supplement the water dedicated under the Bay-Delta Accord for Delta outflow. The resolution of this controversy for the 1996 water year is summarized in the first Draft Administrative Proposal.

Interior continues to believe that the use of (b)(2) water for additional Delta fishery benefits above the standards required in the Accord is appropriate and that such use is consistent with both the CVPIA and the Accord. Interior recognizes the particular importance of the issues surrounding Delta uses of (b)(2) water, not only because of the continuation of the Accord, but because of the longer term need to balance potential impacts to water supplies and the need to address environmental issues in the Delta. Interior believes that the recent public forum process that led to the revised set of measures in Appendix A has been an effective mechanism for developing water-efficient approaches to protecting Delta environmental resources.

(3) Reoperation/Reuse of (b)(2) Water

The stakeholder comment letters indicated a fundamental disagreement over whether water released as (b)(2) water could be recaptured and reused for other project purposes. Many commenters found the discussion of this issue in the first Draft Administrative Proposal somewhat confusing.

Interior believes that the issues related to recapture and reuse are largely resolved in the description of particular measures. In modeling the effects of those measures, Interior has assumed that water released for a fish and wildlife objective upstream will be available in the Delta for consumptive purposes unless the measures in Appendix A or other existing environmental requirements provide an explicit additional fish and wildlife requirement for that water (e.g., it is needed to meet a Delta outflow requirement).[2] Thus, the modeled impacts to deliveries reflect only water released for a fish and wildlife objective that is not later recaptured.

Many commenters were also concerned about so-called "make-up pumping," which refers to the use of water for environmental purposes during one part of the year, and a subsequent effort to pump additional water later in the year to "make it up." The concern expressed (primarily by environmental interests) is that "make up pumping" unnecessarily shifts environmental risks from one part of the year to another.

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[2]This same approach has been used for any modeling of "(b)(3)" water purchases; it has been assumed that (b)(3) water purchased upstream is available for pumping for consumptive uses in the Delta unless it is necessary to use this water to meet environmental requirements in the Delta. For this purposes, (b)(3) water "protected" pursuant to California Water Code Section 1707 (protection of water acquired for instream flow) would be treated as Delta outflow not available for pumping.

While Interior believes that it is appropriate to make use of the flexibility in the system to achieve environmental results without impacts to deliveries, it also acknowledges that "make up pumping" has the potential to shift environmental risks from one time period to another, from one stream segment to another, and/or from one species to another. Interior does not intend to rely on make-up pumping to accomplish the measures set out in Appendix A. In the event make-up pumping is needed for other purposes, Interior will not engage in make-up pumping activities unless those activities are in compliance with water quality standards, State Board Order 95-6, the biological opinions applicable to the Bay-Delta, the provisions of the Bay-Delta Accord, and the spring-run protection plan, and do not compromise Interior's ability to implement the measures in Appendix A.

(4) Shortage Provisions for (b)(2) Water

Under Section 3406(b)(2)(C) of the CVPIA, the Secretary is given discretion to reduce the dedication of the (b)(2) water up to 25 percent "whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water" with the condition that "such reductions shall not exceed in percentage terms the reductions imposed on agricultural service contractors."

Interior has concluded that in critically dry years, it will invoke the shortage provision of section 3406(b)(2)(C), so that impacts of use of the (b)(2) water on deliveries will be reduced to the greater of 600,000 acre feet or the percentage of deliveries to agricultural service contractors. The attached matrix in Appendix A of environmental measures reflects that assumption.

In its evaluation of this shortage provision, Interior recognizes that the use of water year types can seriously misstate the actual hydrological conditions. The recent hydrology of 1997 is a good example: in this year, record floods in January were followed by near-record drought in the remainder of the spring period. Although the formal water year type was "wet" due to the early floods, both biological resources and water contractors faced a significantly more restricted water management problem. Many of the environmental measures in Appendix A incorporate "triggers" that more accurately reflect real time hydrological and biological conditions. Interior will continue reviewing whether a similar "trigger" can be developed to account for the possible inaccuracy of water year types in the shortage provision context.

(5) Priorities for Use of (b)(2) Water

Establishing priorities for the use of the (b)(2) water has also generated some controversy. The debate tends to focus on whether the (b)(2) water should be dedicated to use in the Delta first, or to upstream measures and then to the Delta, or in some combination of those approaches.

The measures attached as Appendix A set out Interior's view of the proper actions for the use of (b)(2) water during the next 5 years.

(6) Status of (b)(2) Guidelines

The June 24 Draft Administrative Proposal included a discussion of the "(b)(2) Guidelines" paper that had been forwarded as a final recommendation from its authors to the Regional Directors of Reclamation and the Service in May 1996. The June 24 Draft Administrative Proposal suggested the need for modification of the (b)(2) Guidelines. The (b)(2) Guidelines are superseded by this proposal.

APPENDIX A

APPENDIX A – SUMMARIES OF THE CURRENT STATUS OF THE AFRP FLOW-RELATED ACTIONS

DELTA ACTION 1: VERNALIS ADAPTIVE MANAGEMENT PROGRAM (VAMP)

Description

Increase flow at Vernalis and reduce CVP and SWP exports during the 31-day pulse flow period (generally April 15-May 15) as an experiment to determine effects on San Joaquin salmon smolt survival through the Delta. Baseline flows determined from the preceding April 1 to April 14 period would be increased to one of five levels (2,000; 3,200; 4,450; 5,700; and 7,000 cfs), with exports set accordingly (1,500; 1,500; 1,500; 2,250; and either 1,500 or 3,000 cfs). Special provisions apply in high flow years.

Purpose

To improve the scientific basis for the protection of San Joaquin chinook salmon smolts during migration through the Delta, and assist in meeting the needs of estuarine species.

Affected Species

San Joaquin chinook salmon smolts, young striped bass, American shad, sturgeon, delta smelt, and other estuarine species could be positively affected.

Experimental Design

Hypotheses. Survival of San Joaquin salmon smolts migrating through the Delta is positively related to San Joaquin River flow and negatively related to exports. Survival of tagged smolts would be determined under the five flow/export conditions over a period of years. Comprehensive details of the monitoring and evaluation aspects of the experiment were initially described by Herbold and Hanson's revised draft (October 1997). Some details of the experiment must wait to be worked out by the San Joaquin River Technical Committee and can't be finalized before March.

Triggers

Flow and export levels would be determined by current and previous year type and baseline flow. If water is unavailable for the VAMP flows, limit exports to 1,500 cfs. If water temperature exceeds a certain threshold (75 °F at Vernalis for 5 consecutive days), salmon survival would be assumed to be low and the experimental conditions would no longer be implemented. Experimental releases of salmon are not recommended at temperatures remaining above 70 °F for 5 days preceding the release.

Implementation

The water to implement VAMP will be acquired from the San Joaquin tributaries (SJRGA). The contractual arrangements are under negotiation with SJRGA to minimally secure up to 110,000 acre-feet for providing the experimental flows of VAMP. Additional waters on a limited willing seller basis are envisioned to potentially be available to support VAMP higher experimental goals. The final framework agreement will address the details.

Reclamation and DWR will produce an April 1 projected plan of operations for the 31-day pulse flow period (generally April 15 to May 15). This plan will include projected flows from upstream tributaries and in the San Joaquin River at Vernalis and export conditions with and without the VAMP scenario in order to demonstrate VAMP compliance on an individual year-to-year basis. The selection of 1,500 or 3,000 cfs exports at 7,000 cfs flow in the first year will be based on an assessment of current and projected hydrological conditions. Thereafter, the exports will be alternated between 1,500 or 3,000 cfs when Vernalis flows are 7,000 cfs, in accordance with detailed implementation criteria being developed.

Flows above 7,000 cfs would generally prevent operation of the Head of Old River Barrier. For purposes of modeling this measure during these high flow periods, Interior used total exports of 1,500 and 3,000cfs. After further review, Interior is proposing operational parameters for high flow periods as follows: (a) when flows are between 7,000 and 10,000 cfs, Interior will continue meeting the 1,500 or 3,000 cfs export limitations; (b) when flows exceed 10,000 cfs, Interior will continue meeting the 1,500 or 3,000 cfs export limitations unless projections indicate that doing so would prevent San Luis Reservoir from filling. In years in which San Luis Reservoir is projected not to fill, Interior will meet the export restrictions contained in the delta smelt biological opinion.

DELTA ACTION 2: HEAD OF OLD RIVER BARRIER

Description

Install, operate, and maintain a barrier of consistent design at the head of Old River

Purpose

Reduce mortality of San Joaquin River chinook smolts during migration through the Delta.

Affected Species

San Joaquin chinook salmon smolts could be positively affected; young striped bass and delta smelt could be adversely affected.

Experimental Design

Hypotheses: Survival of San Joaquin fall-run chinook salmon smolts migrating through the Delta is higher when the Old River barrier is in place than when it is not, at the same export flow levels.

Triggers

The barrier cannot be installed or operated at flows above 5,000 and 7,000 cfs respectively.

Implementation

Implementation of this action will be coordinated with Delta Action 1. A preliminary April 1 Plan of Operations developed by Reclamation and DWR by March 1 will be used to determine whether to install the rock barrier and criteria for its removal. The removal of the barrier between April 15 and June 1 will occur if salmon are not present, or if consultation with the FWS determines that removal is necessary for delta smelt protection. Salmon absence is indicated by 0 catch for 5 consecutive days using ten 20-minute tows. An access agreement with the landowner and the State's final design of the rock barrier are needed by March 1 to allow construction of the barrier by April 15 and to ensure barrier-design consistency between years.

DELTA ACTION 3: ADDITIONAL X2 PROTECTION

Description

Increase X2 requirements in spring to the 1962 level of development during March-June and calculate X2 as for the SWRCB's Water Quality Control Plan (WQCP).

Purpose

Provide ecosystem-level benefits beyond those provided by the existing X2 standard. An increase in the number of days in spring during which X2 is seaward of Chipps Island increases the abundance or survival of estuarine fish, including anadromous fish.

Affected Species

Improved estuarine habitat for several estuarine-dependent species, such as striped bass young-of-year, with probable benefits to chinook salmon smolts and fry, American shad, and sturgeon.

Experimental Design

The X2 measure, as included in both the State's WQCP and in this set of environmental measures, is a broad ecosystem measure based on observed relationships between the position of X2 and abundance data or indices for a large number of aquatic species. Interior will assure that the underlying monitoring that generates the abundance data or indices continues to be done during 5-year periods, so that all parties can review and evaluate these observed relationships in light of the new data. Interior anticipates that this monitoring will be done as an integrated monitoring program as part of the CALFED Bay-Delta Program.

Triggers

The previous month's index (PMI) of unimpaired flows on the eight major Central Valley rivers is the trigger. The table of PMI and X2 days values reflects the addition of a trigger that reduces the number of X2 days in March when the February PMI indicates an extremely dry month. This trigger has been designed to identify those extreme hydrological conditions during which March X2 enhancement imposes excessive water supply impacts on the project.

Implementation

Implementation would be equivalent to the substitution of the WQCP 1971.5 level of development March-June Chipps Island X2 days table with the 1962 level of development X2 days table. The "three ways to win" compliance strategy of either daily water quality, 14-day mean water quality or minimum Delta outflow would remain. Coordination of the CVP operation with the SWP operation will be identified in monthly updates of annual operational plans.

PMI	Mar	Apr	May	Jun
1000	31	3	0	0
1250	31	9	0	0
1500	31	17	0	0
1750	31	23	1	0
2000	31	27	4	0
2250	31	28	13	1
2500	31	29	23	3
2750	31	30	29	7
3000	31	30	30	12
3250	31	30	31	18
3500	31	30	31	23
3750	31	30	31	26
4000	31	30	31	28
4250	31	30	31	29
4500	31	30	31	29
4750	31	30	31	30
5000	31	30	31	30
5250	31	30	31	30

5500	31	30	31	30
99999	31	30	31	30

DELTA ACTION 4: MAINTAIN SACRAMENTO RIVER FLOW

Description

Establish Sacramento River flows at Freeport from 9,000 to 15,000 cfs (7-day average) when striped bass spawn. Flow levels will be established for 1-week periods over a 30-day period (May or as triggered) by Keswick releases if water is available in Shasta Reservoir and release changes at Keswick Dam do not exceed flow fluctuation criteria.

Purpose

Increase early survival of striped bass and improve our understanding of the influence of flow on early survival of striped bass. Any increases in flows over existing levels will contribute to improved survival of migrating chinook salmon smolts and assist in meeting the needs of estuarine species, consistent with Delta Action 3.

Affected Species

Striped bass eggs and larvae in the Sacramento River, with possible collateral benefits to fall-run salmon and estuarine fish, as well as sturgeon, American shad, and steelhead.

Experimental Design

Hypotheses: The mortality rate of striped bass eggs and larvae decreases as Sacramento River flow increases from 9,000 to 15,000 cfs. Flow above a threshold in that range is associated with reduced settling of eggs and larvae and increased rate of transport. The primary goal is to provide stable flows in the range of 9,000 to 15,000 cfs blocks with which to evaluate the effect of flow on egg and larvae striped bass survival for 1-week periods over a 30-day period.

Automated continuous monitoring stations at three locations along the Sacramento River would count eggs and larvae from three depths (near-surface, near-bottom, and mid-depth) through the period of expected spawning, in conjunction with net sampling from boats. Data would include timing and magnitude of pulses of eggs and larvae, travel time, vertical and lateral distribution, and survival. This experiment would build on previous experiments, and results would be placed in the context of the population by examining the relationship between survival from egg to early larvae and survival from egg to adult. A technical group from the Interagency Ecological Program including stakeholders will develop the experimental design proposal in early 1998.

Triggers

This action will be initiated upon reaching a Sacramento River temperature consistent with the onset of striped bass spawning. In the interim, setting the protective period for May would capture about half of the spawning.

Implementation

This action will be implemented opportunistically utilizing runoff and water temperature forecast tools. In most years this action will be implemented using existing flows, and will not increase or decrease flow releases, due to potential impacts on Shasta storage, fish spawning and rearing due to flow fluctuations, and the winter-run chinook salmon biological opinion. Keswick releases will be made to attain target Freeport flows in 1,000 to 2,000 cfs increments between 9,000 and 15,000 cfs for 1-week periods over a 31-day period based on Shasta storage. In drier years if Freeport flows are less than 9,000 cfs during the striped bass spawning period, water in Shasta Reservoir will be needed to meet the winter-run chinook salmon biological opinion (and other existing flow requirements), which may prevent implementation of this action. If the biological opinion or other flow requirements do not interfere, Interior would provide flows to attain one of the target Freeport flow values. In wet years this action would be unnecessary because flow will generally be above 15,000 cfs. The experimental component, (i.e., monitoring and evaluation) should proceed in either case.

The implementation plan and hydrological triggers and criteria have not been developed yet. Seasonal implementation will be developed in April based on the April 1 forecast, and updated with a preliminary May 1 forecast, and will require daily monitoring of CVP operations to minimize potential operational concerns with: (1) Keswick daily flow fluctuations; (2) effects on CVP coldwater pool reserves at Shasta Reservoir on a seasonal basis; and (3) coordination with SWP operations, especially Feather River releases during this time period. Future implementation of this action will need to consider the potential operational interaction between Trinity River Division operations and Shasta Reservoir operations, when and if a new Trinity River flow regime is developed and implemented. It is also important to note that it is very difficult to maintain stable flows at Freeport using Keswick releases due to accretions and depletions in May.

The above notwithstanding, the initial implementation criteria are: minimum instream flow requirements at Freeport shall be based on thresholds of STOR+INFLO as shown below, where STOR is defined as Shasta end-of-April storage in TAF and INFLO is defined as the May through Sep forecasted inflow in TAF. The inflows shall be based on a 50-percent forecast. Oroville is generally not to be drawn upon to maintain these flows.

Month	Criteria

May	If (STOR+INFLO) >or = 6200 TAF, then use 15000 cfs
	If 6200 > (STOR+INFLO) >5000 TAF, then interpolate
	If (STOR+INFLO) = 5000 TAF, then use 10000 cfs
	If 5000 > (STOR+INFLO) >4000 TAF, then interpolate
	If (STOR+INFLO) = 4000 TAF, then use 9000 cfs
	If (STOR+INFLO) < 4000 TAF, then use 0 cfs

DELTA ACTION 5: RAMPING OF SAN JOAQUIN RIVER (SJR) FLOWS

Description

Ramp the San Joaquin River flows down, ramp exports up, or maintain Vernalis flows and exports provided under Delta Action 1 for up to 15 additional days, after the 31-day pulse flow period.

Purpose

Extend the period of protection afforded by Delta Action 1.

Affected Species

San Joaquin chinook salmon smolts, young striped bass, and delta smelt could be positively affected.

Experimental Design

No experiment was recommended for this specific action since it is merely a partial to full extension of Delta Action 1; however, real-time and salvage monitoring will continue and may enable conclusions to be drawn as to the influence of ramping on fish distribution.

Triggers

The triggers to be used are temperatures at Vernalis, presence of salmon at Mossdale (absence indicated by 0 catch for 5 consecutive days using ten 20-minute tows) and reaching the "yellow-light" limit on take of delta smelt at the pumps. All biological triggers will be coordinated with the FWS. Based on the Mossdale catch through May 7, if salmon are projected to be present at the end of the pulse-flow period (generally May 15), scenario 1 or 2 (below) will be implemented.

Implementation

The ability to provide flows for this action would come from the willing-seller basis of the VAMP framework and the New Melones Reservoir interim plan of operations. Coordination of CVP operations with SWP operations, and the potential impacts of export reductions to CVP and SWP water supplies, and flow acquisition opportunities, will be included in an April 1 projected plan of operations. Coordination regarding specific actions related to delta smelt is required between the FWS, Reclamation, and the State in order to be consistent with the delta smelt biological opinion.

Although this action does not offer the opportunity for experiments, it allows for adaptive management through the use of biological triggers; however, information may be gained on the benefit of this action through the analysis of real-time monitoring data and take at the pumps with and without ramping. Four alternative scenarios are proposed:

1. If salmon are still present at Mossdale and acquired water is available, and delta smelt take at the pumps is above the "yellow light" level at the end of the pulse-flow period (generally May 15) and projected to exceed the "red light" within a week, maintain flows and exports under Delta Action 1 for an additional period based on consultation with the FWS.

2. If salmon are present at Mossdale and acquired water is available, and delta smelt take at the pumps is below the "yellow light" level, ramp flow down linearly from existing level at the end of the pulse-flow period (generally May 15) to the June 1 level, and increase exports to the extent permitted under other constraints.

3. If salmon are absent at Mossdale and delta smelt take at the pumps is above the "yellow light" level, at the end of the pulse-flow period (generally May 15) and projected to exceed the "red light" within a week, actions for the May 16 to June 1 period will be determined based on consultation with the FWS.

4. If none of the above conditions is true, do not ramp flows or exports.

As for Delta Action 1, if temperature exceeds a certain threshold (75 °F at Vernalis for 5 consecutive days), salmon survival would be assumed to be low and these salmon protective measures would no longer be implemented. In years when the VAMP cannot be implemented, this action will be implemented to the degree acquired water is available and based on consultation with the FWS.

DELTA ACTION 6: CLOSE DELTA CROSS CHANNEL (DCC) GATES IN DECEMBER-JANUARY AND OCTOBER-NOVEMBER BASED ON THE SPRING-RUN CHINOOK SALMON PROTECTION PLAN

Description

In the first year the action will be implemented as described in the 1997 CALFED Operations Group Sacramento River Spring-Run Chinook Salmon Protection Plan. The action will continue to be implemented in this manner in subsequent years unless and until it is replaced by a more protective plan adopted by the CALFED Ops Group or adopted pursuant to the State or Federal Endangered Species Acts.

Purpose

Increase survival of spring-run salmon smolts migrating through the Delta in winter.

Affected Species

Spring-run and late-fall run chinook salmon smolts, winter-run fry, and fall-run yearlings could be positively affected; adult winter-run salmon could possibly be delayed during upstream migration.

Experimental Design

Hypotheses: Survival of salmon smolts migrating through the Delta in winter is higher when the DCC is closed than when it is open. Upstream migration of winter- and late-fall-run adult chinook salmon can be blocked by the closed DCC gates. Salinity in Rock Slough increases more rapidly with the DCC closed than open.

Smolt survival experiments will be conducted under Delta Action 8, generally with the gates closed; when gates are open for water quality, the experiments will test the effect of gate position on survival. An effort will be made to monitor winter-run salmon adults migrating up into the back side of the DCC. The State in coordination with Reclamation will evaluate the effect of flows and DCC position on the value and rate of change of salinity in the Delta.

Triggers

The gates would be closed on December 1 unless water quality in the Delta is a concern. The water quality triggers as described in the Spring-Run Chinook Salmon Protection Plan will be used to indicate a water quality problem. These water quality triggers will be evaluated and revised as necessary using the experimental results on the response of salinity to DCC closure and flow.

Implementation

If outflow must be increased to maintain water quality standards with the DCC gates closed, coordination of CVP operations with the SWP operations will be necessary. Results of water quality experiments will help determine the operational effects and potential threshold indicators on the relationship of DCC operations to salinity levels in the Delta, including Rock Slough chlorides, and may help the evaluation and coordination of operational goals, both fishery and water quality.

DELTA ACTION 7: JULY FLOWS AND EXPORTS

Description

Establish July exports based on X2 location and June exports.

Purpose

Protect young striped bass, American shad, and other estuarine species from exposure to export pumping.

Affected Species

Striped bass young-of-year and American shad with possible benefits to other species.

Experimental Design

Hypotheses: Losses of young striped bass and other estuarine species to export pumping increases with export pumping rates and decreases as X2 moves seaward. Continuing existing monitoring of adult and young bass and other species would suffice to continue to test this hypothesis.

Triggers

Average export in June and location of X2 in July.

Implementation

Reclamation and the FWS will develop an implementation plan in coordination with the State. During July, a 7-day running average of daily exports will be determined by applying a multiplier to the mean monthly export in June depending on daily X2 location in July. This multiplier would be 1.0 if X2 is at or east of Collinsville (81 km), and would increase linearly with X2 to a maximum of 1.86 when X2 is at Chipps Island (74 km). There would be no export limitation due to this action (beyond existing constraints) when X2 is located seaward of Chipps Island (74km). The estimation techniques for tracking the X2 location on a daily basis will include use of the following Monismith-Kimmerer equation ($X2_t = 10.16 + 0.945 \cdot X2_{(t-1)} - 1.487 \log DeltaQ_t$) after the X2 location has been determined on a specific date in June or July at Chipps Island or Collinsville by measurement of 2.64 EC to address the high variability due to tides and other Delta influences. Other operational details will be included in an implementation plan. A 7-day mean estimate of X2 location may alleviate some of this inherent variability. June exports, in recent years, have been influenced by factors other than WQCP standards, such as delta smelt take indices. To what extent the action considers such June export considerations will be clarified in the implementation plan.

July export is a very critical month in terms of CVP-SWP allocations and operational forecasts, especially for San Luis Reservoir low point considerations and operations; therefore, coordination of CVP-SWP operations is at a premium during this time of year to meet the annual commitments of the two projects. Coordination of CVP operations with the SWP will be necessary.

DELTA ACTION 8: EVALUATE EFFECTS OF EXPORTS ON SMOLT SURVIVAL IN DECEMBER-JANUARY

Description

Perform an adaptive management experiment to determine how variation in exports in December and January affects survival of chinook salmon smolts.

Purpose

Evaluate the potential of using export reductions to increase the survival of chinook salmon smolts migrating through the Delta in winter.

Affected Species

Seaward-migrating spring-run chinook, possibly also late-fall and winter-run.

Experimental Design

Hypotheses: The survival of late-fall-run smolts from the Coleman hatchery is negatively related to exports in December and January.

The design calls for mark-recapture experiments with smolts released under varying conditions of exports. Two alternative designs were discussed. In both designs, exports would be varied between a low value (~ 2000 cfs) and a high value (~ 10,000 cfs) to provide the greatest difference. The first design calls for single releases in Georgiana Slough in each period, with test statistics being the survival indices from Chipps Island and the ocean fishery, and expanded take at the salvage facilities. The second calls for paired releases in the Sacramento River at Ryde and Georgiana Slough in each period, with the test statistic being as above plus the difference in survival between the two release sites. The second design is preferred. The choice of alternative will depend on the availability of tagged smolts.

The flow and export conditions should be held as constant as possible for 2 weeks during each of the two releases (one in early December, and one in early January). Delta inflow is more often under controlled conditions in December than in January, thus making stable experimental conditions more likely in December. It is critical to achieve as wide a difference (a minimum target difference of 7,000 cfs) between the low and high export levels to increase the chance of observing a potential effect of exports on survival. Ideally, the sequence of high and low exports should be alternated each year. Survival data will be gathered each year even if flows are uncontrolled or if achieving both export levels is not possible.

Ancillary work should be performed using particle-tracking and other modeling techniques to evaluate flow patterns under the alternative conditions.

Triggers

A preliminary November 1 plan of operation, at a 70-percent exceedance hydrological condition, will be prepared by Reclamation and DWR for implementation of this action. If the actual hydrologic conditions at time of implementation of the action is drier than projected, the action will be reevaluated. Interior analysis indicates that this action can be implemented in 70 to 80 percent of years with no water supply impacts.

Implementation

Reclamation and the FWS will develop an implementation plan and annual operational plans in coordination with the State. Implementation design should be structured around target exports and the potential flexibility of CVP-SWP operations to achieve the targets on an individual annual basis. This may necessitate some coordination action through CALFED Ops and SWRCB to grant additional operational flexibilities to facilitate experimental conditions.

UPSTREAM RESERVOIR ACTIONS #1 THROUGH #4

Description

Upstream Actions #1- #4 are intended to provide improved flows in the CVP-controlled streams of Clear Creek, Sacramento, American, and Stanislaus rivers. See Implementation Section below for details.

Purpose

In general, the improved flows in the CVP-controlled streams will provide improved spawning and rearing habitat for salmon and steelhead, improve survival of downstream migrating chinook salmon smolts, and assist in meeting the needs of estuarine species.

Affected Species

Fall-run, late fall-run, winter-run and spring-run chinook salmon, steelhead, striped bass, American shad, sturgeon, delta smelt, and other estuarine species.

Experimental Design

One of the assumptions regarding upstream actions is that improved flows in the fall will provide improved spawning habitat, and improved flows in the winter and spring will provide improved rearing habitat and survival of downstream migrating fish through the Delta. Ongoing monitoring and evaluation will continue.

Triggers

Generally, the objective minimum reservoir release to the stream for fishery restoration purposes will be determined by CVP reservoir storage condition or a combination of reservoir storage and projected inflow. Each reservoir facility has its own set of triggers integrated into the reservoir management descriptions.

Implementation

In previous years, the FWS has identified minimum flow objectives for a CVP stream for a specific period of time, that Reclamation would attempt to integrate into CVP operations. The completed (b)(2) water management plan and accompanying CVP-OCAP will guide the planning and integration of the upstream actions with the Delta actions and CVP reservoir operations on a monthly basis, consistent with the approach set out in the May 30, 1997, Revised Draft AFRP. Future implementation of these actions will need to consider the potential operational interaction between the Trinity River Division operations and the rest of the CVP, when and if a new Trinity River flow regime is developed and implemented.

The initial implementation criteria (including storage, flow, and stability criteria) for these four streams are given on the following pages and are consistent with the monthly modeling. They will be implemented based on real-time operational information and coordination between Reclamation and the FWS.

- **Upstream Action #1** - Minimum instream flow requirements below Whiskeytown shall be based on thresholds of Clair Engle storage in TAF as shown below. Stability criteria shall dictate that November and December flows equal or exceed October's flow. The stability criteria shall also dictate that February through May flow equal or exceed January's flow.

Month	Criteria

October	If (End-of-Sep Storage) > 1.40MAF, then use 200 cfs
	If (End-of-Sep Storage) > 0.75MAF, then use 150 cfs
	If (End-of-Sep Storage) < 0.75MAF, then use 100 cfs

November	If (End-of-Oct Storage) > 1.40MAF, then use 200 cfs
	If (End-of-Oct Storage) > 0.70MAF, then use 150 cfs
	If (End-of-Oct Storage) < 0.70MAF, then use 100 cfs

December	If (End-of-Nov Storage) > 1.40MAF, then use 200 cfs
	If (End-of-Nov Storage) > 0.80MAF, then use 150 cfs
	If (End-of-Nov Storage) < 0.80MAF, then use 100 cfs

January	If (End-of-Dec Storage) > 1.15MAF, then use 200 cfs
	If (End-of-Dec Storage) > 0.85MAF, then use 150 cfs
	If (End-of-Dec Storage) < 0.85MAF, then use 100 cfs

February	If (End-of-Jan Storage) > 1.30MAF, then use 200 cfs
	If (End-of-Jan Storage) > 0.90MAF, then use 150 cfs
	If (End-of-Jan Storage) < 0.90MAF, then use 100 cfs

March	If (End-of-Feb Storage) > 1.45MAF, then use 200 cfs
	If (End-of-Feb Storage) > 1.00MAF, then use 150 cfs
	If (End-of-Feb Storage) < 1.00MAF, then use 100 cfs

April	If (End-of-Mar Storage) > 1.60MAF, then use 200 cfs
	If (End-of-Mar Storage) > 1.20MAF, then use 150 cfs
	If (End-of-Mar Storage) < 1.20MAF, then use 100 cfs

May	If (End-of-Apr Storage) > 1.60MAF, then use 200 cfs
	If (End-of-Apr Storage) > 1.20MAF, then use 150 cfs
	If (End-of-Apr Storage) < 1.20MAF, then use 100 cfs

June	If (End-of-May Storage) > 1.10MAF, then use 150 cfs If (End-of-May Storage) < 1.10MAF, then use 100 cfs
July	If (End-of-Jun Storage) > 1.00MAF, then use 150 cfs If (End-of-Jun Storage) < 1.00MAF, then use 100 cfs
August	If (End-of-Jul Storage) > 0.90MAF, then use 150 cfs If (End-of-Jul Storage) < 0.90MAF, then use 100 cfs
September	If (End-of-Aug Storage) > 0.80MAF, then use 150 cfs If (End-of-Aug Storage) < 0.80MAF, then use 100 cfs

- **Upstream Action #2** - Minimum instream flow requirements below Keswick for October through April shall be based on thresholds of Shasta storage in TAF as shown below. Stability criteria shall dictate that November, December, February, March & April's flows be at least 90 percent of their preceding month's flow. The stability criteria shall also dictate that January's flow be at least 80 percent of December's Keswick flow. The stability criteria shall be ignored if the preceding month's flow was above 6000 cfs.

Month	Criteria
Oct-Dec	If (End-of-Sep Storage) > 3.0 MAF, then use 5500 cfs
	If (End-of-Sep Storage) > 2.9 MAF, then use 5250 cfs
	If (End-of-Sep Storage) > 2.8 MAF, then use 5000 cfs
	If (End-of-Sep Storage) > 2.7 MAF, then use 4750 cfs
	If (End-of-Sep Storage) > 2.6 MAF, then use 4500 cfs
	If (End-of-Sep Storage) > 2.5 MAF, then use 4250 cfs
	If (End-of-Sep Storage) > 2.4 MAF, then use 4000 cfs
	If (End-of-Sep Storage) > 2.3 MAF, then use 3750 cfs
	If (End-of-Sep Storage) > 2.2 MAF, then use 3500 cfs
	If (End-of-Sep Storage) < 2.2 MAF, then use 3250 cfs
January	If (End-of-Dec Storage) > 3.2 MAF, then use 5500 cfs
	If (End-of-Dec Storage) > 3.1 MAF, then use 5250 cfs
	If (End-of-Dec Storage) > 3.0 MAF, then use 5000 cfs
	If (End-of-Dec Storage) > 2.9 MAF, then use 4750 cfs
	If (End-of-Dec Storage) > 2.8 MAF, then use 4500 cfs
	If (End-of-Dec Storage) > 2.7 MAF, then use 4250 cfs
	If (End-of-Dec Storage) > 2.6 MAF, then use 4000 cfs
	If (End-of-Dec Storage) > 2.0 MAF, then use 3750 cfs
	If (End-of-Dec Storage) > 1.5 MAF, then use 3500 cfs
	If (End-of-Dec Storage) < 1.5 MAF, then use 3250 cfs
February	If (End-of-Jan Storage) > 3.3 MAF, then use 5500 cfs
	If (End-of-Jan Storage) > 3.2 MAF, then use 5250 cfs
	If (End-of-Jan Storage) > 3.1 MAF, then use 5000 cfs
	If (End-of-Jan Storage) > 3.0 MAF, then use 4750 cfs
	If (End-of-Jan Storage) > 2.9 MAF, then use 4500 cfs
	If (End-of-Jan Storage) > 2.8 MAF, then use 4250 cfs
	If (End-of-Jan Storage) > 2.7 MAF, then use 4000 cfs
	If (End-of-Jan Storage) > 2.2 MAF, then use 3750 cfs
	If (End-of-Jan Storage) > 1.75 MAF, then use 3500 cfs
	If (End-of-Jan Storage) < 1.75 MAF, then use 3250 cfs

Month	Criteria

March	If (End-of-Feb Storage) > 3.4 MAF, then use 5500 cfs
	If (End-of-Feb Storage) > 3.3 MAF, then use 5250 cfs
	If (End-of-Feb Storage) > 3.2 MAF, then use 5000 cfs
	If (End-of-Feb Storage) > 3.15 MAF, then use 4750 cfs
	If (End-of-Feb Storage) > 3.1 MAF, then use 4500 cfs
	If (End-of-Feb Storage) > 3.05 MAF, then use 4250 cfs
	If (End-of-Feb Storage) > 3.0 MAF, then use 4000 cfs
	If (End-of-Feb Storage) > 2.4 MAF, then use 3750 cfs
	If (End-of-Feb Storage) > 2.0 MAF, then use 3500 cfs
	If (End-of-Feb Storage) < 2.0 MAF, then use 3250 cfs

April	If (End-of-Mar Storage) > 3.8 MAF, then use 5500 cfs
	If (End-of-Mar Storage) > 3.7 MAF, then use 5250 cfs
	If (End-of-Mar Storage) > 3.6 MAF, then use 5000 cfs
	If (End-of-Mar Storage) > 3.5 MAF, then use 4750 cfs
	If (End-of-Mar Storage) > 3.4 MAF, then use 4500 cfs
	If (End-of-Mar Storage) > 3.3 MAF, then use 4250 cfs
	If (End-of-Mar Storage) > 3.2 MAF, then use 4000 cfs
	If (End-of-Mar Storage) > 2.4 MAF, then use 3750 cfs
	If (End-of-Mar Storage) > 2.0 MAF, then use 3500 cfs
	If (End-of-Mar Storage) < 2.0 MAF, then use 3250 cfs

May-August	Use 3250 cfs
September	If (End-of-Aug Storage) >2.0 MAF, then use 6000 cfs If (End-of-Aug Storage) <2.0 MAF, then use 4500 cfs

- **Upstream Action #3** - Minimum instream flow requirements below Nimbus shall be based on thresholds of Folsom storage in TAF for October through February as shown below. Minimum instream flow requirements below Nimbus shall be based on thresholds of STOR+INFLO for March through September, where STOR is defined as the beginning-of-month Folsom storage in TAF and INFLO is defined as the forecasted inflow from the current month through September in TAF. The inflows shall be based on a 50 percent forecast. Stability criteria shall dictate that November, December, & January's flows be at least 80 percent of their preceding month's flow. The stability criteria shall also dictate that February & March's flow be at least 90 percent of their preceding month's flow. The stability criteria are ignored if the preceding month's flow was above 4500 cfs.

Month	Criteria

October	If (End-of-Sep Storage) >500 TAF, then use 2500 cfs
	If (End-of-Sep Storage) >463 TAF, then use 2250 cfs
	If (End-of-Sep Storage) >425 TAF, then use 2000 cfs
	If (End-of-Sep Storage) >350 TAF, then use 1750 cfs
	If (End-of-Sep Storage) >300 TAF, then use 1500 cfs
	If (End-of-Sep Storage) >275 TAF, then use 1250 cfs
	If (End-of-Sep Storage) >265 TAF, then use 1000 cfs
	If (End-of-Sep Storage) >255 TAF, then use 750 cfs
	If (End-of-Sep Storage) <255 TAF, then use 500 cfs

November	Same as October
December	Same as October

January	If (End-of-Dec Storage) >500 TAF, then use 2500 cfs
	If (End-of-Dec Storage) >425 TAF, then use 2250 cfs
	If (End-of-Dec Storage) >350 TAF, then use 2000 cfs
	If (End-of-Dec Storage) >300 TAF, then use 1750 cfs
	If (End-of-Dec Storage) >290 TAF, then use 1500 cfs
	If (End-of-Dec Storage) >285 TAF, then use 1250 cfs
	If (End-of-Dec Storage) >280 TAF, then use 1000 cfs
	If (End-of-Dec Storage) >275 TAF, then use 750 cfs
	If (End-of-Dec Storage) <275 TAF, then use 500 cfs

February	If (End-of-Jan Storage) >600 TAF, then use 2500 cfs
	If (End-of-Jan Storage) >350 TAF, then use 2000 cfs
	If (End-of-Jan Storage) >300 TAF, then use 1750 cfs
	If (End-of-Jan Storage) >225 TAF, then use 1250 cfs
	If (End-of-Jan Storage) <225 TAF, then use 500 cfs

Month	Criteria
March	If (STOR+INFLO) >2850 TAF, then use 4500 cfs
	If (STOR+INFLO) >2766 TAF, then use 4250 cfs
	If (STOR+INFLO) >2683 TAF, then use 4000 cfs
	If (STOR+INFLO) >2600 TAF, then use 3750 cfs
	If (STOR+INFLO) >2516 TAF, then use 3500 cfs
	If (STOR+INFLO) >2433 TAF, then use 3250 cfs
	If (STOR+INFLO) >2350 TAF, then use 3000 cfs
	If (STOR+INFLO) >2025 TAF, then use 2750 cfs
	If (STOR+INFLO) >1700 TAF, then use 2500 cfs
	If (STOR+INFLO) >1500 TAF, then use 2250 cfs
	If (STOR+INFLO) >1300 TAF, then use 2000 cfs
	If (STOR+INFLO) >1150 TAF, then use 1750 cfs
	If (STOR+INFLO) >1000 TAF, then use 1500 cfs
	If (STOR+INFLO) > 967 TAF, then use 1250 cfs
	If (STOR+INFLO) > 933 TAF, then use 1000 cfs
	If (STOR+INFLO) > 900 TAF, then use 750 cfs
	If (STOR+INFLO) > 700 TAF, then use 500 cfs
	If (STOR+INFLO) < 700 TAF, then use 250 cfs
April	If (STOR+INFLO) >2450 TAF, then use 4500 cfs
	If (STOR+INFLO) >2383 TAF, then use 4250 cfs
	If (STOR+INFLO) >2316 TAF, then use 4000 cfs
	If (STOR+INFLO) >2250 TAF, then use 3750 cfs
	If (STOR+INFLO) >2183 TAF, then use 3500 cfs
	If (STOR+INFLO) >2116 TAF, then use 3250 cfs
	If (STOR+INFLO) >2050 TAF, then use 3000 cfs
	If (STOR+INFLO) >1800 TAF, then use 2750 cfs
	If (STOR+INFLO) >1550 TAF, then use 2500 cfs
	If (STOR+INFLO) >1350 TAF, then use 2250 cfs
	If (STOR+INFLO) >1150 TAF, then use 2000 cfs
	If (STOR+INFLO) >1075 TAF, then use 1750 cfs
	If (STOR+INFLO) >1000 TAF, then use 1500 cfs
	If (STOR+INFLO) > 967 TAF, then use 1250 cfs
	If (STOR+INFLO) > 933 TAF, then use 1000 cfs
	If (STOR+INFLO) > 900 TAF, then use 750 cfs
	If (STOR+INFLO) > 700 TAF, then use 500 cfs
	If (STOR+INFLO) < 700 TAF, then use 250 cfs

Month	Criteria
May	If (STOR+INFLO) >2050 TAF, then use 4500 cfs
	If (STOR+INFLO) >1932 TAF, then use 4250 cfs
	If (STOR+INFLO) >1816 TAF, then use 4000 cfs
	If (STOR+INFLO) >1700 TAF, then use 3750 cfs
	If (STOR+INFLO) >1600 TAF, then use 3500 cfs
	If (STOR+INFLO) >1500 TAF, then use 3250 cfs
	If (STOR+INFLO) >1400 TAF, then use 3000 cfs
	If (STOR+INFLO) >1200 TAF, then use 2750 cfs
	If (STOR+INFLO) >1000 TAF, then use 2500 cfs
	If (STOR+INFLO) > 950 TAF, then use 2250 cfs
	If (STOR+INFLO) > 900 TAF, then use 2000 cfs
	If (STOR+INFLO) > 850 TAF, then use 1750 cfs
	If (STOR+INFLO) > 800 TAF, then use 1500 cfs
	If (STOR+INFLO) > 775 TAF, then use 1250 cfs
	If (STOR+INFLO) > 750 TAF, then use 1000 cfs
	If (STOR+INFLO) > 725 TAF, then use 750 cfs
	If (STOR+INFLO) > 600 TAF, then use 500 cfs
	If (STOR+INFLO) < 600 TAF, then use 250 cfs
June	If (STOR+INFLO) >1800 TAF, then use 4500 cfs
	If (STOR+INFLO) >1750 TAF, then use 4250 cfs
	If (STOR+INFLO) >1700 TAF, then use 4000 cfs
	If (STOR+INFLO) >1600 TAF, then use 3750 cfs
	If (STOR+INFLO) >1500 TAF, then use 3500 cfs
	If (STOR+INFLO) >1400 TAF, then use 3250 cfs
	If (STOR+INFLO) >1300 TAF, then use 3000 cfs
	If (STOR+INFLO) >1266 TAF, then use 2750 cfs
	If (STOR+INFLO) >1133 TAF, then use 2500 cfs
	If (STOR+INFLO) >1000 TAF, then use 2250 cfs
	If (STOR+INFLO) > 950 TAF, then use 2000 cfs
	If (STOR+INFLO) > 900 TAF, then use 1750 cfs
	If (STOR+INFLO) > 800 TAF, then use 1500 cfs
	If (STOR+INFLO) > 775 TAF, then use 1250 cfs
	If (STOR+INFLO) > 750 TAF, then use 1000 cfs
	If (STOR+INFLO) > 725 TAF, then use 750 cfs
	If (STOR+INFLO) > 600 TAF, then use 500 cfs
	If (STOR+INFLO) < 600 TAF, then use 250 cfs

Month	Criteria
July	If (STOR+INFLO) >1400 TAF, then use 2500 cfs
	If (STOR+INFLO) >1300 TAF, then use 2250 cfs
	If (STOR+INFLO) >1200 TAF, then use 2000 cfs
	If (STOR+INFLO) >1000 TAF, then use 1750 cfs
	If (STOR+INFLO) > 800 TAF, then use 1500 cfs
	If (STOR+INFLO) > 775 TAF, then use 1250 cfs
	If (STOR+INFLO) > 750 TAF, then use 1000 cfs
	If (STOR+INFLO) > 725 TAF, then use 750 cfs
	If (STOR+INFLO) > 600 TAF, then use 500 cfs
	If (STOR+INFLO) < 600 TAF, then use 250 cfs
August	If (STOR+INFLO) >1200 TAF, then use 2500 cfs
	If (STOR+INFLO) >1100 TAF, then use 2250 cfs
	If (STOR+INFLO) >1000 TAF, then use 2000 cfs
	If (STOR+INFLO) > 900 TAF, then use 1750 cfs
	If (STOR+INFLO) > 800 TAF, then use 1500 cfs
	If (STOR+INFLO) > 700 TAF, then use 1250 cfs
	If (STOR+INFLO) > 600 TAF, then use 1000 cfs
	If (STOR+INFLO) > 550 TAF, then use 750 cfs
	If (STOR+INFLO) > 500 TAF, then use 500 cfs
	If (STOR+INFLO) < 500 TAF, then use 250 cfs
September	If (STOR+INFLO) > 800 TAF, then use 2500 cfs
	If (STOR+INFLO) > 750 TAF, then use 2250 cfs
	If (STOR+INFLO) > 700 TAF, then use 2000 cfs
	If (STOR+INFLO) > 600 TAF, then use 1750 cfs
	If (STOR+INFLO) > 500 TAF, then use 1500 cfs
	If (STOR+INFLO) > 400 TAF, then use 1250 cfs
	If (STOR+INFLO) > 350 TAF, then use 1000 cfs
	If (STOR+INFLO) > 325 TAF, then use 750 cfs
	If (STOR+INFLO) > 300 TAF, then use 500 cfs
	If (STOR+INFLO) < 300 TAF, then use 250 cfs

- **Upstream Action #4** - Minimum instream flow requirements below Goodwin Dam on the Stanislaus River shall be based on the criteria in the Two-Year Interim Stanislaus Agreement (attached), until Interior's current efforts to develop long-term criteria are completed, consistent with the Revised Draft AFRP.

APPENDIX B

APPENDIX B -- SUMMARY OF SIMULATED CVP AND SWP DELIVERY IMPACTS BY YEAR TYPE

SUMMARY OF SIMULATED CVP DELIVERY IMPACTS BY YEAR TYPE*

(Negative value indicates a decrease in CVP deliveries)

	Bay-Delta Accord Scenario Versus Base Scenario	3406(b)(1)+(b)(2) Scenario Versus Bay-Delta Accord Scenario	3406(b)(1)+(b)(2) Scenario Versus Base Scenario
Year types based on Sac Basin 40-30-30	March-February Total (TAF)	March-February Total (TAF)	March-February Total (TAF)
N YEARS	21	21	21
WET MAX	-194	-390	-390
WET AVG	**-9**	**-139**	**-148**
WET MIN	0	0	0
N YEARS	9	9	9
A N MAX	-390	-195	-390
A N AVG	**-76**	**-43**	**-119**
A N MIN	0	0	0
N YEARS	14	14	14
B N MAX	-611	-669	-700
B N AVG	**-173**	**-226**	**-399**
B N MIN	113	148	110
N YEARS	16	16	16
DRY MAX	-717	-748	-1138
DRY AVG	**-434**	**-271**	**-705**
DRY MIN	0	24	-293
N YEARS	9	9	9
CRT MAX	-925	-816	-925
CRT AVG	**-416**	**-202**	**-617**
CRT MIN	0	330	0
Run Name	**800B_D68**	**800V_D23**	**800V_D23**

* Operations and proposed actions are not carried out on a year-type basis. Impacts are generally multiyear consequences. The results displayed above are a rough approximation of the impacts to the deliveries of implementing the measures. Some of the biological triggers included in the measures cannot be easily or usefully modeled. It is anticipated that the triggers generally will cause the actual impacts to be less than the modeled impacts. Measure 8 has not been included in these model results because in most years, Measure 8 will have no impacts to deliveries. Measure 2, as modeled, reflects the current VAMP discussions, and as such, includes some purchase water (or "(b)(3)" water).

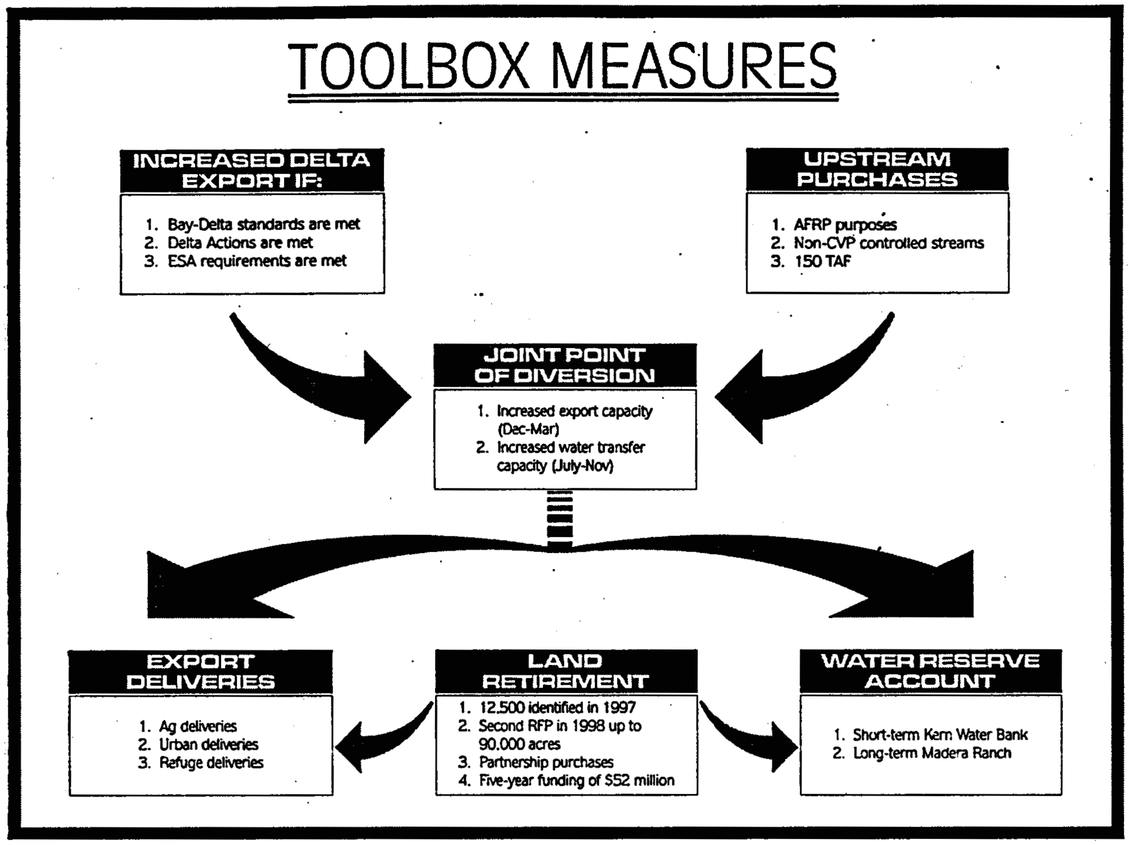
SUMMARY OF SIMULATED SWP DELIVERY IMPACTS BY YEAR TYPE*
(Negative value indicates a decrease in SWP deliveries)

	Bay-Delta Accord Scenario Versus Base Scenario	3406(b)(1)+(b)(2)) Scenario Versus Bay-Delta Accord Scenario	3406(b)(1)+(b)(2) Scenario Versus Base Scenario
Year types based on Sac Basin 40-30-30	**March-February Total (TAF)**	**March-February Total (TAF)**	**March-February Total (TAF)**
N YEARS	21	21	21
WET MAX	0	0	0
WET AVG	0	0	0
WET MIN	0	0	0
N YEARS	9	9	9
A N MAX	0	0	0
A N AVG	0	0	0
A N MIN	0	0	0
N YEARS	14	14	14
B N MAX	-520	-346	-694
B N AVG	0	-50	-50
B N MIN	520	0	346
N YEARS	16	16	16
DRY MAX	-859	-282	-687
DRY AVG	-324	2	-322
DRY MIN	0	339	339
N YEARS	9	9	9
CRT MAX	-693	0	-519
CRT AVG	-286	169	-117
CRT MIN	173	348	346
Run Name	**800B_D68**	**800V_D23**	**800V_D23**

* Operations and proposed actions are not carried out on a year-type basis. Impacts are generally multiyear consequences. The results displayed above are a rough approximation of the impacts to the deliveries of implementing the measures. Some of the biological triggers included in the measures cannot be easily or usefully modeled. It is anticipated that the triggers generally will cause the actual impacts to be less than the modeled impacts. Measure 8 has not been included in these model results because in most years, Measure 8 will have no impacts to deliveries. Measure 2, as modeled, reflects the current VAMP discussions, and as such, includes some purchase water (or "(b)(3)" water).

APPENDIX C

APPENDIX C -- TOOLBOX MEASURES



JOINT POINT OF DIVERSION

Description

Under current operations, the Central Valley Project (CVP) can pump only 4,200 cubic feet per second (cfs) of permitted capacity because of conveyance constraints downstream of the Tracy Pumping Plant (Tracy). By implementing the "joint point of diversion," the 400 csf not currently being pumped by the CVP could be pumped by the State Water Project (SWP) at the Banks Pumping Plant (Banks) and delivered for CVP uses. In addition, capacity above 400 cfs is available at Banks at times when the Bay-Delta standards and the Delta Actions are being met and the State side of San Luis Reservoir is full. This capacity can be used by the CVP, with the concurrence of the California Department of Water Resources (CDWR), for environmental, agricultural, and urban exports. Under joint point operations, pumping at Tracy would remain at 4,200 cfs. Pumping at Banks is limited to 6,700 cfs in most months in compliance with the 1981 Public Notice 5820A ("Four Pumps Agreement") issued by the U.S. Army Corps of Engineers.

Joint point operations could be further enhanced through the operational flexibility provided by an intertie between the Delta-Mendota Canal and the SWP Aqueduct. This would allow the CVP to pump its full permitted amount of 4,600 cfs at Tracy and then convey the water to San Luis through the SWP Aqueduct. As a result, operational flexibility is improved by allowing water to be pumped at either Banks or Tracy in the event either pumping plant is having a "take" impact on a listed species.

Either scenario, joint point or joint point with intertie, provides increased capacity to export water from the Delta during fall and winter months when excess water exists and when the Bay-Delta standards, Delta Actions, and Endangered Species Act (ESA) requirements (including any final Spring-run Chinook Salmon Protection Plan adopted by the California Fish and Game Commission[1]) are being met. Joint point also provides capacity for either of the projects to move additional water from northern storage through the export facilities.

Interior's proposed request for use of the joint point of diversion does not include its use to facilitate water transfers associated with Interior purchases on upstream tributaries. Each water transfer will require a separate State Water Resources Control Board (SWRCB) approval action since the place of use and point of diversion is being changed. Interior believes that its potential water transfer transactions will generally occur in different times of the year than the anticipated use of joint point under this request.

[1]For purposes of the present analysis, Interior has assumed that the California Fish and Game Commission will adopt the Spring-run Chinook Protection Plan prepared by the CALFED Operations Group dated October 27, 1997. Under the proposed Protection Plan, operational actions are to be taken in response to environmental or monitoring indicators. Operational responses are similar to those required within the Winter-run Chinook Salmon Biological Opinion.

Modeling by Reclamation indicates that over the 72-year hydrology, implementation of the joint point will allow for an increase in export capability of up to an average of 250,000 acre-feet. The long-term average assumes that all Bay-Delta standards are met, all Delta Actions are implemented, and the State side of San Luis Reservoir is full. The additional water available for export would be stored in the Federal share of San Luis Reservoir, conveyed to a groundwater basin as San Luis fills, used for the environmental purposes outlined below, or delivered for agricultural or urban use. SWP interruptible deliveries, and water transfers by SWP contractors would have first priority to the San Luis storage capacity. While some storage capacity in the Federal side of San Luis Reservoir exists, new groundwater storage capacity south of the Delta will also be developed as discussed in the Water Reserve Account section.

Proposed Use of Joint Point of Diversion

Interior proposes to submit a request to the SWRCB to use the joint point of diversion under the following conditions and for the following purposes:

(1) Interior will request to pump additional water 250,000 acre-feet using the joint point. This amount will be pumped when the Delta is in an excess flow condition (as discussed above). Interior also recognizes that use of the joint point of diversion will be contingent on the cooperation of the CDWR.

(2) Interior proposes that the additional water pumped would be available for environmental, agricultural, and urban use including: (a) CVP deliveries, (b) wildlife refuge supplies; and (c) banking in the Water Reserve Account for later environmental; agricultural, or urban use.

(3) Water pumped under joint point operations would be proportionally shared as it is pumped. The SWP gain or loss due to implementation of these measures will be considered in determining how the benefits will be shared.

(4) Interior proposes that this request cover the 5-year period beginning January 1998 contingent on SWRCB approval.

Timing of Implementation

Implementation of joint point does not require construction of new facilities. Under SWRCB Water Rights Decision 95-6 (WR95-6) the CVP and SWP can modify pumping operations for fisheries benefits. WR95-6 requires that DWR and the CVP submit a plan describing the modified pumping operations to the CALFED Operations Group (Ops Group) and the Ops Group must approve the plan. Once approved by the Ops Group, a formal letter is submitted to the SWRCB for approval. Interior believes that a plan can be submitted to the Ops Group during its next meeting on December 4, 1997, and the plan could be approved by the SWRCB by December 31, 1997.

Estimated Cost

Based on current rates for SWP wheeling and CVP electric energy, the estimated cost of implementing the joint point is approximately $21 per acre-foot for water pumped by the SWP for the benefit of the CVP. If the intertie is constructed, it is estimated to cost $8 million.

Potential Funding Sources

Funding for costs associated with implementation of the joint point of diversion may be available from several sources. To the extent that the joint point provides water for storage in the Water Reserve Account for later environmental use, the costs associated with making that water available may be funded through any of several environmental funding sources. Table 1 is a partial list of potential funding sources. Interior will determine which of these funds can be most appropriately used to fund the joint point by February 15, 1998.

Table 1

Funding Source	Description	Availability
CVPIA Restoration Fund	Established in the CVPIA for specifically enumerated purposes and water purchases.	Immediately
CVP O&M Funds	Funds available for operation and maintenance of CVP facilities	Immediately
Bay-Delta Environmental Enhancement and Water Security Act	Funding available for long-term CALFED programs. May be used for directed projects or early implementation of CALFED projects.	Immediately
Prop 204 - CVPIA State Cost Share	Funds available for state share of CVPIA projects	Immediately

Environmental Benefits

Increased export capacity is critical to establishing any Water Reserve Account south of the Delta. As described in the Water Reserve Account section, a portion of the water exported from the Delta through the joint point could be delivered temporarily to a Water Reserve Account in San Luis Reservoir from which it may be used for environmental purposes. As the annual filling of San Luis Reservoir progresses, environmental water temporarily stored in San Luis can be moved to groundwater storage as part of the Water Reserve Account. Reclamation analysis indicates that the joint point could allow for early filling of San Luis Reservoir in many years which results in added operational flexibility for environmental benefits. In addition, the use of the joint point of diversion facilitates delivery of water supplies to wildlife refuges south of the Delta.

Water Supply Benefits

Implementation of joint point results in additional export capability, much of which will be used for deliveries to CVP contractors. Water may be exported during times when the Bay-Delta standards, Delta Actions, and ESA requirements are being met. The portion of the water exported but not delivered to the Water Reserve Account will be used for contract deliveries, stored in San Luis Reservoir, or in groundwater storage developed by others. The potential to fill San Luis Reservoir early in many years provides the flexibility to deliver additional water supplies at times when there are fewer environmental impacts.

LAND RETIREMENT

Description

The CVPIA Land Retirement Program is limited to willing buyer/willing seller transactions with a preference for drainage-impaired lands in the CVP service area. Land retirement purchases will occur in two different ways: (1) Reclamation will purchase the land and water and make the water available for direct environmental benefit or delivery into storage as part of the Water Reserve Account, or (2) Reclamation will purchase the land only and the water will remain with the water district. Under either method, land retirement purchases will be based on fair market value.

In response to the Request for Proposals (RFP) issued by Reclamation in 1997, there were 31 offers to sell drainage-impacted lands totaling 27,500 acres, of which Reclamation anticipates funding purchases of approximately 12,500 acres. Funding for purchases from willing sellers under an on-going RFP process will be approximately $50 million over the next 5 years.

Additional funding may be available from districts that choose to partner with Reclamation in land retirement purchases. Under such arrangements, Interior will jointly investigate the possibility of purchasing additional lands on the west side of the San Joaquin Valley with willing partners. Under these partnerships, Interior will use the water acquired during wet years for either direct environmental benefit (including refuge supplies) or for storage in the Water Reserve Account. During other year types the water will be available for use by the partner.

In 1998, Reclamation will issue a second RFP to identify additional lands for purchase during the next 5 years. That RFP will attempt to identify (consistent with the current budget) an additional 40,000 acres of land. The CALFED water quality program has set a target of 90,000 acres for land retirement, and acquisitions under the second RFP would be coordinated with CALFED. If the response to the 1998 RFP exceeds the funding that is currently budgeted, Reclamation will seek additional sources of funding including CVPIA and CALFED funds for land retirement.

Amount of Water

The disposition of water from the Land Retirement Program depends on whether Reclamation acquires land and water, or only the land. It is not anticipated that a significant amount of water will be made available to the Reclamation from the Land Retirement Program.

Timing

The CVPIA Land Retirement Program currently exists. The current program includes numerous steps such as solicitation of offers, selection, appraisals, National Environmental Policy Act (NEPA) analysis, and negotiation for purchases. An estimated 12,500 acres will be retired in 1998 at the appraised value subject to availability from willing sellers.

Estimated Cost

Proposals submitted to the CVPIA Land Retirement Program in 1997 ranged from $1,500 per acre to $6,200 per acre, with an average price of about $2,600 per acre for land sold with water.

Potential Funding Sources

Funding for the CVPIA Land Retirement Program is budgeted as a Restoration Fund and energy and water appropriation expenditure. Table 2 is a list of potential funding sources for land retirement. Interior will determine which of these funds can be most appropriately used to fund land retirement purchases by February 15, 1998.

Table 2

Funding Source	Description	Availability
CVPIA Restoration Fund	Established in the CVPIA for specifically enumerated purposes and water purchases.	Immediately
Energy and Water Appropriations	Funding available to Interior for specific water related projects	2-year lead time
Bay-Delta Environmental Enhancement and Water Security Act	Funding available for long-term CALFED programs. May be used for directed projects or early implementation of CALFED projects.	Immediately
Conservation Reserve Program (1996 Farm Bill)	Funds available to provide monetary incentive to retire highly erodible and environmentally sensitive land.	Revolving enrollment periods

Environmental Benefits

Environmental benefits include: (1) taking drainage-impacted land out of production and reducing salt and selenium loading, (2) creating upland habitat, and (3) shifting demand for water from agricultural use on predominantly drainage-impacted lands to storage in the Water Reserve Account or other environmental needs. Water districts that retain water made available through land retirement will be prohibited from using the water on drainage-impacted lands.

Water Supply Benefits

The CVPIA Land Retirement Program will allow for financial participation by water districts. Participating districts will benefit by retaining the water for use in improving their supply reliability on nondrainage-impacted lands.

WATER PURCHASES ON SACRAMENTO RIVER TRIBUTARIES

Description

Water purchases from willing sellers on tributaries upstream of the Delta will be made during below normal, above normal, and wet years to meet flow requirements previously identified by the U.S. Fish and Wildlife Service (FWS). These upstream water purchases will be structured to achieve tributary flow requirements as identified in the FWS *Draft Guidelines for Allocation of Water Acquired Pursuant to Section 3406(b)(3) of the Central Valley Project Improvement Act.* By upstream tributaries, Interior means those streams tributary to the Sacramento River, San Joaquin River, and the Delta.

Purchased water will be scheduled to meet the identified upstream anadromous fish needs. Once the upstream purpose has been achieved, the purchased water will be available for export from the Delta provided the Bay-Delta standards, ESA requirements, Delta Actions, and any applicable spring-run protections are being met. Water exported from the Delta will be delivered to the Water Reserve Account as described in the Water Reserve Account section or delivered for agricultural or urban uses.

Amount of Water

Water purchases on the upstream tributaries are expected to make available approximately 150,000 acre-feet of water to meet previously identified, high priority Anadromous Fish Restoration Program (AFRP) flows. This water will come from a combination of water purchases negotiated with willing sellers. The actual source of the water will be determined during negotiations with individual sellers.

Interior has currently identified 320,000 acre-feet of water for AFRP purposes (Table 3). Interior will continue to negotiate purchases on upstream tributaries until: (1) contracts are executed for

150,000 acre-feet of high priority AFRP flows on upstream tributaries, (2) the high priority AFRP flows on all upstream tributaries have been achieved, or (3) no willing sellers can be identified on streams where high priority AFRP flows are not being met.

Table 3
Potential AFRP Purchases On Sacramento River Tributaries

			All Standards Being Met			No Water, No Capacity			Transfer Capacity Available					All Standards Being Met
Location & Quantity	AFRP Priority	Purpose	January	February	March	April	May	June	July	August	September	October	November	December
Feather														
36	1	S&I										12	12	12
24	2	R&O				12	12							
36	3	I&R	12	12	12									
Yuba														
19	1	R&O				9.5	9.5							
28	2	I&R	9.3	9.3	9.4									
12	3	O-S						3	3	3	3			
5	4	S&I										1.6	1.7	1.7
14	5	R&O				7	7							
9	6	I&R	3	3	3									
56	11	O-S						14	14	14	14			
Bear														
40	1	S&I										13.3	13.3	13.4
9	2	R&O				4.5	4.5							
32	3	I&R	10.6	10.7	10.7									

S&I = Spawning and Incubation
I&R = Incubation and Rearing
R&O = Rearing and Out-migration
O-S = Over-sumering

Interior fully recognizes the political and institutional hurdles it must overcome to successfully purchase water on upstream tributaries. For this reason Interior is continuing to identify high priority AFRP flow needs on other upstream tributaries and will pursue negotiation of those purchases concurrently with negotiations for purchase of 150,000 acre-feet of the 320,000 acre-feet already identified. Interior intends to specifically focus on identifying AFRP needs and obtaining water on Mill and Deer Creeks in an effort to provide improved flows for spring-run spawning.

In addition to the important concerns of Boards of Supervisors, Water Districts, and local communities, Interior also recognizes that SWRCB approval of these purchases will be required, and DWR approval will be required on the Feather River. It is with these limitations in mind that Interior is continuing to identify high-priority AFRP purchases on other upstream tributaries.

Since release of the October 31, 1997, draft Administrative Proposal, Interior has contacted potential water sellers on the streams identified in Table 3. Through these contacts, Interior has determined that there is a willingness on the part of several entities to open discussions for negotiation of purchases in the amounts and on the timing outlined in Table 3. While none of these parties has yet committed to sell water to Interior and all have identified several issues of concern, Interior is encouraged by the willingness of these entities to discuss Interior purchases for AFRP flows.

Estimated Cost

The cost of water during the 1991, 1992, and 1994 drought water banks was $125 per acre-foot, $50 per acre-foot, and $50 per acre-foot, respectively. More recently, Reclamation has been successful in purchasing water on Sacramento River tributaries during wet and above normal years at a cost of $50 per acre-foot.

In recent discussions with entities on the tributaries identified in Table 3, Interior has learned that purchase prices in the range of $50 per acre-foot are likely. While actual prices paid by Interior will be determined during individual negotiations with water sellers, it is expected that the negotiated price will approximate $50 per acre-foot.

Timing

Based on recent Reclamation experience, short-term water purchases on Sacramento River tributaries could be implemented during 1998. The precise timing and duration of implementing water purchases will be dependent on any necessary NEPA or California Environmental Quality Assessment (CEQA) requirements.

Reclamation has developed Table 4 to describe the necessary timing for implementation of upstream purchases. Table 4 includes the timing necessary for identification, negotiation, environmental review, and approval of water purchases on upstream tributaries. Interior recognizes that changes in this schedule may be necessary to accommodate unique circumstances of individual purchases.

Table 4

UPSTREAM WATER PURCHASES
1998 TEMPORARY WATER TRANSFERS

ID	Task Name	Duration	1998: Nov	Dec	Jan	Feb	Mar	Apr	May
1	Environmental Assessment	117d							
2	Award Contract	14d							
3	Prepare Review (30d)	45d							
4	Public Review (30d)	30d							
5	Prepare Final EA	14d							
6	EA Approval	14d							
7									
8	Water Purchase Agreement	128d							
9	Prepare Draft Agreement	14d							
10	Negotiate Agreement	14d							
11	Finialize Agreement	5d							
12	Agreement Signed/Exec	21d							
13									
14	SWRCB Petition	73d							
15	Prepare Petition	30d							
16	SWRCB Public Notice	30d							
17	SWRCB Approval	14d							

Potential Funding Sources

Funding for upstream water purchases to meet AFRP purposes could potentially come from a variety of sources. Table 5 is an un-prioritized list of those sources. Interior's preliminary review indicates that these sources may be available to assist in funding purchases of flows for AFRP purposes. A determination of the availability of these funds for purchasing AFRP flows will be completed prior to February 15, 1998.

Table 5

Funding Source	Description	Availability
CVPIA Restoration Fund	Established in the CVPIA for specifically enumerated purposes and water purchases.	Immediately
Energy and Water Appropriations	Funding available to Interior for specific water related projects	2-year lead time
Bay-Delta Environmental Enhancement and Water Security Act	Funding available for long-term CALFED programs. May be used for directed projects or early implementation of CALFED projects.	Immediately
Land and Water Conservation Fund	Funding available for land and water acquisition.	Federal budget cycle
State CVPIA Cost Share	Funding for state share of CVPIA restoration efforts.	January, 1997
Prop 204 - Sacramento Valley Water Management and Habitat Protection	Funding available for water management and habitat improvements in the Sacramento Valley	January, 1997

Environmental Benefits

Water purchases on the upstream tributaries will provide a variety of benefits for anadromous fish, including spawning, incubation, rearing, out-migration, and over-summering. In addition, AFRP water purchases on the Sacramento River tributaries will increase flows in the lower Sacramento River to benefit anadromous fish by supplementing the current upstream actions being implemented by Interior since 1993.

Water Supply Benefits

Water made available through water purchases on upstream tributaries will be available for export during periods when the Bay-Delta standards, Delta Actions, applicable spring-run requirements, and ESA requirements are being met.

WATER RESERVE ACCOUNT

Description

Interior proposes creating a Water Reserve Account for environmental, agricultural, and urban uses. In the short-term (1998-2000), the Water Reserve Account could consist of up to 450,000 acre-feet of groundwater banked in the Kern County Water Agency service area; 300,000 acre-feet would be available in the first year, and 150,000 acre-feet would be available in the second year. In the long-term (beyond 2000), the Water Reserve Account could consist of up to 350,000 acre-feet of water banked in the Madera Ranch Groundwater Banking Project located in Madera County. Under either the Kern County or Madera Ranch programs, the Water Reserve Account would be used to store water made available through implementation of the joint point of diversion. Interior continues to study the possibility of developing a portion of the Water Reserve Account in areas north of the Delta.

Water could be placed into storage in the Water Reserve Account from several sources. Water that Interior buys as part of the Land Retirement Program could be placed in the Water Reserve Account. In addition, a portion of the water available as a result of implementation of the joint point of diversion could be placed into the Water Reserve Account.

As currently envisioned, the Water Reserve Account would include up to 200,000 acre-feet of water for environmental uses. Potential uses include: (1) implementation of additional measures or implementation of measures to a fuller extent than originally planned in the same year the water is stored, (2) banking water for use at a later time when new environmental needs arise or when currently identified environmental needs are greater; and (3) providing water for direct delivery to water users in exchange for reduced exports to gain environmental benefits in the Delta or for unforeseen environmental emergencies.

Environmental water can be stored in the Federal portion of San Luis on a space-available basis. Interior estimates that at least 50,000 acre-feet of storage capability will be available at San Luis throughout the year in 40 percent of water years. Environmental water stored in San Luis will be released pursuant to the direction of the FWS for whatever purposes it directs, including water sales or exchanges with proceeds used for other environmental measures.

If environmental water stored at San Luis must be "spilled" to make storage space available for users with more senior storage rights, Reclamation will provide advance notice to FWS. FWS, in consultation with Reclamation, will decide what action should be taken, including any of the following:

(1) The water can be transferred to groundwater storage south of the Delta for subsequent environmental uses.

(2) If the timing is appropriate, the water could be used to provide additional San Joaquin River instream flows in excess of the Vernalis Adaptive Management Plan (VAMP) flows, as long as those additional flows are consistent with the VAMP experimental purposes.

(3) If the timing is appropriate, the water could be used to provide Level 4 water supplies to south-of- Delta wildlife refuges.

(4) If the timing is appropriate, the water could be given to water contractors relying on San Luis supplies in exchange for reduced export pumping during environmentally sensitive times.

(5) The water can be sold to Reclamation or other water users and stored in groundwater storage, with proceeds used for other environmental measures.

If the FWS Regional Director finds there is no environmental reason to deliver additional environmental water to the San Luis Reservoir or other environmental storage sites south of the Delta, the Regional Director may chose to reduce or eliminate the environmental share of new joint point of diversion pumping.

The Water Reserve Account will also include up to 200,000 acre-feet of water for agricultural and urban uses including increased deliveries to consumptive uses compensated at the appropriate contract rate (including Restoration Fund charges).

Short-term Water Reserve Account - Kern County Program.

Overview. The Kern County Program is intended to provide the ability to establish the Water Reserve Account in the short-term while the long-term Madera Ranch Project is being developed and constructed. The program will commence in 1998 and extend through 2000. The program will make up to 300,000 acre-feet of water available from the Water Reserve Account for environmental, agricultural, and urban use.

Borrowing. The Kern County Program will provide Interior with the ability to borrow water previously stored in Kern County groundwater basins. During the first year of recovery, up to 300,000 acre-feet may be borrowed from previously stored supplies. Up to an additional 150,000 acre-feet may be borrowed in the second year. The amount of water available in the third year is limited to the amount of water returned to the program by Interior for storage.

Replacement of Borrowed Water. Borrowed water must be replaced by Interior.

Storage in Advance of Recovery. Interior may store water in advance of recovery to preclude the necessity of borrowing water.

Payment for Water. Interior will pay the Kern County Water Agency (KCWA) an up-front option payment to secure the ability to borrow water. Interior will also pay a negotiated price in the year water is taken, and is responsible for obtaining the power necessary to recover and convey the water.

The KCWA and its member units have developed a preliminary assessment of the amount of water that can be made available through their current groundwater storage programs. This water is currently stored in groundwater basins in Kern County and can be withdrawn in the amounts described in Table 6.

Table 6

Source	SWP Allocation (Acre-Feet)				
	30%	20%	15%	10%	0%
Kern Water Bank	118,800	118,800	118,800	118,800	118,800
Semitropic Water Storage Dist.	119,400	100,800	90,000	90,000	90,000
KCWA In-lieu Programs	71,400	60,100	54,500	48,800	37,600
Total	309,600	279,700	263,300	257,600	246,000

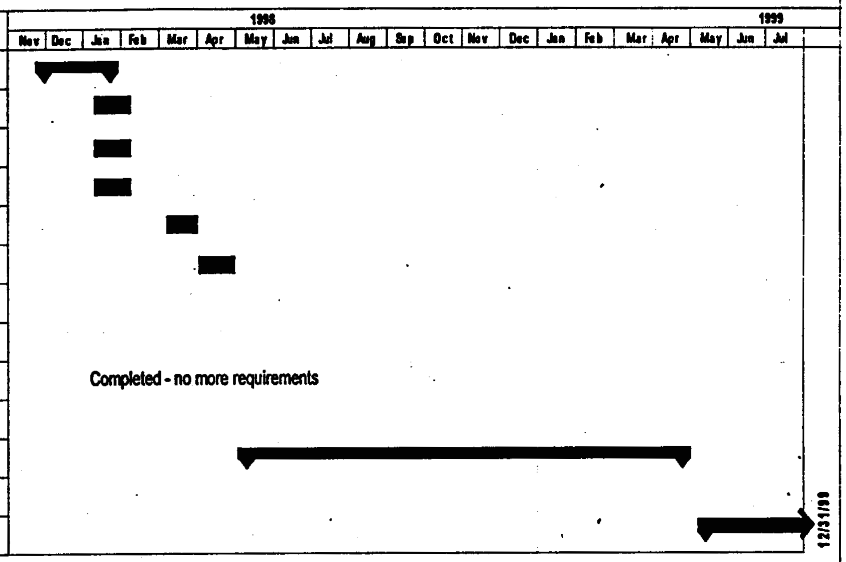
Timing for Implementation

Because the Kern County Program involves water already in groundwater storage, this program provides the best, quickly available source of water for the Water Reserve Account. Preliminary discussions with the KCWA indicate that an agreement for the short-term Water Reserve Account could be negotiated and executed before February 15, 1998 (see Table 7).

Table 7

KCWA WATER SUPPLY PROGRAM FOR USF & WS

ID	Task Name	Duration
1	KCWA Water Supply Program Agreement	
2	Negotiate Agreement (KCWA & DOI, F&W)	70d
3	KCWA/Local approval	30d
4	DWR approval	30d
5	SWC approval	30d
6	Execute Agreement	15d
7	Payment to KCWA	30d
8		
9	KCWA Environmental Requirements	
10		
11	Construction of Local facilities	365d
12		
13	First Possible Initial Recovery	73d



Long-term Water Reserve Account - Madera Ranch Groundwater Banking Project.

Overview. Reclamation is currently investigating the Madera Ranch Groundwater Banking Project in a two-phase process with the intent to use it as the long-term Water Reserve Account. Phase I of the process will begin in November 1997, and Phase II will begin in March 1998. At the conclusion of Phase I in February 1998, Reclamation will have developed sufficient information to determine the suitability of Madera Ranch as a Water Reserve Account.

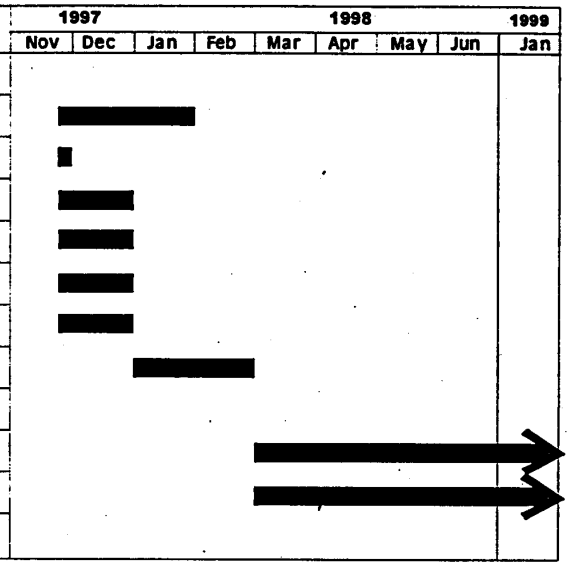
Storage Capacity. The Madera Ranch Groundwater Banking Project has a total storage capacity of up to 390,000 acre-feet. Water can be delivered from the San Luis Reservoir or the Mendota Pool though conveyance facilities constructed as part of the project. Water would be placed in groundwater storage through spreading facilities also constructed as part of the project. Up to 24,000 acre-feet per month can be conveyed and stored under the current design proposal.

Withdraw Capacity. The Madera Ranch Groundwater Banking Project will be capable of returning 200 cfs for either environmental, agricultural, or urban use. Water would be returned from the environmental share for environmental use or from the water-user share for agricultural and urban use.

Timing of Implementation

Table 8

ID	Task Name	Duration
1	**Phase 1**	
2	Geohydrologic Testing	73d
3	Evaluate Flood Channel Diversion	11d
4	Plan NEPA/CEQA	42d
5	Develop Partnership Options	42d
6	Operations Studies	42d
7	Pursue Environment	42d
8	Document Go/No Go	59d
9	Phase 2	
10	NEPA/CEQA Compliance	305d
11	Negotiation for Purchase/Lease	305d
12	Construction (Begins 1/1/99	



Potential Funding Sources

Potential funding sources vary depending on whether funds are being sought for the short- or long-term Water Reserve Account. Because the long-term Water Reserve Account will require construction of facilities and possible purchase of land, there is the possibility of funding through normal energy and water appropriations. Table 9 is a list of the potential funding sources identified to date.

Table 9		
Funding Source	**Description**	**Availability**
Bay-Delta Environmental Enhancement and Water Security Act	Funding available for long-term CALFED programs. May be used for directed projects or early implementation of CALFED projects.	Immediately
CVPIA Restoration Fund	Established in the CVPIA for specifically enumerated purposes and water purchases.	Immediately
State CVPIA Cost Share	Funding for state share of CVPIA restoration efforts.	Immediately

Table 9		
Funding Source	Description	Availability
Energy and Water Funds	Authorized and appropriated for specific water related projects.	2-year lead time

Environmental Benefit

The Water Reserve Account provides environmental benefits by providing up to 200,000 acre-feet of water for in-Delta use or storage south of the Delta for later use in meeting environmental needs. Water in the Water Reserve Account can be used to meet environmental needs in the Delta by delivering water directly to water users and reducing pumping by an equivalent amount. Water could also be used to increase flows in the San Joaquin River by direct releases from the long-term Water Reserve Account.

Water Supply Benefit

As currently envisioned, the Water Reserve Account includes water for up to 200,000 acre-feet of agricultural and urban supplies.

TIME SHIFTING

The Toolbox Group noted that time-shifting of water deliveries is primarily a tool that can enhance the real-time management of the system resulting in substantially less conflict between water-user needs and the environment. As a specific example, time-shifting can enhance the performance of the joint point tool by allowing users south of the Delta to forego taking water in the spring months when impacts to fish are greatest, and then make up the water later in the year because of the increased capacity as a result of the joint point. In addition, time-shifting may be used as a tool to minimize the impacts of the joint point on the ability of water users to carryover or reschedule supplies in San Luis Reservoir. Finally, time-shifting is an important tool to maintain the low point in San Luis Reservoir and provide operational reliability for public health and safety and other critical purposes. Time-shifting requires compensation for the additional risk assumed by the water users that shift their demands.

Interior has determined that as a tool, time-shifting is best used on a limited basis in real-time management situations to address unforeseen environmental or operation circumstances.

United States Department of the Interior

OFFICE OF THE SOLICITOR
Washington, D.C. 20240

NOV 19 1997

Memorandum

To:. Deputy Secretary

From: Solicitor

Subject: Section 3406(b)(2) of the Central Valley Project Improvement Act

This is in response to your request for advice on interpreting section 3406(b)(2) of the Central Valley Project Improvement Act (CVPIA), Pub. L. No. 102-575.[1] Specifically, you ask whether the draft policy released by the Bureau of Reclamation and the U.S. Fish and Wildlife Service on October 31, 1997, is consistent with b(2) and the other requirements of the CVPIA. For the reasons that follow, we conclude that it is.[2]

<u>Background</u>

Enacted in 1992, the CVPIA modified the priority of CVP purposes and established aggressive goals for the restoration of the fish and wildlife in California's Central Valley. The Act provided the Secretary with a number of authorities as tools to accomplish those goals. At the same time, the Act also recognized that additional management and "measurement" tools were needed and would be developed over time.[3]

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[1] Given the necessity to make repeated references to subsections 3406(b)(1), (2), and (3) in this memorandum, we will use the shorthand "b(1)," "b(2)" and "b(3)."

[2] The final administrative paper, which we understand you intend to release to the public along with this document, is based on the October 31 draft. Therefore, the final paper is also consistent with the Act.

[3] For example, section 3406(g) directs Interior, working with the State, to develop readily usable and broadly available models to support the Secretary's efforts at fulfilling the requirements of the Act. Those models are to help improve scientific understanding concerning a variety of topics, including, but not limited to, measures to restore anadromous fisheries to optimum and sustainable levels; the development and use of base flows and channel maintenance flows to protect and restore natural channel and riparian habitat values; and measures to enhance the firm yield of existing CVP facilities, including improved

Subsection b(1) directs the Secretary to develop and implement a program designed to double the natural production of anadromous fish from the average levels that prevailed in the quarter century just prior to enactment of the CVPIA. That subsection also gives general guidance as to how the Secretary is to accomplish that goal, and explains the relationship of the fishery restoration program to the Secretary's other obligations, as follows:

> (A) This program shall give first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection; shall be reviewed and updated every five years; and shall describe how the Secretary intends to operate the [Project] to meet the fish, wildlife, and habitat restoration goals and requirements set forth in this title and other project purposes.
>
> (B) As needed to achieve the goals of this program, the Secretary is authorized and directed to modify CVP operations to provide flows of suitable quality, quantity, and timing to protect all life stages of anadromous fish, except that such flows shall be provided from the quantity of water dedicated to fish, wildlife, and habitat restoration purposes under paragraph (2) of this subsection; from the water supplies acquired pursuant to paragraph (3) of this subsection; and from other sources which do not conflict with fulfillment of the Secretary's remaining contractual obligations to provide Central Valley Project water for other authorized purposes. Instream flow needs for all Central Valley Project controlled streams and rivers shall be determined by the Secretary based on recommendations of the United States Fish and Wildlife Service after consultation with the California Department of Fish and Game.
>
> (C) The Secretary shall cooperate with the State of California to ensure that, to the greatest degree practicable, the specific quantities of yield dedicated to and managed for fish and wildlife purposes under this title are credited against any additional obligations of the CVP which may be imposed by the State... and that, to the greatest degree practicable, the programs and plans required by this title are developed and implemented in a way that avoids inconsistent or duplicative obligations from being imposed upon CVP water and power contractors.

The CVPIA's next subsection, b(2), is identified in b(1) as providing one source of water for the fishery restoration program. It requires that the Secretary, in consultation with other State and Federal agencies, Indian tribes, and affected interests

> upon enactment of this title dedicate and manage annually eight hundred thousand acre-feet of Central Valley Project yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco

Bay/Sacramento-San Joaquin Delta Estuary; and to help to meet such obligations as may be legally imposed upon the [Project] under State or Federal law following the date of enactment of this title, including but not limited to additional obligations under the Federal Endangered Species Act. For the purpose of this section, the term "Central Valley project yield" means the delivery capability of the Central Valley project during the 1928-1934 drought period after fishery, water quality, and other flow and operational requirements imposed by terms and conditions existing in licenses, permits, and other agreements pertaining to the Central Valley Project under applicable State or Federal law existing at the time of enactment of this title have been met.

The subparts of b(2) further define that water:

(A) Such quantity of water shall be in addition to the quantities needed to implement paragraph 3406(d)(1) of this title and in addition to all water allocated pursuant to paragraph (23) of this subsection for release to the Trinity River...; and shall be supplemented by all water that comes under the Secretary's control pursuant to subsections 3406(b)(3), 3408(h)-(i), and through other measures consistent with subparagraph 3406(b)(1)(B) of this title.

(B) Such quantity of water shall be managed pursuant to conditions specified by the United States Fish and Wildlife Service after consultation with the Bureau of Reclamation and the California Department of Water Resources and in cooperation with the California Department of Fish and Game.

(C) The Secretary may temporarily reduce deliveries of the quantity of water dedicated under this paragraph up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water; Provided, That such reductions shall not exceed in percentage terms the reductions imposed on agricultural service contractors; Provided further, That nothing in this subsection or subsection 3406(e) shall require the Secretary to operate the project in a way that jeopardizes human health or safety.

(D) 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.

Subsection b(3) provides for other sources of water for the fishery restoration program, directing the Secretary to:

develop and implement a program in coordination and in conformance with the plan required under paragraph (1) of this subsection for the acquisition of a water supply to supplement the quantity of water dedicated to fish and wildlife purposes under paragraph (2) of this subsection and to fulfill the Secretary's obligations under paragraph 3406(d)(2) of this title. The program should identify how the Secretary intends to utilize, in particular the following options: improvements in or modifications of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land.

Interior is currently developing the long-term program called for in b(1) for doubling the natural production of anadromous fisheries.[4] The water dedicated in b(2) provides one source of water at the Secretary's disposal to carry out that program. Congress did not, however, restrict the use of that water to anadromous fish restoration, nor did Congress want dedication and use of the water under b(2) to await completion of the long-term fish restoration program. Instead, the Act directs the Secretary to begin managing b(2) water "upon enactment."[5] Further, while the water dedicated in b(2) is for the primary purpose of fish, wildlife, and habitat restoration, the statute also makes it available for the secondary purposes of assisting in meeting water quality standards in the Delta and in meeting the needs of endangered species listed after passage of the CVPIA. Thus, the water dedicated in b(2) is an important component of the anadromous fish restoration program, but the use of the dedicated water is not limited to that program.

Since the CVPIA became law, the Bureau of Reclamation and the Fish and Wildlife Service have been implementing b(2) through annual joint determinations of management measures to help achieve the fish and wildlife restoration goals of the Act. To improve upon this rather unsystematic implementation of this key feature of the CVPIA, the Department has been seeking to develop a more specific, overall plan for implementing b(2), pending completion of the long-term anadromous fish restoration plan. In this effort, the Department has sought extensive public and stakeholder input. That public process, which began in late 1995 and continues today, has guided and informed the Department's developing approach to b(2).

Much of the discussion regarding Interior's implementation of b(2) to date has focused on the question of how to "account" for or "measure" the 800,000 acre-feet (AF) dedicated by b(2). This question has fostered a wide range of possible interpretations and generated considerable controversy.

Some commenters have viewed b(2) as requiring that -- as a means of accounting for the water -- CVP water deliveries to farmers and other non-fishery users must be reduced by 800,000 AF in all, or at least all but the very wettest, years. We have dubbed this, for convenience, the "fish-friendly" interpretation.

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[4] On June 24, 1997, the Department released for public review and comment a Revised Draft Anadromous Fish Restoration Plan. That Plan will be revised, as necessary, and finalized following completion of the Programmatic Environmental Impact Statement mandated by section 3409 of the CVPIA.

[5] See Westlands Water District v. Natural Resources Defense Council, 43 F.3d 457 (9th

At the opposite end of the spectrum, others have advocated an accounting approach that would direct the Secretary to provide water for fisheries in times of drought, but that would not result in additional water for fisheries in other years, nor result in any reduction in CVP water deliveries to non-fishery interests except in the very driest years, years that match the hydrologic conditions of the 1928 to 1934 drought. We will refer to this as the "contractor-friendly" interpretation.[6]

Despite the wide gulf between them, the "contractor-friendly" and "fish-friendly" approaches reach nearly the same result on how b(2) should be implemented during dry and critically dry years. Dedicating the 800,000 AF called for by b(2) in those severe drought years will, under either approach, have a direct effect on contract deliveries, because it will reduce the "delivery capability" of the project by the amount dedicated. This means that the basic debate is over how b(2) will be implemented in more normal or wet water years.

The Department itself has explored the viability of various methods of addressing this very complex issue. (See, e.g., "Guidelines for Section 3406(b)(2) Water," dated May 28, 1996; "Draft CVPIA Administrative Proposal,'" dated July 1, 1996; "Draft CVPIA Administrative Proposal," dated June 24, 1997; "Draft CVPIA Administrative Proposal," dated October 31, 1997.) In the course of those deliberations, and based on the legislative history of early versions of the statute, the Department has even considered whether b(2) can be viewed as establishing the Fish and Wildlife Service as a contractor -- essentially vesting 800,000 AF of water annually in the U.S. Fish and Wildlife Service, much as other project water is dedicated by contract in specific quantities to specific users, such as irrigation districts.

After exhaustive deliberation, including consideration of substantial comments from stakeholder interests and the public, Reclamation and the Fish and Wildlife Service have jointly concluded that none of the approaches mentioned is genuinely and wholly faithful to the statutory design. Indeed, the agencies have concluded that the controversy over "accounting" is largely misplaced, reflecting a misguided effort to separate the measurement of b(2) water, which is an aspect of dedication, from its use; that is, its annual management to serve its primary purpose.

Consequently, in light of Congress' mandate that the Secretary "dedicate and manage annually" the water under conditions specified by the Service to help achieve, inter alia, the fish doubling goal, the two agencies have concluded that the most appropriate and

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[6] Admittedly, we are drawing a somewhat oversimplified description of the competing views of the statute, and the labels we have appended are not intended to suggest that all contractors favor one result and all friends of fish favor another, nor for that matter, to suggest that contractors are not "friends of fish." Our discussion is derived from comments we have received from various outside sources during the public review process and from internal deliberations.

responsible way to implement b(2) is to fuse the two concepts of dedication and use. This, in turn, has led to the agencies' proposal, as set out in the October 31 draft, that b(2) water will be "accounted for" by setting forth how that water is to be used to serve the purpose for which it was dedicated -- i.e., by creating environmental conditions needed for restoration of the anadromous fishery in the Central Valley. The question is whether the approach is consistent with the statute.

Analysis

At a superficial level, the directive from Congress appears to be simple to implement. In fact, however, implementing the directive is enormously complex.

That complexity arises from several sources. First, there is the immense physical and hydrological scope of the Central Valley Project:

> The grand design of the Project was to conserve and put to maximum beneficial use the waters of the Central Valley of California, comprising a third of the State's territory, and the bowl of which starts in the northern part of the State, and, averaging more than 100 miles in width, extends southward some 450 miles.

Dugan v. Rank, 372 U.S. 609, 612 (1962). The CVP itself embraces nearly twenty dams and reservoirs and hundreds of miles of canals and other water conveyance facilities.[7] From those facilities, the Project delivers an average of approximately 5.8 million acre feet of water annually. Much of it is used for agricultural irrigation on more than 2.6 million acres of farmland.

Second, the federal project does not operate in isolation. It is closely associated with the State Water Project, drawing water from many of the same sources and sharing some of the same facilities:

> California's water supply is physically linked from the Trinity River in the northwest corner of the State to the Imperial Valley in the far southeast. The degree of interrelationship is such that it is fair to say that almost three-quarters of the State's population lives on (and from) the same 'river.' That web of interconnection is a product of 80 years of efforts by Southern California interests to secure water supplies for that area's economic growth and Central Valley agricultural interests to secure surface water supplies to replace depleted ground water aquifers.

H.R. Rep. No. 102-576, Part I, at 15 (1992).

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[7] For a further description of the expansiveness and complexity of the Project, see U.S. v. Gerlach Live Stock Co., 339 U.S. 725 (1950), and Ivanhoe Irrigation District v. McCracken, 357 U.S. 275 (1958).

Managing and tracking water releases and deliveries through this vast system is a challenging task. Accounting for water is complicated by, among other things, the fact that water released from upstream storage facilities may be used and reused several times for multiple purposes as it makes its way through the system.

In the specific context of implementing b(2), further complexity is introduced by the need to respond quickly to changing biological and hydrological conditions so as to meet the goals of the Act. Fishery management requires "real-time" monitoring and adjustments to accommodate and respond to the constantly changing needs of a variety of fish species as they move through or are affected by the Project.

At the same time, measuring the water dedicated by b(2) in any real world sense is extremely difficult. Unlike water deliveries to agricultural or municipal contractors, water made available for fish or for environmental restoration is typically not delivered to or diverted at a set point and on a calendar schedule. For example, fishery restoration may require water releases as necessary to keep salinity concentrations or temperatures at certain levels in certain reaches at certain critical times. Moreover, water for fish and environmental restoration is typically not consumed to the same degree as water for other uses, but rather remains in the system and available for other uses, thus further complicating the task of measuring b(2) water.

In addition, existing computer models, while essential in the operation and management of the CVP and the State Water Project in California, have certain inherent limitations. For example, the computer model that simulates the operations of the CVP and the State Water Project functions on a monthly time-scale, rather than daily or weekly. This limits its ability to reflect the ever-changing needs of the fishery. In addition, implicit in the computer model is the assumption of perfect foresight as to future streamflows. Thus, the computer model assumes that the project operates much more efficiently than the real world allows, and the real-world impacts of certain actions may, or may not, be what the model predicts.

Finally, one of the biggest challenges that Interior faces in implementing the Act is the difficulty of assessing the impacts of certain actions -- including "dedicating and managing annually" the b(2) water -- when the impacts of those actions on the environment and on contractors may fall in future years. Deliveries to contractors in any given year are dependent, to a certain extent, on carryover storage. Therefore water management actions taken in one year may have impacts in future years that cannot be predicted with certainty. Likewise, the effects of environmental restoration activities may take several years to become apparent. Only as the full ramifications of operational and fishery management decisions play out over successive years can the full implications of those decisions be assessed.

Against that complexity, two competing interpretations of b(2) -- the "fish-friendly" and the "contractor-friendly" approaches -- have been proposed. Each struggles to find simplicity. But each views fragments of the statute in hermetic isolation, rather than viewing the statute as a whole and in the context of the realities of operating a complex, multifaceted project like the CVP. While the effort to simplify is understandable, even desirable in more typical statutory settings, here it does not do justice to, or effectuate the purposes of, the statute as a whole.

In administering the CVPIA, the Department must give meaning to all parts of the statute so as to carry out the intent of Congress. In determining that intent, we start with the language of the statute. Words in the statute are to be given their ordinary meaning, unless otherwise defined in the statute.

In b(2), Congress directed the Secretary to "dedicate and manage annually" a certain quantity of "the delivery capability of the [project] during the 1928 to 1934 drought period" after certain fishery, water quality, and other flow and operational requirements have been met. The word "dedicate" generally means to "set apart formally." Webster's New International Dictionary. In the context of land, to "dedicate" is to "appropriate and set apart one's private property to some public use; as to make a private way public by acts evincing an intention to do so." Black's Law Dictionary, 6th Ed. (1990). See also, Media General Cable of Fairfax, Inc. v. Sequoyah Condominium Council of Co-Owners, 991 F.2d 1169, 1173 (4th Cir. 1993) ("'Dedicated' is a term of art with reference to property matters," citing to the definition in Black's Law Dictionary.) "Manage annually," given its ordinary meaning, requires that the water is to be controlled or directed so as to allow its use for its intended purposes in every year.

Congress then described that quantity of water in terms of "yield," which it defined to mean the delivery capability of the project from 1928 to 1934, after certain adjustments are made. While we must attempt to give statutory language its literal, common sense meaning, a slavishly literal reading of b(2) is impossible. Construction of the Central Valley Project did not start until well after 1934; therefore, the Project had no "real" delivery capability during those years. Thus, Congress could not have intended that the provision be read literally.

The concept of "yield" is not a new one to water projects, yet the meaning can vary depending upon the context. Clark's treatise on "Waters and Water Rights" defines "project yield" as meaning "the water made available by all features of a project, including those features which could be operated independently of all other features." Waters and Water Rights, Vol. 6, at 954 (1991). In a complex, multi-reservoir project such as the CVP, any calculation of yield must of necessity incorporate the understanding that individual water particles are used and reused many times. Hence, the "project yield" might be significantly more than the "absolute" quantity of water -- assuming, of course, that such an "absolute" quantity could ever be measured.

Reclamation has stated that "estimated yield" has historically been used as "a measure of the annual quantity of water that could be delivered by the [Project] under specific operating conditions," Bureau of Reclamation, Central Valley Project Estimates of Yield (September 1994), at 1. Another somewhat different concept, "firm yield," is defined by Clark's treatise as "the water supply from a project that is expected to be available in every year except a specified percentage of years." Id. at 953. The CVP's "firm yield" has historically been defined in terms of the water supply that would be available in the future, assuming that the critically dry hydrologic period that occurred in the Central Valley from 1928 to 1934, were to recur. Such a "firm yield" calculation would thus reflect a conservative estimate of the quantity of water that the Project could be expected to deliver at all times.

Actual calculation of the firm yield of the CVP has varied, however, affected by a number of factors that have changed over time. These have included the addition of new facilities to the project, as well as variations in hydrological conditions, such as historic rainfall patterns, the interaction between groundwater and surface water systems, and the tributary basin inflows and in-basin water uses that are assumed for the future. In addition, the hydrologic period used to estimate long-term supplies; institutional agreements and regulations that control water quality or water releases; and assumptions made concerning project operations, such as flood control; have also varied. Among the assumptions that have changed over time are those regarding how shortages are allocated over the period evaluated. Beginning in about 1967, the Bureau's calculation "assumed a deficiency in water delivery totaling 100 percent of one year's demand spread over the seven year period, or approximately 25 percent in any one critically dry year." Central Valley Project Estimates of Yield, at 1-1. This meant that a 25 percent reduction in deliveries to all project water users in the very driest ("critically dry") years was built into the yield definition.

The CVP firm yield methodology, once done manually and now by computer modeling, has long been subject to criticism for not representing actual CVP operational practices. Id. at 2-1. The main criticism has been that Reclamation has reduced deliveries differently in its actual operation of the project from what the "yield" analysis assumed. In addition, the need to operate the project to provide minimum instream flows in certain streams to satisfy permit conditions, to protect endangered or threatened species, and to meet water quality standards in conformity with the Clean Water Act, no longer allows CVP deficiencies to be held to a cap of 100 percent cumulative deficiency over seven consecutive years. But firm yield analysis has little to do with actual project operations. In recognition of that, in recent years Reclamation has characterized project operations in terms of average deliveries over either the period of record or historical dry periods. Id. at 2-2.

The "Contractor-Friendly" Approach

Proponents of what we call the "contractor-friendly" approach give the greatest weight to the statutory definition of "yield". Advocates of this view suggest that Congress, by its definition of yield in b(2), intended the Department to determine, through computer modeling, a quantity of water that would have theoretically been available during a drought similar to that of 1928 to 1934. Proponents of that reading of the statute point for support to what they characterize as the historic Reclamation practice discussed above -- in particular the Reclamation calculation of "firm yield" -- and apparently assume that Congress was adopting that practice.

flexibly used by Interior to respond to new information or opportunities during the course of the year. After reviewing comments on the different possible forms of a water reserve account, Interior has concluded that it is best viewed and used as an adjunct of the toolbox measures. A description of the form and operation of the water reserve account is included in Appendix C.

(C) Crediting of Bay/Delta Requirements Towards the WQCP

The December 15, 1994, Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government ("Accord") provide that, for the term of the Accord, "All CVP water provided pursuant to these principles shall be credited toward the CVP obligation under Section 3406(b)(2) of the CVPIA to provide 800,000 acre feet of project yield for specified purposes." Stakeholders appear to agree that this crediting arrangement should remain in place for the life of the Accord. There is not consensus, however, as to whether the credit should be extended beyond the 3-year life of the Accord.

Sections 3406(b)(1)(C) states that Interior shall cooperate with the State "to the greatest degree practicable" to ensure that the water dedicated under (b)(2) is credited against additional obligations of the CVP arising after the enactment of the CVPIA, and that "to the greatest degree practicable" the programs required by the Act "avoid[ ] inconsistent or duplicative obligations from being imposed" on CVP water and power contractors. Section 3406(b)(2) states that one of the purposes of the (b)(2) water is to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Many of the anadromous fish habitat restoration measures and management of the (b)(2) water, as provided in Appendix A, will have conjunctive benefits to other aquatic resources in the CVP streams and Delta ecosystem. Interior, therefore, believes that there is both legal and policy rationale supporting the use and extension of the credit, and intend to continue crediting water provided for meeting the CVP's share of the State's water quality standards towards the dedication of (b)(2) water.

Interior's conclusion on this issue is based in part on the assumed equal sharing of the burden of the Bay-Delta Accord between the State and Federal water projects. The two projects are moving towards a review and revision of the sharing formula in the Coordinated Operations Agreement (COA) governing joint operations of the projects. If the current formula for sharing the burdens of meeting current Endangered Species Act and Delta water quality requirements changes substantially, Interior will reevaluate this policy of crediting water provided under the Accord towards the (b)(2) water.

In addition to the three major issues discussed above, Interior's Draft Proposals also discussed six additional issues that had been raised by stakeholders at various times. Many of those issues were important in the context of evaluating various approaches to the (b)(2) water. Interior's resolution of those issues, however, has largely been subsumed by dedication and management of the water for fish and wildlife restoration as discussed above. The additional six issues and their resolution are discussed below.

(1) Defining the (b)(2) Baseline

One issue that has generated many comments involves the question of the proper "baseline" against which to measure the dedicated water. That question is largely subsumed by Interior's approach to accounting for the (b)(2) water by meeting certain environmental measures. It remains relevant, however, for purposes of modeling the impacts to water deliveries. As explained in the Draft Administrative Proposal, some stakeholders believe that the proper baseline conditions should include only those requirements that were formally in place at the time of the CVPIA's passage (October 1992), including the D-1485 Bay-Delta standards along with the 1992 Biological Opinion's winter-run salmon temperature requirements. The fundamental issue is whether any of the 1993 winter-run Biological Opinion's requirements are appropriate for inclusion in the baseline.

Interior continues to believe that the proper baseline includes not only the literal language of the 1992 Biological Opinion, but also those requirements from the 1993 Biological Opinion (as well as the related State Water Resources Control Board requirements to meet temperature targets) that were inherently part of the 1992 Biological Opinion. The 1992 Biological Opinion was a 1-year opinion only and did not have to consider issues such as long-term temperature objectives. The 1993 Biological Opinion is intended to be a long-term, multiyear opinion. As such, it was necessary in the 1993 Opinion to explicitly articulate the related conditions that would lead to compliance with the 1992 Biological Opinion temperature requirements over a broader range of hydrological conditions.

Interior believes that including the Shasta Reservoir storage requirements from the 1993 Biological Opinion is the best way to reflect how the temperature requirements of the 1992 Biological Opinion would affect CVP operations into the future. Accordingly, Interior is including those requirements in its baseline for purposes of modeling the impact of using the dedicated (b)(2) water. Similarly, Interior is using this same baseline in its analysis of the CVPIA in the Programmatic Environmental Impact Statement.

Interior notes that other measures included in the 1993 Biological Opinion, such as the "Q-West" requirements, are not being included in the baseline. This is because, consistent with the reasoning above, these requirements were additional to, rather than explanatory of, the measures in the 1992 Biological Opinion.

(2) Appropriateness of Delta Uses for (b)(2) Water

During the Spring 1996 water allocation process, a dispute arose about the appropriateness of using (b)(2) water to supplement the water dedicated under the Bay-Delta Accord for Delta devoted to the environment exclusively, it must of necessity not be delivered to irrigation districts and other traditional contractors. Hence, proponents of this approach argue, the water must be "measured" through direct reductions in contract deliveries.

Such an approach is superficially attractive; it seems simple, easy to explain, and readily measurable. But a more careful scrutiny of the statute shows serious flaws with it. First, other sections of the statute flatly contradict such a reading. In section 3408(j), Congress directed:

> In order to minimize adverse effects, if any, upon existing Central Valley Project water contractors resulting from the water dedicated to fish and wildlife under this title, and to assist the State of California in meeting its future water needs, the Secretary shall, . . . develop and submit to the Congress, a least-cost plan to increase, within fifteen years. . . the yield of the Central Valley Project by the amount dedicated to fish and wildlife purposes under this title . . . . (emphasis added).

The underscored phrase "if any" can only be read to reflect a congressional understanding that, while there might be an adverse impact to existing contractors from the dedication of b(2) water, there might not be. Such a statutory provision clearly refutes any suggestion that Congress intended to cut back contract deliveries to traditional contractors by 800,000 AF, or any other amount, in each and every year.[11]

Second, measuring b(2) water solely by reductions to contractors is also inconsistent with the cautious approach to fish and wildlife restoration activities that Congress set out in b(1). As that subsection makes clear, in restoring the anadromous fisheries of the Central Valley, the Secretary is to "give first priority" to habitat restoration actions, "modifications to [project] operations, and implementation of the supporting measures" set out in the remainder of section 3406(b). This means that the provision of flows, as authorized in subsection 3406(b)(1)(B) - which includes the dedicated b(2) water - is not to be the Secretary's first choice of restoration tool. Instead, b(2) water is to be provided "[a]s needed to achieve the goals of [the anadromous fish restoration] program." Id. (emphasis added). We find nothing in that carefully restrained approach to the use of the dedicated water that would support a conclusion that Congress intended the dedicated water to necessarily result in reductions to contractual deliveries.

Third, the statute does not direct the Secretary to dedicate "water," but instead to dedicate

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[11] Section 3406(b)(2)(D) allows the Secretary to make the b(2) water available for other project purposes if he finds that the quantity dedicated, or any portion thereof, is not needed for the purposes of the section. Because this authorizes reducing the b(2) water only when the fisheries do not need the water, subsection b(2)(D) provides no basis for harmonizing the "fish-friendly" approach with the Congressional desire to minimize impacts to contractors.

"yield." As discussed above, "yield" is a common concept in water projects that, among other things, recognizes complexities in operation, such that individual molecules of water may be used and reused many times between first capture and escape to the sea, the ground, or the skies.

The limited legislative history also shows no support for such an "impacts to delivery" approach. Instead, it too reflects a desire to minimize impacts to the existing contractors. In the floor debate in the Senate, Senator Wallop explained modifications in the bill that had led him to ultimately support it, including a description of his understanding of the dedicated water:

> I want to emphasize that this is not a dedicated permanent supply, but a temporary commitment which will be released to other beneficial uses as soon as it is no longer needed.
>
> With some judgment, the Secretary should be able to use portions of that water in a fashion which permits its use for agriculture or urban use at the same time it is used for fish and wildlife. Water used for pulse flows for fish can be taken up downstream for M&I. Water used for over wintering water fowl could have had a previous life for rice fields. This is not single use water.

138 Cong. Rec. S17,660 (daily ed. Oct. 8, 1992).

The concern found in both the text of the statute and the legislative history regarding possible impacts to contractors simply does not support a reading of the statute that reductions to contract deliveries is the best means of "accounting" for the use of the water dedicated by b(2).

The Federal Agencies' Approach

For all these reasons, neither the contractor-friendly nor the fish-friendly interpretations fits into the statutory text or, more broadly, its architecture. In light of the flaws identified above in each of these approaches, Reclamation and the Fish and Wildlife Service have proposed a significantly different approach to dedicating and managing the b(2) water. That approach was set out in the October 31, 1997, draft "Administrative Proposal" on management of the b(2) water.

To summarize, Reclamation and the Service have concluded that the concepts of dedicating and managing the 800,000 AF of yield cannot be separated in implementation of the statute. This has led them to the position that the most reasonable means to "account" for the b(2) water is through the description of how that water will be used. To this end, the Service, in consultation with Reclamation and others, has identified the measures that it believes should be taken to begin restoration of the Central Valley fisheries, pending completion of the

Anadromous Fish Restoration Program.[12]

The measures vary with the type of water year, and have been designed as "protective experiments" that will provide information about the biological processes at work within the ecosystem, while at the same time providing a level of protection of the resources that is consistent with the goals of the statute. In the process of satisfying b(2), Interior will maximize its operational flexibility, pursuant to section b(1), to provide flows for fishery restoration, and will also exercise its authority in sections b(1) and b(3) to acquire water through a variety of measures. In this connection, it is important to note that, while b(3) is often referred to as authorizing water acquisition simply by purchase, it is actually much broader: "[P]urchase, lease, and option of water, water rights, and associated agricultural land" comes only at the end of a substantial list of ways to acquire more water. The first way identified is "improvements in or modifications of the operations of" the CVP. This reference to project operations thus directly links b(3) to b(1), which speaks to project operation.

Because of the complexities of the system, and the interrelationship between operational flexibility of b(1) and b(3) and the dedication of the b(2) water, the individual measures that will be taken under b(1), b(2), or b(3) cannot be readily identified by specific subsection. Instead, Interior will use the flexibility of b(1), b(2), and b(3), where appropriate, to maximize the benefit to the fisheries while minimizing the impact to contractors.

Interior's implementation of b(1), b(2), and b(3) in concert with one another will, at times, affect contractual deliveries. While impacts to contract deliveries is not the way Interior will account for or "measure" the use of the b(2) water, Interior has, through computer modeling -- to the extent it is possible to do so -- analyzed the impacts to existing contractors of meeting the matrix of measures. The measures that Interior is proposing, however, call for actions to be implemented, in many cases, based on real-time "biological triggers." For example, certain flows on the Sacramento River (Delta Action #4) would be initiated only when water temperatures were consistent with the onset of striped bass spawning, while the closure of the Delta Cross Channel (Delta Action #6) would be dependent on water quality triggers, such as closely monitored chloride levels in the Western Delta. Such measures are difficult, if not impossible, to model given the limitations of existing models.[13] Thus, the modeled impacts are, at best, only a rough approximation. Those impacts will vary, depending on water years, but the modeled average impact to project deliveries will be approximately 800,000 AF in dry years, and approximately 600,000 AF in critically dry years. In years that are not dry or critically dry, the modeled impact to contractors will be significantly less than 800,000 AF.

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[12] See n. 4, supra.

[13] See p. 7, supra.

As explained in the October 31 proposal, the agencies expect that the use of "biological triggers" will reduce actual impacts below the modeled results. Additionally, the agencies' proposal includes, as Appendix C, several measures, called the "Toolbox," which are designed to mitigate adverse effects on CVP contractors of implementing the fishery measures. We understand that the estimated impacts of the Toolbox measures will be modeled and released with the final proposal.

Finally, the proposal addresses the view by some that, if deliveries to contractors are reduced by less that 800,000 AF, then the agencies have not met the requirements of the statute despite accomplishing the environmental measures. The proposal relies on subsection 3406(b)(2)(D) and the Secretary's finding that additional fish measures (and hence water) will not be needed under certain hydrological and operational conditions during the period covered by the proposal. Thus, under the October 31 proposal, the statutory reference to 800,000 AF of project yield is implemented as a cap on the average amount that contract deliveries can be reduced, but does not mandate that or any other specific level of reduction to deliveries.

Given the complex task of managing a multifaceted project for multiple purposes, with no "real-time" means of measuring water used for fish and wildlife restoration, the approach set out in the October 31 proposal appears faithful to the responsibilities placed on the Secretary by the statute. As discussed above, b(1) directs the Secretary to provide flows of "suitable" quantity, quality, and timing to protect all life stages of anadromous fish. The statute does not define "suitable." Thus, Congress clearly left to the Secretary's scientifically informed judgment the decision as to the quantity of water that is "suitable" to "achieve the goals" of the fish restoration plan.[14]

Section 3406(b)(1)(B) sets out the sources from which the Secretary is to "provide" the needed flows. The water is to come from the quantity "dedicated" in b(2), from water acquired in b(3), and from "other sources" that "do not conflict with fulfillment of the Secretary's remaining contractual obligations to provide . . . [project] water for other authorized purposes." Section b(3), while authorizing purchase of water, also authorizes improvements or modifications in project operations as a means of acquiring water, as does b(1).

Congress provided the Secretary with some flexibility as to the "other sources" and the operational modifications or improvements that might be needed to meet the goals of the Act.

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[14] The Secretary's decision regarding instream flows is to be "based on recommendations of the United States Fish and Wildlife Service after consultation with the California Department of Fish and Game." §§ 3406(b)(1)(B). The water dedicated under b(2) is to be "managed pursuant to conditions specified by the [Service] after consultation with the Bureau of Reclamation and the California Department of Water Resources and in cooperation with the California Department of Fish and Game."

We see nothing on the face of the statute that would require the Secretary to specify which quantity of water might be provided through project modifications under b(1), versus project modifications under b(3), versus "other sources." Instead, it would appear from the face of the statute that the Secretary may exercise his authorities in a manner to best accomplish the fish restoration goals of the Act, and is not required to identify specifically which use of water is provided from which source.

In section 3406(b)(1), Congress placed some limits on the Secretary's authority. First, in achieving the goals of the fish restoration plan, the Secretary must place "first priority" on habitat restoration and modifications to project operations. Second, to the extent he deems it necessary to "achieve the goals" of the fishery restoration program, the Secretary must provide "flows of suitable quality, quantity, and timing", but only so long as he can provide such flows from the b(2) water or other sources that do not "conflict with fulfillment of the Secretary's remaining contractual obligations" to provide CVP water for other authorized purposes.

Two more limits are found in section 3406(b)(2). That subsection directs the Secretary to "dedicate and manage annually 800,000 AF of the yield of the project" after making certain adjustments. Thus, the amount of water available to the Secretary under b(2) is to be in addition to the water needed to comply with water quality or other operational requirements in existence when the statute was passed, and is to be managed pursuant to conditions set by the Fish and Wildlife Service (after consulting with the Bureau of Reclamation and the California Department of Water Resources, and in cooperation with the California Department of Fish and Game).

The net effect is this: Congress left to the Secretary to determine (a) the amount of water needed for fishery restoration based on the Fish and Wildlife Service's biological expertise, (b) the sources of that water in general, and (c) the order in which to use the various sources. But it also directed that water be available during even the driest years, over and above that needed for existing operational and environmental requirements.

We believe that the best reading of the statute is that Congress has, in effect, designated a unique type of project yield in b(2). This is project water whose "use" manifests itself through the accomplishment of certain conditions, such as instream flows, water temperature, or salinity levels. Therefore, we believe that it is a reasonable reading of the statute to conclude that, rather than specifying a simple measurement tool like a yardstick for the Secretary to use in identifying the environmental restoration water, or requiring that b(2) water be identified and measured through a computer modeling exercise, Congress instead established a mechanism whereby the b(2) water is to be managed pursuant to conditions specified by the Fish and Wildlife Service, in concert with flows that can be obtained through modification of project operations under b(1) and b(3). Further, Congress set an upper limit, of 800,000 AF, on the extent to which such flows provided for fish and wildlife habitat restoration could result in reduced deliveries to contractors under b(2).

For the reasons set out above, we believe the current proposal is a reasonable interpretation of the statutory text. This result is not only reasonable, but probably inevitable, in light of the complexity of the project, the impossibility of "measuring" the water in any "real" sense, and the lack of precise knowledge about the needs of the fisheries.

Nothing in the CVPIA's legislative history undercuts that approach. The enacted text of section 3406(b)(1 - 3) was finally settled on in the Conference Committee, following passage in the House and Senate of two differing bills. The House had passed H.R. 5099, "The Central Valley Project Improvement Act", which was then appended as title 34 of H.R. 429, the "Reclamation Projects Authorization and Adjustment Act of 1992." It was that bill -- H.R. 5099 -- which was the inspiration for much of what became section 3406(b)(1-3) in the finally enacted statute. In contrast, the Senate had included the text of S. 2016, "The Central Valley Project Fish and Wildlife Act," as title 34 of H.R. 429.[15]

Thus, the history of H.R. 5099 is most helpful in shedding light on how b(2) was crafted and why the current confusion exists, for it shows that Congress itself approached the issue of providing water for fish restoration from a variety of directions -- "trying on for size" different approaches -- until finally settling on the enacted statute. The history of H.R. 5099 is especially relevant because, while the bill's provisions changed many times during its consideration, the conference committee ultimately revived the concept of dedicated water that was first introduced in the early versions of H.R. 5099.

Section 6 of H.R. 5099, as introduced, directed the Secretary to

> (1) develop and implement a program which strives to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustained, on a long-term basis, at levels not less than twice the average levels attained during the period of 1981-1990. . . .
>
>> B) As needed to achieve the goals of the program, the Secretary is authorized to modify Central Valley Project operations to provide from project facilities flows of suitable quality, quantity, and timing to protect all life stages of anadromous fish, except that water used to provide such flows shall be provided from the quantity of water dedicated to fish, wildlife, and habitat restoration purposes under paragraph (2) of this subsection or from other sources which do not conflict with fulfillment of the Secretary's contractual obligations to provide water for irrigation or municipal and industrial purposes

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[15] The Central Valley Project Fish and Wildlife Act, as passed by the Senate, did not contain a provision allocating a quantity of water for fishery restoration, nor a fish-doubling goal. Instead, that text directed the Secretary to undertake a number of specific measures to improve fish and wildlife habitat, and thus provided the inspiration for much of what became subsection 3406(b)(4-22) of the finally enacted statute.

(2) Upon enactment of this Act, assign to 1.5 million acre-feet of project yield the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this Act, except that such quantity of water shall be in addition to the water required to implement b(6) and subparagraph b(15)(A)[16] of this section. If requested by the State of California within one year after enactment of this Act, the Secretary shall place such water under contract, not to exceed twenty years in length, with the State of California. The contract shall provide that such water shall be managed by the state in consultation with the Secretary and the Fish and wildlife Advisory Committee for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures of this Act. . . . In the event that the State of California does not enter into a contract under this paragraph, the Secretary shall manage such water . . . . The Secretary may temporarily reduce fish, wildlife, and habitat water supplies provided under this subsection, including the water required to implement paragraph b(6) and subparagraph b(15)(A) of this section, because of weather or hydrologic conditions only when reductions are imposed on deliveries of Central Valley Project water, and only by the same percentage as the smallest percentage by which the Secretary reduces deliveries.

(emphasis added).

Thus, as introduced, H.R. 5099 called for the Secretary to "assign" a "primary purpose" to a set quantity of project "yield." The bill assumed that the 1.5 million acre feet of yield would be managed under contract with the State, assuming the State agreed. If not, the Secretary was to manage the water himself as though under contract for fish and wildlife purposes. Thus, in early deliberations, Congress contemplated that the water would be treated as would other water under contract for other project purposes.

The meaning of the provision, however, generated differences in opinion, even at that early stage of drafting. At a May 14, 1992, Congressional hearing on the bill, Tom Graff, testifying on behalf of the Environmental Defense Fund, described the allocation in these terms:

> ... the way I read the bill with the 1.5 million acre-feet, what it is, I used the word set aside in my testimony. I'm not sure that's exactly the right word. It is an allocation of CVP yield to fish and wildlife which has the same priority as that of the prior rights and exchange contractors whom you referenced earlier. . . .

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[16] Section b(6) directed the Secretary to meet all flow standards and objectives and diversion limits in existing State regulatory and judicial decisions. Subparagraph b(15)(A) directed delivery of Level 2 water supplies to certain refuges, where "Level 2" had been defined in an earlier study as the existing average annual delivery of water to those refuges.

It is also true that the million and a half acre-feet is not necessarily all consumptive use. The way it is stated is that its primary use is to be for fish and wildlife but it can be used for fish and wildlife purposes and then re-diverted for other purposes.

Management and Operation of the Central Valley Project, California: Hearing on H.R. 5099, H.R. 3876, and H.R. 4687 before the Subcommittee on Water, Power and Offshore Energy Resources of the House Committee on Interior and Insular Affairs, 102nd Cong. 219 (1992).

Following further discussion, Mr. Graff then added:

> ... One of the things that [a particular study] doesn't account for is that in wet years you can still deliver the full six million to contractors and 1.5 million to fish and wildlife and not short anybody. In fact, you've got water left over.

Id. at 228.

Opponents of the bill, however, had a different view of the meaning of the provision in that early version of the bill. In what is the only discussion we have found as to what Congress might have been advised the term "yield" meant, David Kennedy, Director of the California Department of Water Resources, and Congressman Dooley engaged in the following discussion:

> Mr. Dooley: I'm wondering, in terms of the one and a half million acre-feet that we're talking about being allocated to fish and wildlife purposes which the secretary would sign to contract with the state, the way that I understand it, what is your interpretation of how that would impact existing contracts? Is any of that water going to be available to be used in your assessment and interpretation of the legislation?
>
> Mr. Kennedy. I believe the legislation uses the expression one and a half million acre-feet of project yield. It specifically, I believe, uses the word yield. And, as a water supply person, I would interpret that as meaning it is a reduction in supply available for other purposes.
>
> I know there has been some talk -- I think Mr. Graff, this morning, talked about that number this morning as though it was an aggregate of releases from different streams and you could double count it in some way. If that were the case, and I think the word yield is misapplied here. If the word yield were to stay in there then I would interpret that as meaning the Bureau simply has to reduce its overall deliveries by a million and a half acre-feet and then take that water and divert it to this other purpose.

Mr. Dooley. So if we were going to fashion legislation to be consistent with what Mr. Graff indicated this morning that we would need to change the definition of the one and a half million acre-feet of yield to some other -- without the yield certainly.

Id. at 371. (emphasis added).

Thus, hearing witnesses interpreted the "assignment" of project yield to either require a direct impact to overall deliveries in even non-dry years or, on the other hand, to mean an indication of priority use that might very well have no impact on contractors at all.

The Committee did change the bill. As reported out of Committee, H.R. 5099 no longer included the directive to allocate 1.5 million acre feet of yield in a fish and wildlife contract. In its place was a new directive for the Secretary to:

> (2) develop and implement a program for the acquisition of a water supply adequate to meet the purposes and requirements of this section. Such a program should identify how the secretary will secure this water supply, utilizing the following options in order of priority: improvements in or modifications of the operations of the project; conservation; transfers; conjunctive use; purchase of water; purchase and idling of agricultural land; reductions in deliveries to Central Valley Project contractors.

H.R. Rep. No. 102-576, Part I, at 6 (1992) (emphasis added).

The Committee explained this change in the following way:

> The intent of this section is to make clear that the Secretary is expected to acquire a water supply for the fish and wildlife restoration program. This water supply will have to come from a variety of sources and those sources are enunciated in order of priority. The priority list has been included to make it clear that reducing deliveries to CVP contractors should be viewed as a last resort. However, it is fully anticipated that water will have to be diverted from irrigation contractors as outlined in section 4 of this Act.[17] It is the Committee's intent that the Secretary make every effort to obtain water for fish and wildlife from conservation, modifications of project operations, transfers, conjunctive use, purchases and idling of land before reducing deliveries to contractors.

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[17] Section 4 of the bill provided that "Any [CVP] water service or repayment contract entered into, renewed, or amended under this section shall provide that the Secretary may, under procedures specified in this Act, allocate a portion of the water supply contained in such contract for the purposes specified in section 6 of this Act."

Id. at 31.

H.R. 5099 was further amended on the House floor, with the following provision inserted:

> (2) Upon enactment of this Act, and after implementing the operational changes authorized in subsection (b)(1)(B), make available project water for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this section, except that such water shall be in addition to that required to implement subsection (b)(6) and (b)(15)(A). This water may be assigned immediately to supplement instream flows. The U.S. Fish and Wildlife Service shall conduct studies and monitoring activities as may be necessary to determine the effectiveness of such flows in meeting the goal established in subsection (b)(1). At the end of the initial five year period, the Secretary shall adjust the quantity of water assigned as necessary to meet the goal.

138 Cong. Rec. H4931-4932 (daily ed. June 18, 1992)

It was this version that passed the House. Thus, the House-approved bill directed the Secretary to "make available project water" for fish and wildlife restoration purposes, but the precise quantity of water to be made available was left unstated. The provision makes no mention of project "yield," of "dedication," or of measurement methods.

The bill was then appended to H.R. 429, the omnibus water project act, which had previously been passed by the Senate, and which, as discussed above, contained a significantly different "Central Valley Project Fish and Wildlife Act," as title 34. The House then asked for a conference with the Senate to resolve differences in the bills. The result of that Conference is the statutory language ultimately enacted by Congress as the Central Valley Project Improvement Act, and in particular, the precise language of b(1), b(2), and b(3).[18]

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[18] Some stakeholders have offered interpretations of the statutory text based upon their understanding of the bargaining in the conference that was called to resolve the differences between the House and Senate bills. Bargaining positions expressed in conference committees are not officially reported and do not constitute the kind of legislative history that either the agency tasked with administering the statute, or the courts, can or should rely on to determine the intent of Congress. Cf. City of Milwaukee v. Illinois and Michigan, 451 U.S. 304, 331 n. 24 (1981) ("The proposal was never introduced in either House of Congress; it does not even appear in the Congressional Record. . . . [Its] fate . . . has under our precedents dealing with statutory interpretation nothing whatever to do with Congress' intent"). On the other hand, what the official legislative history shows is that the conference revived the concept of a dedicated amount of water for environmental restoration that had first appeared in H.R. 5099, sponsored Congressman Miller. Thus, to the extent that any legislative history is relevant in understanding the provisions of subsection 3406(b)(1-3), it is

As the previous discussion shows, Congress contemplated various approaches to the dedication of water for fishery restoration. As the statutory language evolved, one consistent theme was the interplay between the provisions of b(1), b(2), and what ultimately became b(3). The statute as enacted maintains that interplay, and in fact strengthens the interconnectedness of the three provisions so as to make it difficult to separate them.

Conclusion

Congress, in enacting the CVPIA, directed the Secretary to develop and implement a program for restoring the anadromous fishery of the Central Valley. In so doing, Congress left to the Secretary, within certain limits identified within this opinion, the basic decisions about how to achieve that goal. These include determining the amount of water "suitable;" the precise mix and order of using sources for that water, including the b(2) dedication and others specified in the Act; the conditions under which to manage the water; the circumstances under which water can be used and then recaptured for other uses; and how the project operations should be modified.

The wielding of this array of tools needs to be evaluated against the statute's fundamental requirement to set aside a quantity of water that will be reliably available in all years, including periods of extreme drought, for management pursuant to conditions specified by the Fish and Wildlife Service, to the extent needed to achieve the goals of the fish restoration program. The approach Interior is proposing is faithful to the overall thrust of the CVPIA, and fits within the statutory text better than any of the alternatives. So long as Interior fully implements the measures, we believe Interior will be meeting the requirements of the Act.

This Opinion was prepared with the primary assistance of Barbara Geigle in the Division of Land and Water, Office of the Solicitor, with contributions from David Nawi, Regional Solicitor, Sacramento, and Wendy Thurm, Special Assistant to the Solicitor.

John D. Leshy
Solicitor

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the recorded history of the development of the CVPIA, not the unofficial bargaining among members of Congress and their staffs.

Attachment G8

DECISION ON IMPLEMENTATION OF SECTION 3406(b)(2) OF THE CENTRAL VALLEY PROJECT IMPROVEMENT ACT

United States Department of the Interior

OCT 0 6 1999

U.S. Fish and Wildlife Service
California/Nevada Operations Office
2800 Cottage Way
Sacramento, California 95825

U.S. Bureau of Reclamation
Mid-Pacific Region
2800 Cottage Way
Sacramento, California 95825

Dear CVP Stakeholders, CALFED Participants, and Interested Parties:

Today, the Department of the Interior is releasing the Final Decision on Implementation of Section 3406(b)(2) of the Central Valley Project Improvement Act (Decision) (enclosed). Additional copies of the Decision may be obtained in two ways:

- A PDF version may be downloaded from the Bureau of Reclamation's web site at www.mp.usbr.gov

- Printed copies may be obtained by calling 916/978-5100 (TDD 916/978-5608).

By this Decision, Interior implements the provisions of Section 3406(b)(2) of the Central Valley Project Improvement Act and the intent of Congress. The Decision and accompanying attachments set out a calculation of CVP yield, the method of accounting for use of the dedicated CVP yield and procedures for management of the yield, and describe how the U.S. Fish and Wildlife Service will engage State agencies and stakeholders in deciding which potential fishery measures to prescribe.

The Decision reflects months of detailed analysis, careful consideration of the public's views, and extensive consultation with the State of California. You will find attached to the Decision Interior's responses to comments from the public and from California's Department of Water Resources and Department of Fish and Game. The Decision represents the next step in Interior's mandate to "dedicate and manage annually" the CVP yield Congress allocated to designated environmental purposes. It establishes a framework to engage State agencies and stakeholders every year in discussing how Interior will use the (b)(2) supplies for the mandated purposes. It takes effect immediately and applies to the water year beginning October 1, 1999, and subsequent years.

Sincerely,

for Michael J. Spear
Manager
California/Nevada Operations Office
U.S. Fish and Wildlife Service

Kirk C. Rodgers
Acting Regional Director
Mid-Pacific Region
U.S. Bureau of Reclamation

Enclosure

Department of the Interior
DECISION ON IMPLEMENTATION OF SECTION 3406 (b)(2) OF THE CENTRAL VALLEY PROJECT IMPROVEMENT ACT
October 5, 1999

INTRODUCTION

Section 3406(b)(2) of the Central Valley Project Improvement Act, Pub. L. No. 102-575, Title XXXIV (CVPIA), directs the Secretary of the Interior to:

> dedicate and manage annually 800,000 acre-feet of Central Valley Project yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help to meet such obligations as may be legally imposed upon the Central Valley Project under State or Federal law following the date of enactment of this title, including but not limited to additional obligations under the Federal Endangered Species Act.

Project yield is defined in section 3406(b)(2) [(b)(2)] as the delivery capability of the Central Valley Project (CVP or Project) during the drought period of 1928 - 1934 as it would have been with all facilities and requirements on the date of enactment of the CVPIA (October 30, 1992) in place.

This final decision, and its three attachments (collectively, the Decision), sets out the calculation of CVP yield in accordance with the statutory definition (Attachment 1), the method of accounting for use of the dedicated yield, and procedures for management of the dedicated CVP yield. Attachment 2 sets forth the process for implementation of fish protection and habitat restoration actions proposed or likely to use (b)(2) water. Attachment 3 summarizes the comments received from the public during the 30-day public comment period and the responses of the Department of the Interior (Interior) to those comments. Attachment 3 also lists the comments received from the State of California during Interior's consultation with the State and Interior's response to those concerns. The Decision is the final agency action and supersedes the Interim Decision of July 14, 1999. The July 14, 1999 interim decision and the accounting system it prescribed were developed and applied, in the context of pending litigation, to account for yield dedicated and managed in the 1999 water year, defined in a court order as March 1, 1999 through February 28, 2000. This final decision setting forth the accounting methodology and (b)(2) policy to be applicable in future water years will be applied effective October 1, 1999.

Interior provided a 30-day public comment period on its proposed decision on the accounting methodology and other aspects of the (b)(2) policy. Interior has also conducted extensive consultation with the State of California on (b)(2) implementation. That consultation began before the Interim Decision with telephone consultation. Following the release of the Interim Decision, Interior and the State, including the Department of Water Resources and the Department of Fish and Game, have met at least nine times. During the consultation, several issues regarding coordination were identified and have been addressed in two sections of this Decision, the Accounting Process, section II. C., and Coordination, section VI, as well as in Attachment 2. Additional issues regarding the relationship of (b)(2) to the Coordinated Operations Agreement (COA) were also identified. Interior and the State have determined that those issues should be addressed in renegotiating the COA.

In developing this final decision, Interior has sought to effectuate the statute in accordance with the language of the statute and the intent of Congress. The first two purposes of the CVPIA as set out in the statute are to protect, restore and enhance fish, wildlife and associated habitats in the Central Valley and Trinity River basins, and to address impacts of the CVP on fish, wildlife and associated habitats. Section 3402(a) and (b). These overall purposes of the CVPIA are reflected in the primary purpose of the water dedicated under (b)(2) – implementing the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA.

Consistent with these purposes, Interior interprets the requirement of section 3406(b)(2) that 800,000 acre feet of yield be dedicated annually, coupled with the definition of yield based on the drought period of 1928-1934, as requiring that the specified quantity of water be provided even during the driest of times as well as, consequently, during conditions of wetter hydrology. Thus, the water dedicated under (b)(2) is to be a reliable supply of water for the environment under varying hydrologic conditions.

Interior has calculated the yield of the Project in accordance with the statutory definition, and also has developed a system that accounts for the amount of yield dedicated and managed annually for (b)(2) purposes. The annual accounting of yield dedicated and managed under (b)(2) does not affect the determination of the underlying yield of the Project because the statutory definition of yield incorporates specific, fixed conditions which are not affected by subsequent actions to use the dedicated water. The accounting system thus provides the means for assuring compliance with the statutory directive to dedicate and manage a specified quantity of project yield annually.

I. CALCULATION OF YIELD

Attachment 1, entitled "Calculation of Central Valley Project Yield for Section 3406(b)(2) of the Central Valley Project Improvement Act," describes the calculation of CVP yield for purposes of (b)(2). In summary, the calculation set out in Attachment 1 is based on the average delivery capability of the Project during the 1928-1934 period, adjusted to reflect requirements in effect on the date of CVPIA enactment (October 30, 1992). The CVP yield as calculated for (b)(2) purposes is 5,826,000 acre feet. That total is slightly greater than the yield identified in the July 14, 1999 Interim Decision and reflects a correction of an error in the modeling. Of that amount, Congress has directed that 800,000 acre-feet[1] be dedicated for the purposes set out in (b)(2). As noted above, under the statutory scheme, the calculation of Project yield is not affected by annual actions to dedicate and manage the 800,000 acre feet.

In response to public comments and its consultations with the State of California, Interior has modified Attachment 1 as follows:

- Pages 1 and 3, clarified the definition of storage.
- Pages 1, 3, and 7, changed the phrase "Delta Exports" to "Delta Division" to more accurately capture all the Delta components.
- Page A-3, added text to the discussion of Clear Creek Basin criteria, to provide the references for the minimum flows.
- Page A-4, clarified language explaining the basis for flows in the American River Basin.

II. PROCESS AND ACCOUNTING

The accounting methods and procedures set out in this Decision have been developed to provide a guide for, and verification of, Interior's compliance with the statutory requirement that 800,000 acre feet of CVP yield be dedicated and managed annually.

A. **Accounting Period.** The accounting period for determining the use of CVP yield dedicated under section 3406(b)(2) (hereinafter (b)(2) water) will be October 1 through September 30.

Explanation: The water year October 1 through September 30 begins with the onset of the yearly precipitation season and is the same water year that has traditionally been used at irrigation projects throughout the West. (See U.S. Geological Survey Circular 1123, 1995).

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[1] CVPIA Section 3406(b)(2)(C) provides that water dedicated to (b)(2) purposes may be reduced up to 25 percent when deliveries to agricultural contractors are reduced because of hydrologic circumstances.

In contrast, CVP water service contracts currently are based on a year that runs from March 1 to February 28. This period reflects the beginning of the irrigation and growing season for the majority of crops within the CVP, and promotes efficiency in allowing agricultural and municipal contractors opportunities for better planning.

Just as the Bureau of Reclamation (Reclamation) selected a contracting period that would promote efficiency for water service contractors, Interior has selected an accounting period to promote more efficient use of the (b)(2) water for fishery purposes. The accounting period of October 1 through September 30 will allow the Fish Wildlife Service (FWS) to prescribe spring fishery actions with a more complete knowledge of the year's hydrology and the amount of (b)(2) water actually used for the fall/winter actions. Consequently, this will result in management prescriptions that make the most accurate and effective use of the dedicated water. If the March to February year were used, FWS would have to speculate on the fall\winter hydrology (the period when reservoirs are refilled by fall and winter storms) and the impacts of fall/winter actions to storage when it prescribed the spring measures, potentially resulting in the dedication of too much or too little of the 800,000 acre feet (AF).

B. Accounting Methodology.

The appropriate accounting methodology for the dedication and management of CVP yield for (b)(2) purposes depends upon where in the project the water is used and at what time of year it is used. The measurement methods, or metrics, set out below have been adopted to account for those differences. Measurement of water banked, transferred or exchanged will be accounted as set out in section III.

1. **Upstream Actions - October 1 through January 31.** Upstream fishery actions from October 1 through January 31 will be accounted as the difference between the cumulative net change in storage in upstream reservoirs (Shasta, Trinity, Folsom, New Melones) at the end of the period with the fishery actions and the cumulative net change in storage that would have resulted from simulated CVP operations during the same period without the fishery actions.

Explanation: The change-in-storage metric for the fall\winter period (October – January) was selected because, during this period, Project storage is generally being accumulated for release later in the year. Changes in storage resulting from the fishery measures will affect the delivery capability of the Project and are an accurate indicator of impacts to the upstream component of yield.

The ending date (January 31) for the fall\winter accounting period is the same date used for other data (e.g., snowpack, anticipated storage) that form the basis of the Project's February 15 water allocation determination, on which irrigators generally base their spring planting decisions.

Similarly, the January 31 date for the end of the change-in-storage metric will allow Interior to determine the amount of (b)(2) water remaining to be dedicated in the water year (i.e., 800,000 AF less net cumulative change in storage as of January 31), and to incorporate that amount into its determination of February allocations to contractors and forecasted project operations for the remainder of the accounting period.

After water released for upstream actions in this period has served the purpose for which its release was prescribed, it is available for recapture and reuse by the Project, including for export south of the Delta. Water released solely for an upstream fishery action under this section II.B.1 is not available for banking, transfer or exchange under section III, and shall be accounted solely under this section. On the other hand, banking, transfer, or exchanges of b(2) water released under section II.B.1 can occur during this period if the water is identified for banking, transfer or exchange before it is released. Such releases will be accounted solely for under the applicable provisions of section III.

2. Upstream Actions - February 1 through September 30.

a. Accounting Methodology: Upstream fishery actions from February 1 through September 30 will be accounted as the change (increase or decrease) in releases from storage from upstream reservoirs[2] with the fishery actions, compared to releases from storage that would have resulted from simulated CVP operations during the same period without the fishery actions. The calculation of change in release with the fishery measures will be based on daily changes in releases resulting from the (b)(2) measures prescribed by FWS, accumulated over the period.

Explanation: The metric for upstream actions from February through September (releases from storage) reflects the amount of Project yield dedicated to (b)(2) purposes through those actions. Under this metric, the net change in releases will be used in the calculation of (b)(2). For example, increased releases from Shasta Reservoir for fishery purposes may permit Reclamation to reduce planned releases from Folsom Reservoir while still meeting project obligations. The reduced releases from Folsom Reservoir would commensurately offset the increased releases from Shasta Reservoir in the (b)(2) calculation.

b. Upstream Releases may Flow through Delta: If specified by FWS, based on a written assessment of biological benefits to the fishery, Reclamation will allow upstream releases in the February – September period to

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[2] Releases from Trinity Reservoir for Trinity River flows pursuant to 3406(b)(23) of the CVPIA are excluded from the accounting under this provision.

flow through the Delta. Upstream releases specified to flow through the Delta will be accounted solely under this provision, and not as Delta actions.

Explanation: Releases from upstream storage are frequently needed to assist juvenile anadromous fish in their downstream migration to move safely through the Delta into saline water. This provision will permit the upstream releases to assist in the downstream migration when specified by FWS. It applies only in the February through September period because that is generally when Delta outflows will be needed to move the fish through the Delta into saline water. Releases specified to flow through the Delta will be excluded from the calculation of the export/inflow ratio necessary to meet Water Quality Control Plan (WQCP) requirements. (The WQCP requires that exports not exceed a certain percentage of inflow into the Delta. If the water released for (b)(2) purposes were included as inflow in the export/inflow ratio, a portion of the water could be exported and the full benefit of the outflow through the Delta would not be realized.) If FWS specifies that the release is needed for Delta outflow, Interior will take steps as needed to protect the specified flows, including obtaining a California Water Code Sec. 1707 permit.

If FWS does not specify that the release is needed for Delta outflow, it is available for recapture and reuse by the Project, including for export south of the Delta. Water released solely for an upstream fishery action under this section II.B.2 is not available for banking, transfer or exchange under section III and shall be accounted solely under this section. On the other hand, water released under this section II.B.2 can occur if the water is identified for banking, transfer, or exchange before it is released. Such releases will be accounted for solely under the applicable provisions of section III.

3. **Delta Actions that affect Exports - October 1 through September 30.**

a. Accounting Methodology: Delta actions that affect exports will be accounted throughout the water year as the reduction in exports from the Delta resulting from the prescribed fishery actions.

Explanation: This metric applies only to those actions in the Delta which affect exports. The metric of export reduction for such Delta measures was selected because it is the most accurate indicator of the impact of the fishery measures on Project yield south of the Delta. Actions designed to affect conditions in the Delta that entail releases from upstream reservoirs and that do not reduce exports will be accounted using the applicable upstream metric.

b. Limitation on Delta Actions – February 1 to August 31: During the period February 1 to August 31 (the "low point" for CVP storage in San Luis Reservoir), (b)(2) prescriptions for export reductions will be limited to a maximum of 640,000 AF (80 percent of 800,000 AF of (b)(2) water). This maximum amount (640,000 AF) will be reduced during times of shortage, as determined under CVPIA Section 3406(b)(2)(C) and in accordance with the shortage criteria set out in section V below, to 80 percent of the reduced amount of (b)(2) water.

Explanation: This provision is intended to manage impacts to deliveries south of the Delta prior to the San Luis Reservoir low point in late August. The provision is based on an 80%-20% ratio of unconstrained water supply capability before and after the low point. Under unconstrained conditions, the pumping and storage capability of the Project can provide 80 percent of the annual water supply prior to August 31 (the San Luis Reservoir low point) and 20 percent following the low point. Interior will apply that same constraint on its designation of (b)(2) measures affecting exports south of the Delta. The CVPIA provides that the 800,000 acre feet dedicated under (b)(2) can be reduced by up to 25 percent during times of drought. If the amount dedicated under (b)(2) is reduced pursuant to this provision, the maximum amount used for (b)(2) in the Delta during this time period will be reduced as well.

C. Accounting Process

To assist Interior in implementing the methodology and (b)(2) policy set forth in the final decision, Interior has established a B2 Interagency Team (B2IT). Interior will seek the participation of the California Department of Water Resources (DWR) and the California Department of Fish and Game (DFG) in this team. With the State agreement and participation, this interagency team of project operators and project and resource agency biologists will consist of representatives from the following agencies: DWR; DFG; Reclamation; FWS; and National Marine Fisheries Service (NMFS).

To assist the B2IT and Interior in developing the annual actions to dedicate and manage the 800,000 acre feet, Interior has established a stakeholder process as described in Attachment 2. The stakeholder process will be used as an opportunity for the project operators and resource agencies to present and discuss information and seek input regarding the development of the annual b(2) fishery action plan and how the plan is integrated into the operations forecast. This will be accomplished through bi-annual workshops with all interested parties as described in Attachment 2.

1. **Reclamation's Forecast.** Reclamation will provide FWS a preliminary 12-month baseline forecast of operations on the 15th day of each month, to be updated monthly thereafter. The forecast will be based on the applicable CVP Operations Criteria and Plan (OCAP). Reclamation intends to revise the current OCAP following issuance of the Record of Decision on the CVPIA Programmatic Environmental Impact Statement and the decision by the State Water Resources Control Board on the water quality control plan implementation.

2. **FWS Schedule.** FWS will submit to Reclamation its 12-month schedule for fishery measures, including proposed transfers, exchanges and banking, on the first day of each month, to be updated monthly thereafter. Based on end-of-September storage conditions and anticipated OCAP operations for the fall and winter months, FWS will target a maximum of 200,000 - 350,000 acre-feet of (b)(2) water to be used to implement upstream fall/winter releases for fishery purposes. These measures will be adjusted periodically, as the season's hydrology evolves and CVP operations respond, to stay within the target and retain sufficient (b)(2) water to implement desired spring/summer measures, both in the Delta and upstream.

3. **Monthly and Final Accounting:** Reclamation and the FWS will jointly develop an initial accounting of (b)(2) water on the 15th day of every month showing the current accounting for that accounting year as of the end of the previous month. To assist in making preliminary allocations for the coming contract year, initial assessments of the amount of (b)(2) water used for the fall/winter measures will be made just prior to the preliminary allocations on February 15 of each year. An accounting of the amount of (b)(2) water used for these actions during the October-January period will be completed by March 15 of each year. Final accounting for all (b)(2) actions during the entire water year will be calculated by October 31.

III. WATER BANKING AND TRANSFER/EXCHANGES OF WATER

A. **Banking:** Subject to section III.C below, the FWS may bank (b)(2) water in CVP or non-CVP facilities for fish and wildlife purposes. Any amount banked within the reservoir of origin will be accounted as (b)(2) water on a one-to-one basis at the time it is banked. Any water banked elsewhere shall be accounted on a one-to-one basis only once, at the time it is released from the reservoir of origin. Any banked water shall be accounted solely under this provision, regardless of the time of storage or release. The amount banked will not be included for any purpose in the accounting of (b)(2) water under II.B.1 or 2, above.

B. **Transfers to or exchanges with other water users:** Subject to section III.C below, the FWS may transfer or exchange water from upstream CVP reservoirs to or with other CVP water users or non-CVP water users during any part of the water year to accomplish (b)(2) purposes. Any amount transferred or exchanged shall be accounted as (b)(2) water on a one-to-one basis as released from the reservoir of origin, and shall be accounted solely under this provision. FWS may transfer or exchange (b)(2) water from San Luis Reservoir only to the extent that it has delivered (b)(2) water to that reservoir. The amount transferred or exchanged will not be included for any purpose in the computation of (b)(2) water under II.B.1 or II.B.2.

C. **Limitations:** The costs of any banking, storage, diversion or delivery (applicable cost of service rate) necessary to carry out the banking, transfers, and exchanges under this section, including carriage water costs and/or other costs normally incurred with a transfer, exchange, or banking, will be arranged by FWS. Any accomplishment of a transfer, exchange, or banking of water will be dependent upon the capability of the conveyance and/or storage facilities involved. Water transfers, exchanges or banking must comply with state water law and include appropriate environmental documentation. Priority of access to storage or conveyance capacity must be arranged by FWS before or at the time of the transfer, exchange, or banking transaction. The transfer, exchange, and/or banking of (b)(2) water cannot interfere with the storage, diversion, or delivery of water for other purposes of the CVP.

IV. WATER TO MEET WQCP REQUIREMENTS

During the life of the Bay/Delta Accord, Interior will continue to fulfill the commitment in the Accord that all CVP water provided to meet the Accord will be credited toward the (b)(2) obligations. Following expiration of the provisions of the Accord governing (b)(2) credits, Interior will continue to credit the amount of water provided to meet the 1995 Delta Water Quality Control Plan (WQCP) requirements toward (b)(2), up to a cap of 450,000 acre-feet annually unless the FWS determines that it is a biological priority to credit water above that cap toward (b)(2).

The Bay/Delta Accord provides that all project water provided pursuant to the Accord shall be credited toward the (b)(2) obligation to provide 800,000 acre-feet, and does not expressly set out a cap on that commitment. At the time the Accord was signed in 1994, however, it was assumed that the combined CVP and SWP water costs associated with it would not exceed one million acre-feet, one half of which would be borne by the CVP. Of that amount, the CVP share of the fishery measures in the Accord was estimated to be a maximum of 450,000 AF. The State Water Resources Control Board is currently conducting hearings to allocate responsibility for meeting the WQCP standards. That decision is expected in mid-2000. Upon expiration of the Accord provisions on responsibility for meeting the standards, Interior will continue to credit up to 450,000 AF of CVP water used to meet the WQCP obligations toward the (b)(2) requirements, consistent with the assumptions underlying the Accord. An additional amount may be credited based upon a written assessment by FWS that it is the highest biological priority for use of the remaining (b)(2) water.

V. SHORTAGE CRITERIA

CVPIA Section 3406(b)(2)(C) provides: "The Secretary may temporarily reduce deliveries of the quantity of water dedicated . . . up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of CVP water." The Shasta Criteria, which are in existing San Joaquin River Exchange Contracts and which set out a formula for reducing deliveries to those senior water rights holders during hydrologically dry periods, will be used to define the hydrologic circumstances that trigger the provisions of Section

3406(b)(2)(C). For developing operation plans, the 90 percent exceedance hydrologic forecast will be used.

VI. COORDINATION

Interior recognizes that the implementation of Section 3406(b)(2) will be important in the preparation of a Water Management Strategy that is an integral part of the CALFED Bay-Delta Stage I Program. To better coordinate the (b)(2) policy and CALFED, the B2IT will serve as a subgroup to the CALFED Operations Group. The CALFED Operations Group will assist Interior in coordinating the b(2) fishery action plan with other operational programs or resource related aspects to protect and restore the Bay-Delta. Such an interrelationship will also serve as an opportunity, in addition to the workshops described in Attachment 2, for stakeholders to interact with the project operators and resource agency staff. Project operators and resource agency staff will use this opportunity to update stakeholders on the progress of implementing provisions of this Decision and to receive input.

In preparation for the implementation of Stage I of the Bay-Delta Program, the B2IT will coordinate with CALFED in the development and implementation of an Environmental Water Account and Water Management Strategy. This coordination initially will take place through the CALFED Water Management Coordination Team. Coordination of the Decision is essential in accomplishing a coordinated program to support the environmental restoration goals of the program.

Section 3406(b)(2)(B) provides that the water dedicated under (b)(2) shall be managed pursuant to conditions specified by the FWS after consultation with Reclamation and the California Department of Water Resources (DWR) and in cooperation with the California Department of Fish and Game. In addition, FWS, in managing for anadromous fish species, routinely coordinates and consults with the National Marine Fisheries Service. It is Interior's intent to accomplish much of this coordination through participation and discussion with stakeholders and state and federal agencies in the CALFED process described above. Additional coordination with these and other agencies and stakeholders will also be necessary and will be carried out.

Interior's policy is that (b)(2) actions will not be permitted to adversely affect the State Water Project (SWP), operated by DWR, and that any adverse impacts will be made up. However, this policy does not extend to impacts to the SWP that result from its obligations under either the WQCP or Endangered Species Act. Interior believes that any gains that the SWP accrues from release of (b)(2) water from upstream reservoirs should be credited against any impacts to the SWP, as a result of (b)(2) actions that would otherwise have to be made up. Interior will meet with DWR to agree on make-up obligations and credits against such obligations. As a result of the consultation with the State, Interior and the State have determined that these issues would be best addressed as a part renegotiating the COA. Therefore, Interior and the State have committed to an expedited schedule for renegotiating the COA.

Attachment 1

Calculation of

Central Valley Project Yield

For Section 3406 (b)(2) of the

Central Valley Project Improvement Act

U.S. Department of the Interior
5 October 1999

Executive Summary

The Central Valley Project (CVP) is a multipurpose water project that consists of a system of storage, conveyance, and power facilities to make multiple use of the water supplies developed and controlled by those facilities. The initial project authorization (1937) provided that the CVP "shall be used first, for river regulation, improvement of navigation, and flood control; second, for irrigation, and domestic uses; and third, for power" generation. The Central Valley Project Improvement Act (CVPIA) amends the previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes with equal priority to irrigation and domestic uses, and fish and wildlife enhancement as a project purpose equal to power generation.

The Central Valley Project Improvement Act defined Central Valley Project yield for purposes of Section 3406 (b)(2) ("(b)(2)") as:

> *"the delivery capability of the Central Valley Project during the 1928-1934 drought period after fishery, water quality, and other flow and operational requirements imposed by terms and conditions existing in licenses, permits, and other agreements pertaining to the Central Valley Project under applicable State or Federal law existing at the time of enactment of this title have been met."*

Calculation of yield, in accordance with this definition and appropriate assumptions, has been accomplished and the results are summarized in this document. **That calculation shows that CVP yield, as defined in (b)(2), is 5,826,000 acre-feet per year.** That calculation assumes that delivery capability during the 1928-34 period is the average annual delivery to CVP users over that period. This definition does not include storage remaining in CVP reservoirs which has been recognized in some yield analyses as incremental supply. The yield is calculated at the projected 2020 level of development when CVP contractors could be expected to maximize use of the CVP supply available to them under their contracts without the CVPIA actions. The yield calculation, which shows the yield for five areas, is summarized below.

Area	**Average Annual Deliveries** **1928 to 1934 Period** **With Requirements in Effect on 10/30/92** **(thousands of acre-feet/year)**
Sacramento River Basin	2,059
American River Basin	670
Delta Division	2,154
Stanislaus River Basin	3
Friant Division	940
TOTAL	5,826

Introduction

The Central Valley Project (CVP) is a multipurpose water project that consists of a system of storage, conveyance, and power facilities to make multiple use of the water supplies developed and controlled by those facilities. The initial project authorization (1937) provided that the CVP "shall be used, first, for river regulation, improvement of navigation, and flood control; second, for irrigation, domestic uses; and third, for power" generation. The Central Valley Project Improvement Act (CVPIA) amends the previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes with equal priority to irrigation and domestic uses, and fish and wildlife enhancement as a project purpose equal to power generation.

The CVP has been developed to include 20 reservoirs with a combined storage capacity of more than 12 million acre-feet. The CVP also includes 8 powerplants, 2 pumping-generating plants, and approximately 500 miles of major canals. Figure 1 shows the location of the major CVP facilities. Waters included in the calculation of CVP yield for purposes of (b)(2), are diverted and stored in reservoirs on the Trinity, Sacramento, American, Stanislaus, San Joaquin Rivers, and in San Luis Reservoir. Table 1 lists the facilities included and not included in the (b)(2) yield calculation. CVP facilities that are not included in the (b)(2) yield calculation divert and store water on smaller tributaries to the Sacramento and American Rivers. Those facilities not relevant to the yield calculation either do not contribute to the yield (such as flood-control-only facilities) and/or are not hydrologically integrated into the operation of the CVP.

Historic CVP Yield

Historically, CVP yield was used as an index of water supply available through the operation of project facilities in accordance with entitlements under water rights permits and applicable laws, contracts, and agreements. Calculations of yield included a predefined set of deficiencies to CVP water contractors.

The historical definition of CVP Yield taken from the Bureau of Reclamation Mid-Pacific Region, "Central Valley Project Estimates of Yield", dated September 1994 follows:

> "the supply (subject in critically dry years to set percentages of supply reductions or deficiencies) that is available from the project under conditions that would be expected to occur under future levels of in-basin and project water demands (currently based on year 2020). Yield calculations are based on the critically dry hydrologic period that occurred in the Central Valley during 1928 through 1934. The calculation assumes a deficiency in water delivery totaling 100 percent of one year's demand spread over this seven year period or approximately 25 percent in any one critically dry year."

Applying this definition, CVP yield was calculated using monthly inflows and storage in CVP reservoirs to provide water for contractual obligations to be met by the CVP. Trinity, Shasta, Folsom, Whiskeytown, and San Luis Reservoirs were operated in an integrated manner. Operations of these Reservoirs and CVP export facilities were then simulated to meet project obligations over the study period. Project obligations included flood control, instream flow requirements, in-basin uses, delta outflow needs, contractual commitments, and other existing operating agreements. Deficiency criteria as defined above were applied. After the 1976-1977 drought the 25% value in any one year was modified to be 50% in any one year with a seven year maximum of 100%.

Yield was the average annual (1928 through 1934) deliveries of the Sacramento River Basin, American River Basin, and Delta Division, plus the "incremental supply." *(Incremental supply is the difference between the lowest cumulative storage in Shasta, Folsom, and Trinity Reservoirs that would occur during the 1928 through 1934 period and the minimum pool requirement (as defined in reservoir operating procedures). This difference was divided by the number of years it took to reach minimum reservoir storage during the 1928 through 1934 period .)*

For more details on traditional calculations see the "Central Valley Project Estimates of Yield," Bureau of Reclamation Mid-Pacific Region, dated September 1994.

Definition of Yield for to the CVPIA Section 3406 (b)(2)

In contrast to the historical definition, the CVPIA defined CVP yield as:

> *"the delivery capability of the Central Valley Project during the 1928-1934 drought period after fishery, water quality, and other flow and operational requirements imposed by terms and conditions existing in licenses, permits, and other agreements pertaining to the Central Valley Project under applicable State or Federal law existing at the time of enactment of this title have been met."*

Given this definition, and appropriate assumptions, Reclamation has calculated CVP yield for the purposes of (b)(2). The calculation assumes that delivery capability during the 1928-34 period is the average annual deliveries to CVP users over that period. This definition does not include storage remaining in CVP reservoirs which has been recognized in some yield analyses as incremental supply.

Calculation of CVP Yield Pursuant to CVPIA Section 3406 (b)(2)

The assumptions used for this calculation of CVP yield for purposes of (b)(2) are generally consistent with the assumptions used in the Draft Programmatic Environmental Impact Statement (DPEIS) No Action Alternative for the CVPIA, released in November 1997, with the following key modifications:

- Sacramento-San Joaquin Delta water quality requirements were based on SWRCB D-1485 and D-1422 rather than the SWRCB 1995 Water Quality Control Plan.

- Full Contract amounts were assumed rather than the "historic maximum" used in the DPEIS.

- Allocation percentages to refuges were the same as allocations to CVP agricultural service contractors.

This yield calculation used both supply and demand based on the 2020 Hydrology, which is based on the projected 2020-level land use and demographics from DWR Bulletin 160-93. It was assumed CVP water contractors, maximum CVP use would be either contract amounts or demands in the DWR depletion analysis. This is consistent with historic yield calculations which were based on future level development. Modeling assumptions are described in detail in Appendix A. The model simulations were completed using an integrated suite of models consisting of PROSIM 99.0, SANJASM, STNMD99FSH.WK4, and WSTRN99.WK4. PROSIM 99.0 was released by Reclamation at a PROSIM Workshop on November 20, 1998. This version of the model includes a number of enhancements to the model logic and input hydrology to the version used in the DPEIS. Enhancements to the model are described in Appendix B.

Table 1 lists CVP facilities relevant to the determination of the (b)(2) yield as well as those not relevant. The facilities not relevant either do not contribute to the yield (such as flood-control-only facilities) or are not hydrologically integrated into the operation of the CVP. Based on the definition of "Central Valley Project" contained in the CVPIA, the Friant Division and Stanislaus River Basin have been included in this (b)(2) yield calculation. Since the operation of the Friant Division has a relationship to Reclamation's responsibility for providing CVP water to the San Joaquin Exchange and Mendota Pool contractors, it was determined appropriate to include the yield of the Friant Division within the (b)(2) yield calculation. The operation of the Stanislaus River Basin relates to the ability of the CVP to comply with certain provisions of the 1995 Water Quality Control Plan and serves as an important fish and wildlife resource under CVPIA.

Applying these assumptions, hydrology and facilities, the models were then used to simulate the operation over the 1922 to 1990 period. Deliveries for contract years 1928 to 1934 were then extracted from the modeling results to determine the yield in accordance with (b)(2). The CVP contract amounts (including water right settlement agreements and historic refuge amounts which are not necessarily considered CVP "contracts") and average annual deliveries over the 1928 to 1934 period are shown in Table 2. These results indicate that the yield for the CVP based on the definition in the statute and the assumptions included in this evaluation is 5,826,000 acre-feet. These models produce yield calculations based on numerous assumptions about hydrology, demands, and operational constraints and should not be considered as absolute values for yield. This yield calculation does not directly relate to any specific actual year and should not be used to predict actual deliveries for a given year. It is important to keep in perspective that planning models like PROSIM, SANJASM, and STNMD99FSH are best used in a comparative manner.

Figure 1
Major CVP Facilities

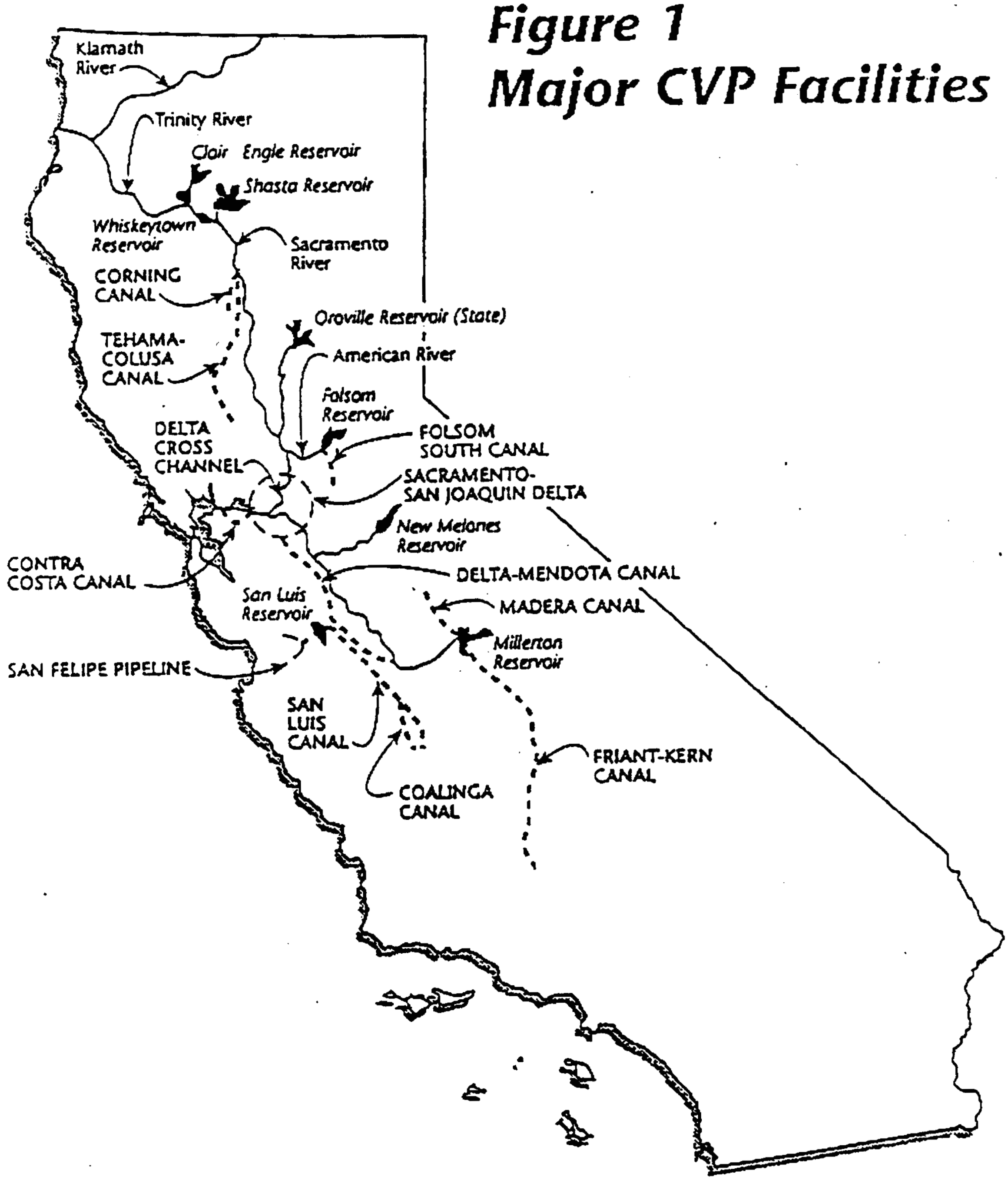


Table 1

CVP Facilities Included in CVPIA 3406 (b)(2) Yield Calculation			
Dams	**Reservoir Capacity (Acre-Feet)**	**Canals & Conduits**	**Initial Capacity (cfs)**
Shasta	4,552,000	Delta Cross Channel	3,500
Trinity	2,447,000	Delta-Mendota	4,600
New Melones	2,400,000	Contra-Costa	350
San Luis (CVP portion)	974,000	Corning	500
Folsom	975,000	San Luis (CVP portion)	6,000
Friant	521,000	Coalinga	1,100
Whiskeytown	240,000	Tehama-Colusa	2,530
O'Neill Forebay	57,000	Folsom-South	3,500
Keswick	24,000	Clear Creek Aqueduct	73
Lewiston	15,000	Cow Creek Aqueduct	92
Nimbus	9,000	Clear Creek Tunnel	3,600
Spring Creek	6,000	Spring Creek Tunnel	4,200
Red Bluff Diversion	-	Pacheco Tunnel	670
Contra Loma	2,000	Friant-Kern	4,000
		Madera	1,000

Facilities Not Included in CVPIA 3406 (b)(2) Yield Calculation			
Dams	**Reservoir Capacity (Acre-Feet)**	**Canals & Conduits**	**Initial Capacity (cfs)**
Sly Park	41,000	Camino	125
Black Butte	160,000	Forest Hill	25
Camp Creek Diversion	-	Camp Creek Tunnel	500
Franchi Diversion	-		
Little Panoche Detention	6,000		
Los Banos Detention	35,000		
Hidden	90,000		
Buchanan	110,000		
Sugar Pine	16,500		

Table 2
CVP Contract Amounts and Average Annual Deliveries 1928 to 1934

Water Users	Cont Amt TAF/YR	Avg Del TAF/YR	Comments
Sacramento River Basin			
Settlement	2,217	1,908	Includes cities of Redding & W. Sac
Agricultural	394	119	
M&I	6	5	Redding/Buckeye included above
Refuge	92	27	Historic Level 2 - Sacto Complex
Subtotal	**2,709**	**2,059**	
American River Basin			
Water Rights	526	520	
Agricultural	92	25	Includes PCWA 92 TAF/YR
M&I	286	125	Includes PCWA 25 TAF/YR & EBMUD
Subtotal	**904**	**670**	
Delta Division			
Contra Costa	195	150	Maximum delivery 175 TAF/YR
Exchange/Mendota	885	761	Includes Fresno Slough Schedule II
DMC Agricultural	526	278	
DMC Refuge	147	78	Historic Level 2
San Felipe AG	89	47	Includes Pajaro Valley 19.9 TAF/YR
San Felipe M&I	128	110	
San Luis AG	1,237	644	
San Luis M&I	17	15	Some M&I for San Luis & Panoche WDs
Cross Valley Canal	128	65	
South San Joaquin	10	6	Historic Level 2 - Kern NWR only
Subtotal	**3,362**	**2,154**	
Stanislaus River Basin			
CVP Firm Water	49	3	Long term contract for firm water
CVP Interim	106	0	Based on build-up of In-Basin demands
Subtotal	**155**	**3**	
Friant Division			
Class I	800	751	Long term contract for firm water
Class II	1,400	189	Supply based on hydrologic conditions
Subtotal	**2,200**	**940**	
GRAND TOTAL	**9,330**	**5,826**	

APPENDIX A

MODELING ASSUMPTIONS FOR A PRE-CVPIA CONDITIONS YIELD RUN

OBJECTIVE

The objective of this study was to determine the average annual delivery capability for the March 1928 through February 1935 period while meeting the system requirements as of October 30, 1992, which is being used to represent yield pursuant to the (b)(2).

METHODOLOGY

The operation of the system's reservoirs was simulated based on balancing priorities considering multiple conflicting goals and constraints. The foremost consideration was flood control, and Reclamation Safety of Dams, followed by minimum instream flow requirements, including Delta outflow, required in-basin demands, and water right settlement demands. Next, storage retention for temperature control was considered (where appropriate), followed by water supply for M&I demands, agricultural, and refuge demands.

This study was completed using PROSIM, SANJASM, WSTRN99.WK4 and STNMD99FSH.WK4. DMC deliveries from PROSIM were input to WSTRN99 to develop westside return flows to the San Joaquin River. These westside return flows and PROSIM deliveries to Mendota Pool were input to SANJASM. Flow and quality on the San Joaquin River above the Stanislaus from SANJASM were input to STNMD99FSH. The resulting Vernalis flows were output from STNMD99FSH as a time series for input to PROSIM. The suite of models was iterated until there were no significant changes in DMC deliveries and Vernalis flows.

PROSIM

PROSIM version 99.0, described in Appendix B, and 20B2_015.MCF data set was used in this study.

Hydrology and Demands

- The State of California's Department of Water Resources (DWR) Bulletin 160-93 hydrologic data set HYD-C-09A was used. This data reflects the historic hydrology superimposed on an assumed constant projected level -- in this case, the year 2020. The building blocks of this data (Consumptive Use and Depletion Analyses data for HYD-C-09A) were organized into the required format for PROSIM.

- Eastside Streams - Pre-Operated: A time series of monthly flows representing the combined net inflow to the Delta from the Cosumnes, Mokelumne and Calaveras rivers was taken from SANJASM output used in the Draft PEIS Cumulative Impacts Study (study 1d). See Draft PEIS documentation, Technical Appendix Volume 7 for additional details. Refer to the SANJASM section for further details.

- San Joaquin River - Vernalis flows from STNMD99FSH are input as a time series. Refer to the SANJASM section for further details.

- CVP demands - Full Contractual amounts for contracts in effect as of October 1992 were used. Demands include:

  1) Refuge Water Supply at historical "Level II" without losses.

  2) A Pajaro Valley demand of 19.9 TAF/YR for San Felipe Project.

  3) No interim water supplies.

- Delta Consumptive Use : The gross consumptive use and Delta precipitation from DWR's hydrology were used.

- State Water Project export demands: The variable annual demand (3.4 - 4.2 MAF based on the Southern California Wetness Index) and the monthly pattern were taken from DWRSIM run 514. No inclusion of interruptible demands.

PHYSICAL FACILITIES

Reservoirs

PROSIM simulated the operation of the reservoirs listed in the table below. The southern SWP reservoirs of Pyramid, Castaic, Silverwood and Perris Lakes were represented by two aggregated storage facilities, East Branch Reservoir and West Branch Reservoir. The reservoir characteristics are shown below:

RESERVOIR NAME	Maximum Possible Storage (TAF)	Maximum Power Release (CFS)
Clair Engle	2447	3300[1]
Whiskeytown	240	Not Used
Shasta	4552	Varied
Oroville	3538	Not Used
Folsom	974	5000[2]
CVP San Luis	972	Not Used
SWP San Luis	1067	Not Used
East Branch	200	Not Used
West Branch	489	Not Used

[1] This limitation is actually based on Carr Power Plant's turbine capacity, not Trinity Dam's turbine capacity. Further, in this study, the hydraulic capacity was assumed to remain constant regardless of Whiskeytown's storage.

[2] This limitation is actually based on Nimbus Power Plant turbine capacity, not Folsom Dam's turbine capacity.

Delta Export Pumping Plants Physical and/or Regulatory Limits

(CFS)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Tracy[1]	4600	4600	4600	4600	4600	4600	4600	3000[2]	3000[2]	4600	4600	4600
Banks	6680	6680	7590[4]	8500[4]	8500[4]	7590[4]	6680	3000[3]	3000[3]	4600[2]	6680	6680

[1] These limits frequently go unrealized due to the DMC capacity reductions shortly downstream of the pumps (4300 cfs @ DMC Mile Post 20.62 and 4200 cfs @ DMC Mile Post 33.71).

[2] SWRCB's D-1485 criteria for striped bass survival. Additional pumping of federal water by the State called "wheeling" occurs later in the year to make up for these restrictions.

[3] SWRCB's D-1485 criteria for striped bass survival. In addition, pumping is restricted further (to 2000 cfs) if storage withdrawals from Oroville are being made - per January 5, 1987 interim agreement between California's Department of Fish and Game (DFG) and California's Department of Water Resources (DWR).

[4] Pumping at Banks between Dec 15 and March 15 may be augmented above the 6680 up to the limits listed depending upon flow in San Joaquin River at Vernalis per the Corps' October 13, 1981 Public Notice criteria. A maximum of 8500 cfs is assumed based on hydraulic constraints surrounding the pumps. South Delta improvements which would allow the full 11 pumps' capacity of 10,300 cfs to be realized are assumed not to be in place.

MINIMUM FLOW CRITERIA ASSUMED

Trinity River Basin

340 TAF/YR fishery flow volume per year - Interim Secretarial Decision of 1991

(CFS)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	300	300	300	300	300	300	300	1591	578	450	450	450

Clear Creek Basin

This is per Reclamation operating policy, based largely on a Memorandum dated May 3 1967, from the National Park Service to Reclamation , which in turn is based on the Agreement dated March 31, 1960 between DFG and Reclamation.

(CFS)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Normal	50	100	100	50	50	50	50	50	50	50	50	50
Critical	50	70	70	50	50	50	50	50	50	50	50	50

Upper Sacramento River

Minimum flows and temperature control objectives are consistent with general operations to meet requirements of the Winter-Run Chinook Salmon Biological Opinion issued by the National Marine Fisheries Service (NMFS) in October 1992. Reclamation must maintain *daily* average water temperature in the Sacramento River at no more than 56° F within the winter-run chinook salmon spawning grounds below Keswick Dam. It is not possible, however, to simulate temperature criteria in the PROSIM model. Instead PROSIM includes criteria consistent with temperature control objectives and those results are evaluated for their general compliance to temperature control goals. To that end the PROSIM contains the following flow criteria and minimum year end storage criteria.

(CFS)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Normal	3250	3250	3250	3250	3250	3250	3250	3250	3250	3250	3250	3250
Critical	3000	3000	3000	3000	3000	3000	3000	3250	3250	3250	3250	3000

Reclamation must maintain a minimum end-of-water-year (September 30) carryover storage in Shasta Reservoir of 1.9 MAF. NMFS recognizes that it may not be possible to maintain a minimum carryover storage of 1.9 MAF in the driest 10 percent of water year types. This PROSIM model simulation is checked to ensure that this storage criteria is met.

Lower Sacramento River

Wilkins Slough/Navigation Control Point Objective - This objective balances the relationship of river stages and diversion structures along the Sacramento River with the need for conservation of storage at Shasta Reservoir for temperature control purposes. Generally, the objective varies between 5000 cfs for good hydrologic and storage conditions and 4000 cfs for moderate hydrologic and storage conditions. In years of poor hydrologic and storage conditions, (i.e., years in which NMFS would require re-consultation for temperature control objectives) the Wilkins Slough objective is modeled to allow dropping of flows to 3500 cfs to help conserve storage at Shasta Reservoir.

American River Basin

The Lower American River minimum flows were between 250 cfs (D-893, Folsom Dam water right decision) and 3000 cfs (flows mandated by Judge Hodge for EBMUD to receive deliveries from the American River). This criteria is known informally as "Modified D-1400." (D-1400 is the Decision regarding Auburn Dam.) For modeling, the criteria that were used were between 3000 cfs when water availability is good and 250 cfs when water availability is very poor, based on a combination of Folsom storage and hydrologic conditions.

The Hodge Decision determined when EBMUD receives water during the years when court-mandated minimum flows are met. EBMUD receives water to a maximum of 150 TAF/YR.

DELTA CRITERIA

D-1485 Water Quality Standards and 1986 COA framework between the CVP and SWP for implementing those standards on a coordinated basis. The COA defines the sharing of the water supplies and responsibilities in the Delta on a conditional and formula basis. When the Delta is in a surplus condition, no sharing is required. When the Delta is being supported by unregulated flow, the available water is shared on a 55% CVP 45% SWP basis. When the Delta requires storage withdrawals to support Delta standards then the responsibility is shared on a 75% CVP 25% SWP basis.

The Delta Cross Channel Gates were modeled as closed February through April per the 1992 and 1993 Winter-Run Chinook Salmon Biological Opinions.

WHEELING

Three quantities of water were possibly assumed to be transported by the State for the Federal government. A description of these is given below:

D-1485 Wheeling

This CVP water is exported from the Delta by Banks pumping plant each year as compensation for the pumping restrictions placed on Tracy pumping plant in May and June per SWRCB's Decision 1485. The following assumptions were made:

- Wheeling (payback) was assumed to occur within the July - November time frame.
- Up to 194 TAF could be moved in a single month.
- Whether Tracy was pumping at its maximum permissible rate during May and June was not considered.
- D-1485 wheeling was not required if the CVP simulation imposed a deficiency level greater than 19 (Ag 10% delivery).
- Wheeling was done to the extent needed to fill CVP share of San Luis Reservoir to its rule curve.
- Wheeling was only done to the extent the SWP had available capacity at Banks, i.e., SWP was not forced to wheel all 194 TAF each calendar year.
- CVP excess in the Delta was labeled wheeling water to the extent possible.

Cross Valley Wheeling

This CVP water (up to 128 TAF/YR) is exported and banked in the SWP share of San Luis Reservoir as necessary to satisfy CVP contractor demand (Cross Valley water) from the California Aqueduct.

Refuge Wheeling

This scenario included additional wheeling for Kern National Wildlife Refuge.

ALLOCATION GUIDELINES

Reclamation guidelines set minimum CVP deliveries to M&I Water Service Contractors at 75 percent of the historic use (which is generally assumed to be equivalent to the contract amount at the 2020 level). The allocation guidelines for Sacramento River Water Rights and San Joaquin River Exchange Contractors are 75 percent of the full contract amount based on the Shasta Index. CVP minimum water deliveries to Agricultural Water Service Contractors can go as low as zero percent of the full contract amount. Refuge allocations are assumed the same as Agricultural Water Service Contractors. Reductions to allocations do not necessarily equal the lowest allocation allowed but are based on a combination of available reservoir storage and projected runoff. In addition, Reclamation may make additional allocations for drought mitigation for the Refuges and hardship water for Agricultural and M&I users on a case by case basis which is not modeled.

CVP MINIMUM ALLOCATIONS

Water User	Minimum Allocation Guidelines used in CVP Yield Calculation
Sacramento River Water Rights and San Joaquin River Exchange Contractors	75% based on Shasta Criteria
Agricultural Water Service	0% per Contract
M&I Water Service	75% per Historical Use
Refuges	Same as Agricultural Water Service

VARIABLE STATE WATER PROJECT (SWP) DEMANDS

PROSIM 99.0 incorporates variable water demands for SWP entitlement holders south of the Delta. DWR developed these demands for its monthly SWP/CVP simulation model (DWRSIM) and demands vary based on precipitation levels south of the Delta. These revised demands are more representative of actual SWP operations than the constant annual demands assumed in the Draft PEIS PROSIM analyses. In the Draft PEIS, the constant annual demands were 4.2 million acre-feet. The revised annual demands range from 3.4 to 4.2 million acre-feet.

SANJASM

SANJASM version 3.61x was run with the BASE_IT1.MCF data set.

Hydrology and Demands

- The input hydrology for SANJASM is based on historical records modified for projected level conditions. The inflows were based on DWR's Bulletin 160-93 projected changes in upstream consumptive use.
- Demand levels for the Middle San Joaquin River, Merced River, and Tuolumne River are assumed to be the same as recent historic because these streams are fully developed.
- Demands on the Stanislaus River were balanced to provide equitable allocations to each interest. This river is seriously over-allocated and it is not possible to fully meet each requirement.
- Demands on the Calaveras River and Mokelumne River are based on projections of 2020 water use by SEWD and EBMUD. The Cosumnes River inflow is modified to allow for increased demand from Jenkinson Lake by El Dorado County.
- Westside Return flows are based on historical "Level II" without losses.

PHYSICAL FACILITIES

Reservoirs

SANJASM simulates the operation of the reservoirs listed in the table below.

RESERVOIR NAME	Maximum Possible Storage (TAF)
Friant	521
Hidden	90
Buchanan	151
New Exchequer	1024
New Don Pedro	1900
Modesto	29
Turlock	45
New Melones	2420
Tulloch	67

RESERVOIR NAME	Maximum Possible Storage (TAF)
New Hogan	325
Pardee	210
Camanche	431

Canals

SANJASM simulates exports through Friant-Kern Canal, Madera Canal and East Bay Aqueduct.

MINIMUM FLOW CRITERIA

Middle San Joaquin River

A minimum flow of 5 cfs is maintained in the reach between Friant Dam and Gravelly Ford to ensure adequate flow levels for the riparian users in this reach.

Fresno River

No minimum instream flow requirement.

Chowchilla River

No minimum instream flow requirement.

Merced River

Instream flows are defined by the FERC license agreement and the Davis-Grunsky agreement. Flows range from 85 TAF to 68 TAF dependent upon year type.

Tuolumne River

Instream flows are defined by the original FERC license agreement. Flows range from 169.4 TAF to 66 TAF dependent upon year type.

Stanislaus River

Simulated in STNMD99FSH.WK4.

Calaveras River

No minimum instream flow requirement.

Mokelumne River

Instream flows are based on EBMUD's proposed Lower Mokelumne River Plan (LMRP) and range from 113.7 TAF to 18.7 TAF depending on year type.

Cosumnes River

No minimum instream flow requirement.

ALLOCATION GUIDELINES

Demand allocations are handled differently for each river in the San Joaquin Basin. Each stream is modeled based on operating criteria provided by the responsible entities or on recent historical delivery patterns.

Middle San Joaquin River

Exports to the Friant-Kern and Madera Canals are based on linear regressions which were developed against recent historic (1968 - 1990) deliveries. These exports utilize almost the entire inflow to the reservoir with the exception of flood spills and releases for riparian demands downstream. Releases for riparian diverters between Friant Dam and Gravelly Ford are based on historic patterns.

Fresno and Chowchilla Rivers

Deliveries are based on recent historic delivery patterns. Deficiencies are taken based on water year type. The maximum deficiency is 50% for critical years.

Merced River

Maximum demand is based on testimony provided during the D-1630 hearings. Deficiencies are taken based on water year type. The maximum deficiency is 40% for critical years.

Tuolumne River

Deliveries are based on recent historic delivery patterns. Deficiencies are taken based on water year type. The maximum deficiency is 40% for critical years.

Stanislaus River

For this study, the Stanislaus River was simulated in STNMD99FSH.

Calaveras River

Demand levels were provided by SEWD. Deficiencies on the Calaveras River are computed on an iterative basis, with the deficiency level being determined by the desired carryover storage level.

Mokelumne River

EBMUD contracts contain deficiency criteria is based on projected end of year total system storage. Each contract contains different criteria and is modeled independently in SANJASM. The maximum deficiencies taken vary by contract and range from 15 % to 60%.

STNMD99FSH.WK4

STNMD99FSH is a variation of Reclamation's STANMOD spreadsheet. This version allows the 1987 DFG agreement (98.3-302 TAF/YR) to be modeled with a variant to allow instream flows to be reduced to 69 TAF/YR under certain criteria. This spreadsheet takes as input the flow and water quality at Maze Rd, just upstream of the Stanislaus River on the mainstem San Joaquin River, as modeled in SANJASM. It then simulates the Stanislaus River from New Melones Reservoir to the confluence of the San Joaquin River, and on down to Vernalis. Output from STNMD99FSH includes flow and water quality at Vernalis, as well as resulting Stanislaus River operations.

Stanislaus River Basin

There is inadequate supply in the Stanislaus Basin to meet all of the contracts, permits, agreements and standards which apply during an extended dry period. The 1987 Agreement between USBR and DFG (1987 Fish Agreement) and the D-1422 Water Quality standards are assumed to have equal priority. The assumptions used in the STNMD99FSH are discussed below:

- For this modeling only, the 1987 Agreement between USBR and DFG outlining a minimum fishery flow volume of 98.3 - 302 TAF/YR is modified to use 69 TAF/YR in years when the Water Quality Standard is relaxed (see next bullet). Instream flows are not increased above 98.3 TAF/YR until all other requirements (Water Quality, CVP contracts, Dissolved Oxygen) are met in full.

- D-1422 Water Quality Standard of 500 mg/l TDS throughout the year at Vernalis was modified to be 500 mg/l TDS from April through September and 600 mg/l TDS from October through March in years where the end of February storage plus the March through September forecasted inflow is less than 1.7 MAF. The modified standards during the extremely dry years is consistent with historical operations during the 1987-1992 drought.

- The modified water quality standards are relaxed by a factor ranging from 1.2 to 1.11 during these same years. To obtain the modified standards two model runs were made. The first run contained the 1995 inflows. This run determined the Vernalis water quality relaxation factors and the associated CVP deliveries. A second run with 2020 inflows used the same Vernalis water quality relaxation factors and reduced the CVP contract water deliveries to obtain the same minimum storage level in New Melones reservoir as the 1995 run.

- Ripon Dissolved Oxygen (D.O.) requirement of 7.0 mg/l on a daily basis in the Stanislaus Basin Plan is modeled using a minimum flow of 222 cfs in June, 264 cfs in July, 267 cfs in August and 240 cfs in September. These flow criteria were extrapolated from historic 1995 operation records. In 1995, it was only necessary to release water quality water for Ripon D.O.; this provides a good estimate of the flow needed to meet the D.O. requirement.

- Deliveries to the Oakdale/South San Joaquin Irrigation Districts (water rights settlement contractors) are made based on the formula contained in the 1988 Water Rights Settlement Agreement. This settlement allows for deliveries of 600 TAF/YR in years when inflow to New Melones is greater than 600 TAF/YR. Reductions are taken based on the formula when the inflow to New Melones drops below 600 TAF/YR.

- CVP contract allocations are based on February end of month storage plus forecasted inflow. When the Water Quality requirements at Vernalis are relaxed and the instream flow allocation is 69 TAF/YR, then CVP contractors do not receive any water. The CVP contracts are set at a maximum of 155 TAF/YR for the 1995 level run to determine the Vernalis Water Quality relaxation factors for the dry years. The 2020 run used inflows to New Melones from DWR Bulletin 160-93, which are 6 TAF/YR less than the 1995 level. This reduced inflow was assumed to be consumptively used by upstream users who are not necessarily CVP contractors. The interim CVP contracts were reduced by 6 TAF/YR for the final 2020 run, to adjust for the decrease in inflow. CVP contractors receive 149 TAF/YR in all years when instream flow receives 302 TAF/YR. In all other years, allocations to CVP Contractors range between 0 and 149 TAF/YR.

- Goodwin releases were limited to 1250 cfs based on the 1987 Department of Fish and Game Agreement, except during flood control operations.

<u>WSTRN99.WK4</u>

This is a spreadsheet data pre-processor for SANJASM. It takes the DMC deliveries from PROSIM, allocates them to SANJASM nodes, and computes return flow quantities for each node. The resulting data file is input to SANJASM along with the DMC deliveries for PROSIM nodes 48 + 54 (Mendota Pool deliveries).

APPENDIX B

The PROSIM analysis for the estimation of CVP Yield was conducted with the most recent version of PROSIM, referred to as PROSIM 99.0, released by Reclamation in November 1998. This appendix presents the enhancements incorporated into the PROSIM 99.0 model by Reclamation and the U.S. Fish and Wildlife Service (Service), as compared to an older version of the model that was used to perform the Draft PEIS analyses. The surface water modeling conducted for the Draft PEIS, which was the basis for the information used in the yield study, used Reclamation's PROSIM model version 5.49 with some additional modifications specific to the Draft PEIS alternatives (Modified PROSIM 5.49). All of the Draft PEIS alternatives were evaluated at a future level of development using projected hydrology based on DWR Bulletin 160-93.

In comparison to Modified PROSIM 5.49, PROSIM 99.0 includes the following enhancements:

- A correction for the inconsistency in the input hydrology associated with the use of theoretical storage
- A revised nodal configuration
- Improved coordination of Trinity and Shasta Division operations
- Updated logic for implementation of 3406(b)(2) water management actions
- Other corrections to the input hydrology.

These enhancements provide a more refined estimate of the available water supply and a better characterization of CVP operations. The net cumulative effect of the hydrology corrections is a general reduction in the estimated average annual water supply available in the Sacramento Valley with more prevalent reductions in drier years.

A detailed presentation of the modifications incorporated into PROSIM 99.0 was presented by Reclamation at a public workshop on November 20, 1998. A brief summary of the major model logic and input hydrology improvements incorporated into PROSIM 99.0 as presented at the workshop are provided in the following sections.

PROSIM 99.0 MODEL ENHANCEMENTS

This section summarizes the major code and model logic improvements, input hydrology corrections, and other enhancements included in PROSIM 99.0, as compared to Modified PROSIM 5.49.

CODE AND MODEL LOGIC ENHANCEMENTS

Code and model logic changes include a correction for the inconsistency associated with the use of theoretical storage as well as other improvements to allow PROSIM 99.0 to better characterize CVP operations.

Theoretical Storage Operations

As part of the development of PROSIM 99.0, Reclamation modified the model logic and input hydrology to eliminate the inconsistency discovered in the use of theoretical storage. Withdrawals from theoretical storage generally represent additional groundwater pumping, above historic levels, that would occur at future levels of development due to increased water demand or reductions in available surface water supplies. Modified PROSIM 5.49 used a pre-operated time series of monthly values derived from the DWR Depletion Analysis Model. As described in the PROSIM M/M Technical Appendix to the DPEIS, the Depletion Analysis Model provides the basic hydrologic data that is used to develop the PROSIM input hydrology. The addition of this withdrawal time series to Modified PROSIM 5.49 gains was inconsistent with the logic used within PROSIM to allocate CVP surface water supplies to Sacramento Valley CVP Contractors.

In PROSIM, water deliveries to Sacramento Valley CVP Contractors are composed of available Sacramento River flow, local gains, and releases from CVP reservoir storage. The addition of the withdrawals from theoretical storage to the gains caused PROSIM to incorrectly credit for withdrawals as part of available CVP surface water supplies, thereby reducing the amount of water that needed to be released from Shasta Lake to meet contractor demands. This inconsistency occurred primarily in drier years when the Depletion Analysis had utilized withdrawals from theoretical storage to supplement limited surface water supplies.

To correct the inconsistency, Reclamation removed the withdrawals from theoretical storage from the gains and developed new model logic that includes a dynamic monthly calculation of withdrawals from, and recharge of, theoretical storage. This new logic is consistent with the DWR methodology for calculating withdrawals from, and recharge of, theoretical storage and is consistent with CVP allocation guidelines for deliveries to Sacramento Valley CVP Contractors. As compared to Modified PROSIM 5.49, these PROSIM 99.0 corrections do not change the amount of water delivered to CVP Sacramento River Water Rights Contractors, but do increase releases from Shasta Lake in drier years to meet these contract obligations. As a result, there may be less CVP reservoir storage available to meet other CVP operational objectives, including deliveries to water service contractors.

Revised Node Configuration

To better characterize the locations of the major agricultural diversions within the Sacramento River Basin, six additional nodes were added to PROSIM 99.0. A model node represents a physical location where accumulated gains, losses, diversions, and return flows are accounted. Descriptions of the locations of the additional nodes, including corresponding Modified PROSIM 5.49 node numbers and associated DWR Depletion Areas (DA), are presented in Table B-1. Figure B-1 shows a schematic of the PROSIM 99.0 node configuration.

TABLE B-1

ADDITIONAL PROSIM 99.0 NODES

PROSIM 99.0 Node Number	Modified PROSIM 5.49 Node Number	Associated DWR DA Number	Description of Node Location
4	4	62	Shasta Lake
66	4		Keswick Dam
61	5	58	DA58 Diversions
62	5		Confluence of Sacramento River and Clear Creek
5	5		Red Bluff Diversion Dam
9	9	12	Tehama-Colusa Canal and Associated Diversions
67	9	12	Glenn-Colusa Canal and Associated Diversions
59	9	12	Provident/Princeton-Codora-Glenn/Maxwell Diversions
60	9	12	Colusa Basin Drain

Trinity - Shasta Division Operations

To better characterize the coordinated operation of the Trinity and Shasta Divisions of the CVP, Reclamation developed a new storage-diversion relationship to determine the amount of water to divert from the Trinity River Basin to the Sacramento River. This storage-diversion relationship accounts for both Shasta and Clair Engle Lake storage levels when determining the minimum amount of water to be diverted in a given month. The relationship in Modified PROSIM 5.49 accounted for Clair Engle Lake storage only. The minimum monthly and seasonal diversion targets used in this new relationship were developed by Reclamation based on current Trinity-Shasta Division operations.

INPUT HYDROLOGY ENHANCEMENTS

In addition to modifications to the PROSIM model logic, Reclamation also incorporated a number of improvements associated with the model input hydrology. These improvements allow better characterization of the projected future available water supply in the American and Feather River Basins. Following is a brief discussion of the hydrology modifications.

American River

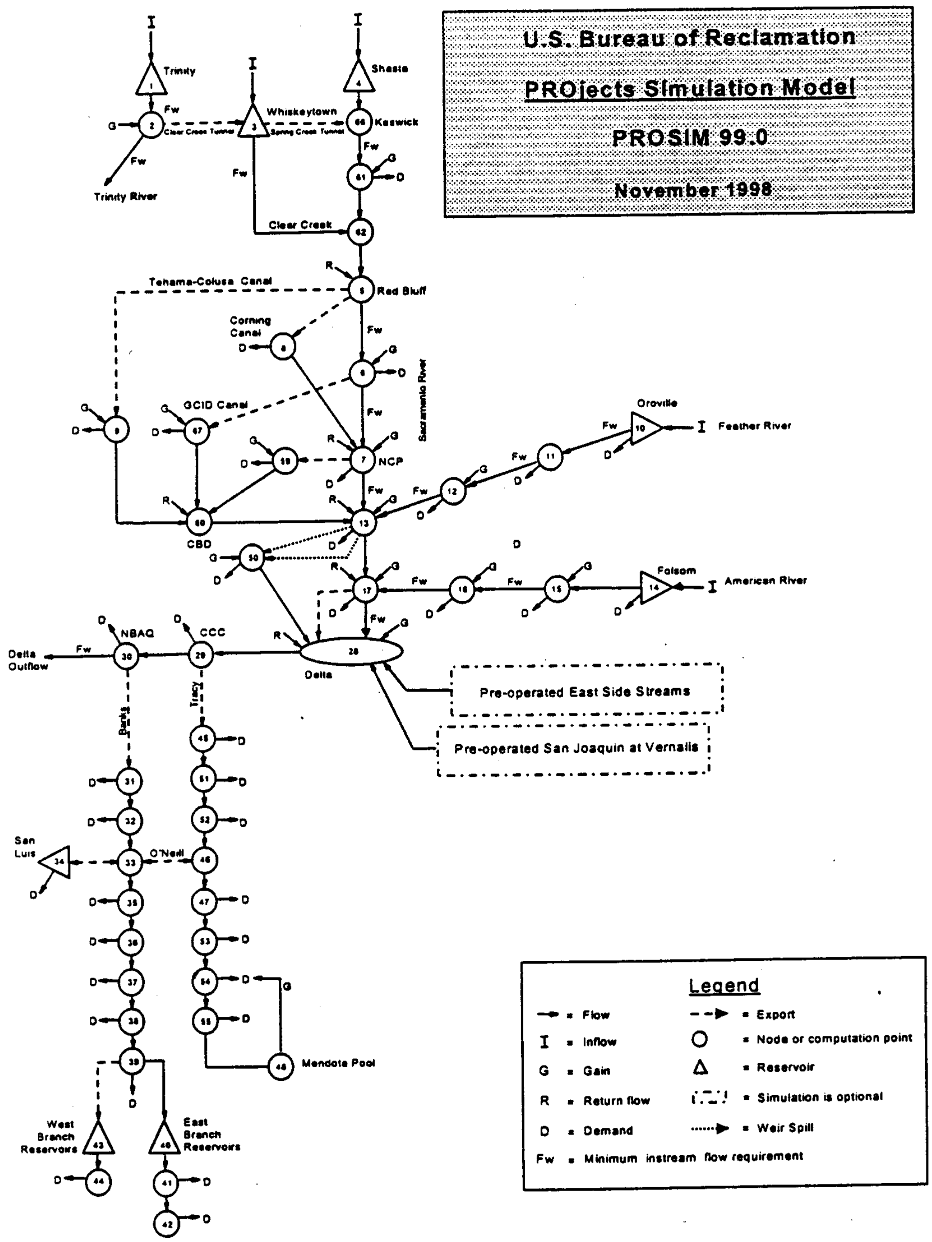
Two modifications were made to the PROSIM input hydrology associated with the American River. The first change included revised estimates for losses to groundwater along the lower American River. In the Draft PEIS, annual losses were assumed to be 42,000 acre-feet per year and were incorporated as a twelve month repeating pattern. PROSIM 99.0 includes a time series of monthly seepage losses developed as part of the American River Water Resources Investigation (ARWRI). The use of the time series increases average annual losses to groundwater to about 130,000 acre-feet per year.

The City of Sacramento is located in DA 59, but it is included in DWR's calculation of DA 70 historic depletion. To be consistent with DWR accounting, the second change corrected double counting of historic City of Sacramento exports in the original DA 70 PROSIM input hydrology. As a result, the revised DA 70 water supply is reduced by about 48,000 acre-feet on an average annual basis.

Feather River

Two corrections were ~~made to the input hydrology~~ associated with the Feather River. The first change corrected double counting of inflow from Kelly Ridge, downstream of Lake Oroville, by modifying the DA 69 water supply calculations. This reduced available water supply in the Feather River Basin by about 70,000 acre-feet on an average annual basis. Secondly, the location of return flows from Feather River diversions were adjusted to be consistent with DWR assumptions in the DWRSIM planning model. In the Draft PEIS, return flows were located at downstream nodes on the Feather River. In PROSIM 99.0, return flows are located on the Sacramento River below Verona.

FIGURE B-1


U.S. Bureau of Reclamation
PROjects Simulation Model
PROSIM 99.0
November 1998
Trinity
Whiskeytown
Shasta
Keswick
Trinity River
Clear Creek
Tehama-Colusa Canal
Red Bluff
Corning Canal
GCID Canal
Sacramento River
NCP
CBD
Oroville
Feather River
Folsom
American River
NBAQ
CCC
Delta Outflow
Delta
Pre-operated East Side Streams
Pre-operated San Joaquin at Vernalis
Banks
Tracy
San Luis
O'Neill
Mendota Pool
West Branch Reservoirs
East Branch Reservoirs
Legend
= Flow
= Inflow
= Gain
= Return flow
= Demand
= Minimum instream flow requirement
= Export
= Node or computation point
= Reservoir
= Simulation is optional
= Weir Spill

Attachment 2

Department of the Interior
Process for Implementation of
Fish Protection and Habitat Restoration
Actions Proposed or Likely to Use (b)(2) Water

The Fish and Wildlife Service (FWS) has identified actions, which are set out in the following chart, that contribute to the CVPIA goal of doubling the natural production of anadromous fish. The actions were developed as part of the Anadromous Fish Restoration Program [CVPIA Section 3406(b)(1)] and address several of the identified population limiting factors including the needs for improved instream flows for adult upstream migration, spawning, egg incubation, rearing, and juvenile outmigration; reductions in flow fluctuations; temperature control; and safe passage of juvenile past points of diversion and through the estuary. The actions were developed with extensive input from fishery experts representing agencies and stakeholders and biologists from throughout the western United States. Many of these fish actions were described in the Appendix A of the November 20, 1997, CVPIA Final Administrative Proposal on the Management of Section 3406(b)(2) Water. Additional actions have been included in this list based upon information developed with public input during the AFRP process. This list will be used to implement Section 3406(b)(2) actions and to ensure that Interior can carry out the Congressional direction to dedicate and manage 800,000 acre-feet of CVP yield for fish, wildlife and habitat restoration and other purposes each year. This list provides a basis for fish actions that will be available to coordinate with and support an Environment Water Account developed through the CALFED process.

The FWS anticipates selecting from the listed actions for the annual management of yield dedicated under (b)(2). Not all actions on the list will be implemented in any given year, but instead the FWS will annually select the appropriate actions for use of the (b)(2) water based on biological needs, hydrologic circumstances, and water availability. The FWS will select appropriate actions for any given year following consultation with the Bureau of Reclamation and the California Department of Water Resources and in cooperation with the California Department of Fish and Game and consistent with the stakeholder coordination process described below.

To assist Interior in implementing the methodology and (b)(2) policy set forth in the final decision, Interior has established a B2 Interagency Team (B2IT). Interior will seek the participation of California Department of Water Resources (DWR) and California Department of Fish and Game (DFG) on the team. With the State's agreement, this interagency team of project operators and project and resource agency biologists will consist of representatives from the following agencies: DWR; DFG; Reclamation; FWS; and National Marine Fisheries Service (NMFS).

To assist the B2IT and Interior in developing the annual actions to dedicate and manage the 800,000 acre feet, Interior has established the following stakeholder process. The stakeholder process will be used as an opportunity for the project operators and resource agencies to present and discuss information and receive input on the development of the annual b(2) fishery action plan and how the plan is integrated into the operations forecast.

This will be accomplished through bi-annual workshops with all interested parties.

- A fall (mid-November) workshop will be held to present, discuss and receive input on the annual b(2) fishery action plan and the operations forecast for the coming water year (October - September).

- A second workshop will be held in mid-winter (January or February) to present, discuss and receive input on updates to the annual b(2) fishery action plan resulting from the fall/winter operations of the project. This will also provide information on the updated operations forecast and resulting water supply allocations.
- Additional information will be made available through the monthly CALFED Operations Group meetings as the annual b(2) fishery plan and operations forecast are adjusted to reflect more current hydrologic and biological data.

The B2IT process will coordinate the development and management of the annual b(2) fishery action plan. The following process has been established and will be updated monthly:

- During the month of September Reclamation will prepare an annual operations forecast representing the 1992 baseline conditions and the conditions under the 1995 Water Quality Control Plan (WQCP).
- Based on the operations forecast using the 1995 WQCP the FWS will consult with biologists from the other federal and state agencies (DWR, DFG, FWS, Reclamation and Service) in preparing an annual b(2) fishery action plan to be presented to the Reclamation and DWR operations staff.
- Reclamation and DWR operations staff will prepare a forecast of project operations for the coming water year that incorporates the annual b(2) fishery action plan. An iterative process between the operations staff and biologists will take place in developing the final operations forecast.
- Weekly coordination of the B2IT will be used in updating the b(2) fishery action plan and monthly operations forecast to reflect current hydrologic and biological data.
- Weekly, or more frequently as needed, coordination will occur between Reclamation and FWS regarding incidental operational changes and b(2) accounting. Reclamation and the FWS will consult with other members of the B2IT as necessary to implement any operational changes.

As measures are implemented and evaluated, reassessment of their relative contribution to the restoration of Central Valley fish populations may result in changes to the actions or additions/deletions to the list. The FWS anticipates that (b)(2) water used for anadromous fish restoration will provide concurrent benefits to other fish and wildlife, will assist in meeting water quality control plan (WQCP) standards, and will help to meet additional Endangered Species Act obligations.

The list is not all inclusive but represents those actions believed at this time to be most important. While the FWS will attempt to prioritize the actions over the long term and implement them in order of priority, it must be recognized that the biological value and water cost, and therefore, the priority, of an action will depend largely on the hydrologic and ecological circumstances at the time of implementation. As actions are implemented, they will be evaluated, and an assessment of their relative contribution to CVPIA goals may result in changes to the actions or additions/deletions to the list.

It must be recognized that (b)(2) will not provide sufficient water to implement all of the actions each year and that the extent to which an action is needed or able to be implemented will depend on the hydrology at the time.

POTENTIAL FISHERY ACTIONS

FISH ACTIONS	BIOLOGICAL BENEFITS
• Improve instream flow conditions with releases from CVP reservoirs (target flows described in AFRP's May 1997 Plan): 1) Sacramento River - Rio Vista flow (December through January per WQCP) - Freeport and Knights Landing flows (May) 2) Clear Creek 3) American River 4) Stanislaus River	• Improves conditions for upstream migration, spawning, egg incubation, and rearing of anadromous fish. Increases survival of striped bass eggs and larvae and increases survival of other juvenile anadromous fish and resident estuarine fish.
• Close Head of Old River Barrier : 1) October 2) mid-April to mid-May, whenever flows are ≤7,000 cfs.	• Retains attraction flow in San Joaquin River and improves conditions for upstream migration of chinook salmon. Increases survival of juvenile salmon outmigrants from the San Joaquin Basin.
• Close Delta Cross Channel gates: 1) October through January 2) February through June (per WQCP)	• Increases survival of downstream migrant anadromous fishes from the Sacramento Basin.
• Curtail total Delta CVP/SWP export during critical outmigration periods: 1) November through January 2) April through June 3) July through September	• Increases survival of outmigrating juvenile spring-run chinook salmon and other anadromous and resident estuarine fish by reducing entrainment, and improves habitat in the South Delta. Improves survival of larval and juvenile striped bass and other estuarine species.
• Maintain export/inflow ratio at < 35%, February through June (per WQCP)	• Increases survival of juvenile anadromous fish and estuarine resident fish.
• Maintain X2 standard (per WQCP)	• Increases abundance of estuarine and anadromous fish and their food sources.
• Additional X2 requirements to 1962 level of development, March-June	• Provides ecosystem benefits beyond those provided by existing X2 standard.
• Ramp exports up gradually after export curtailment	• Increases survival of juvenile anadromous and resident estuarine fish by reducing entrainment and improves habitat in the South Delta.
• Maintain positive QWEST flows	• Increases survival of juvenile anadromous fish and resident estuarine fish.
• Increase end-of-September storage in CVP reservoirs	• Provides improved temperature control for releases in early fall for spawning salmon.

Attachment 3

Department of the Interior
Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
The yield modeling for the Stanislaus River does not show enough water being provided for instream fishery needs.	DFG	Interior recognizes that it has a responsibility to provide a certain amount of water for Stanislaus River fishery purposes before it has any right to Project water at New Melones. The yield modeling demonstrates that, in some years, New Melones does not have enough water to fulfill even its permit requirements for water quality and fishery needs. In years when New Melones cannot satisfy all its permit requirements, the amount of flow provided for each permit requirement is reduced evenly. In years when New Melones can satisfy its minimum permit conditions (including the 98,300 AF for fishery needs), the models show project purposes receiving the next increment of supply before fish receive additional water, as provided in the 1987 DFG Agreement. In any case, the 1928-34 modeling does not necessarily reflect how Interior will operate New Melones in the future. These issues will be discussed in the stakeholder process for development of a long-term New Melones operations plan.
Upstream storage releases that are diverted by the CVP to San Luis Reservoir should not be counted as (b)(2) water.	DFG	Interior disagrees. Consistent with the Court's Memorandum Opinion, water released for instream, (b)(2) purposes may be diverted for a second purpose downstream. Because it has been used for (b)(2) purposes at one time, it is reasonable for such water to be counted as a (b)(2) use.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Upstream (b)(2) releases should be allowed to flow through the Delta -- and not be subject to CVP/SWP rediversion – at anytime throughout the year, not just during the February-September period.	DFG	Interior applied this provision to releases from February 1 through September 30 because that is generally when Delta outflows will be needed to move the fish through the Delta into saline water. While Interior considered the suggested approach, Interior does not believe that it would represent the wisest use of the resource in light of the limited biological benefit.
The rationale for allowing upstream releases to flow through the Delta should be expanded to include avoidance of diversion effects on Delta fish.	DFG	Agreed. Reducing diversion impacts on Delta fish may be one of the biological benefits that FWS would determine justified additional Delta outflow is necessary.
COA should be renegotiated to provide an equitable approach to accounting for the effects of the CVPIA on SWP operations.	DFG	Agreed. Interior and DWR already have agreed to begin negotiations to modify the COA.
Using 800,000 AF every year does not implement the statutory language allowing reduced use of (b)(2) supplies.	DFG	As DFG notes, Interior has identified shortage criteria for dry years. While Interior anticipates using the full 800,000 AF in most years, it will rely on the statutory authority to make a finding that less water is needed, if such finding is biologically justified.
Modeling of simulated CVP operations must recognize storage releases for other purposes (e.g. water quality, flood control).	DFG	Agreed. The CVP simulated operations model will acknowledge releases required for other non-(b)(2) purposes.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
During the transition to the hydrologic-year accounting, Interior needs to coordinate between (b)(2) actions and existing fishery flow agreements based on the contract year.	DFG	Interior recognizes the importance of coordination. It believes that the Decision establishes a process that will provide the coordination that DFG seeks. Interior will continue to explore this issue during (b)(2) implementation.
Coordination process for (b)(2) planning and implementation should be memorialized in an agreement.	DFG	The Decision provides greater detail on the process for working with stakeholders and other agencies, particularly DWR and DFG in the planning and implementation of (b)(2) actions. Interior is willing to consider negotiating a specific MOU reflecting this process, if the state agencies believe the process outlined in the Decision does not provide sufficient process documentation.
Decision should define how (b)(2) actions will adjust to new public trust allocations for instream use.	DFG	The statute requires Interior to dedicate and manage (b)(2) yield *annually*, which makes (b)(2) an inherently flexible tool that necessarily will adjust to new hydrological and biological information, including public trust allocations.
Reducing Interior's obligation to makeup SWP losses when SWP pumps upstream releases provides a disincentive for SWP to cooperate with Interior in implementing (b)(2). Need to renegotiate COA.	DWR	Interior understands DWR's perspective on credits for upstream releases. Interior will continue to pursue this issue in our anticipated negotiation of the COA. Interior looks forward to working with DWR to resolve the issue on an interim basis before proceeding to a full COA negotiation, where a broad array of new project operating conditions will need to be addressed.
Interior should commit to a well-defined process for state-federal coordination.	DWR	Agreed. The Decision provides additional detail as to how Interior and state agencies have agreed to proceed in developing and implementing (b)(2) each year.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
What happens if use of the entire 800,000 AF is not practical or cannot be accomplished in cooperation with SWP?	DWR	Interior will implement all parts of (b)(2), including the provisions for dry-year reductions and release of some (b)(2) water for other purposes when not needed. The statute's requirement of *annual* dedication and management demands that Interior respond to situations where actual use of the full 800,000 AF is difficult or impossible on a case-by-case basis. While Interior understands DWR's concerns, it is committed to using all of its flexibility to accomplish full (b)(2) implementation.
Interior and DWR should work together in calculating the use of (b)(2) water.	DWR	Agreed. The Decision reflects additional refinements that include joint estimations of (b)(2) use. The 1999 accounting used the number that DWR provided for how much it had used in cooperating with Interior on (b)(2) implementation.
Interior will have to manage carefully the CVP deliveries during the irrigation season to avoid the San Luis Reservoir "low point" and not unnecessarily reduce allocations.	DWR	Agreed. Interior and DWR have formed an interagency team of operators to review the forecasts and allocations of (b)(2) actions. In addition, the B2IT will coordinate with the CALFED Ops Group regarding (b)(2) forecasts, allocations and other operational issues.
Interior should develop, in advance, sources of supply for repayment of SWP water lost due to (b)(2) cooperations	DWR	The Decision reflects Interior's commitment to work with DWR early in the water year to forge a plan for make-up of the SWP's export reductions.
Interior should reimburse DWR for increases in SWP power costs due to (b)(2) actions.	DWR	Agreed. Interior and the State will form an interagency team, for estimating and reviewing power costs. Interior is committed to reimbursing the state for such costs.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Interior should commit to develop in CALFED additional actions to fill the CVP share of San Luis Reservoir by early spring.	DWR	Interior will continue to work in CALFED, particularly through the Water Management Development Team, to develop new options for increasing water supply for all beneficial uses.
Interior should acquire water to make-up for lost CVP contractor deliveries, if the CVP's WQCP responsibilities exceed 450,000 AF in 2000 and the Accord is not extended.	DWR	Traditionally, Interior has fulfilled its water quality responsibilities by reducing the CVP yield delivered to contractors. Interior has no plan, at this time, to acquire water to make-up for such water quality responsibilities. Interior notes that those responsibilities may change when the SWRCB issues its WQCP implementation plan.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
There is no relationship between proposed accounting methods and the baseline yield.	EBMUD, SLDMWA, CFBF, Agricultural Water Contractors	Interior has calculated the CVP yield in accordance with the statutory definition. The accounting of the amount of yield dedicated annually does not affect the determination of the underlying yield, because the statutory definition of yield incorporates specific conditions that are not affected by subsequent actions to use the dedicated water. Consistent with pre-1992 CVP practice, Congress defined CVP yield based on the 1928-34 period to ensure that 800,000 acre-feet of CVP's core supply would be used for (b)(2) purposes, not only in critically dry years but in wetter years as well. The calculation of CVP yield for (b)(2) purposes is a one-time action, while the dedication and management must be annual, based on the hydrologic conditions for the current year. Due to the complex nature of CVP operations and the variability of hydrologic conditions, each metric used for accounting requires a different explanation for why it is an accurate measure of the use of CVP "yield," as that term is defined in (b)(2). The Decision provides those explanations.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Interior must coordinate closely with DWR in implementing fishery actions.	SWC, DWR	Interior agrees. Interior already coordinates closely with DWR and DFG in implementing (b)(2), as required by the statute. Due to the short Court-imposed time line for developing the proposed (b)(2) metrics, Interior was able to consult with the state only once before issuing the Proposed Decision. Since that time, Interior has met with DWR and DFG several times to chart a course for the 1999-2000 water year. It is intended that near the beginning of each water year, both state and federal agencies will have a plan for implementing (b)(2) for that year, which would be adjusted as hydrological or biological conditions change. A process for assuring that effective coordination occurs with DWR and DFG, as well as with interested stakeholders, has been incorporated into the final decision in response to public comments and the consultation with the State.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Allows "extraordinary discretion" to use (b)(2) water for secondary (b)(2) purposes (i.e. ESA and Clean Water Act requirements), leaving little available for CVPIA restoration.	Environmental Groups	The statute requires Interior to "dedicate and manage *annually*" (emphasis added), which provides broad discretion and requires Interior to use that discretion to respond to the unique hydrological and biological conditions each year. Consistent with the language in the statute, Interior will continue to use the (b)(2) water for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes of the Act, particularly anadromous fish restoration. It should be noted that the Delta water quality control plan include standards that promote restoration of certain fish. As for ESA uses, Interior plans to use water generally for planned, not reactive, actions that help endangered species. In response to comments on the broad discretion, Interior has included in the final decision a description of a process that Interior plans to follow in developing the annual (b)(2) fishery plan. That process will include participation by project operators, and project and resource agency biologists, and will provide for stakeholder discussions. In exercising its discretion, Interior will carefully consider stakeholder input it received in the process will be followed.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Use of the (b)(2) water for WQCP requirements and post-enactment Endangered Species Act requirements is "double counting."	Environmental Groups	Interior disagrees. The statute clearly authorizes the use of (b)(2) water to "assist" in meeting Water Quality Control Plan requirements and to "help" meet post-enactment Endangered Species Act obligations of the Central Valley Project. In 1999, Interior has applied (b)(2) water to some -- but not all -- ESA actions. Moreover, applying (b)(2) water to ESA and WQCP purposes is not double-counting.
Interior should require findings of no need for primary purpose before using (b)(2) water for secondary purposes	Environmental Groups	Interior disagrees. The CVPIA delegates substantial discretion to Interior agencies in managing the (b)(2) supplies. Apportioning such supplies among the different purposes is a cornerstone of that discretion. Requiring a finding of no need before (b)(2) water could be used for uses other than the primary purpose would unnecessarily hinder the flexibility provided by the statute to manage the dedicated water in a manner most beneficial to the environment. Therefore, such findings are neither necessary nor reflective of wise resource management..
The SWP receives a windfall by CVP reimbursing water used for (b)(2) and then SWP pumping (b)(2) upstream releases.	Environmental Groups	Interior remains committed to the principle that use of (b)(2) water cannot impact the SWP. Interior, however, recognizes that upstream (b)(2) releases could lead to a SWP windfall unless otherwise accounted for. Interior will seek, as part of renegotiating the COA, to receive a credit toward any make-up obligation for any increases in SWP supply that result from (b)(2) releases.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Interior is obligated to use (b)(2) for all water quality and ESA requirements.	SLDMWA	Interior disagrees. The statute does not support this contention. Implementation of the fish, wildlife, and habitat restoration provisions of the statute is clearly identified as the "primary" purpose for which the (b)(2) water is to be used. Post-1992 ESA obligations and water quality are secondary purposes. Further, those secondary purposes are framed in terms of "helping" and "assisting," suggesting that Congress understood that water other than that dedicated under (b)(2) would be used for those purposes.
November 19, 1997 legal opinion by Interior's Solicitor is incorrect.	Smiland & Khachigian	The November 19, 1997, legal opinion addressed the November 20, 1997, Administrative Proposal. The Interim Decision of July 14, 1999, and the final decision adopt a different accounting system than that analyzed in the November 19, 1997, Solicitor's opinion.
Contradicts the terms of the Bay/Delta Accord.	State Water Contractors	Interior disagrees. The Bay-Delta Accord language cited by the State Water Contractors describes an intention to use CVP/SWP operational flexibility to eliminate, to the extent possible, loss of project water supplies. Interior agencies have worked continuously through the CALFED operations group to identify and implement project flexibility options. The Accord does not commit Interior to using (b)(2) water for SWP make-up. Indeed, the Accord provides for a credit to (b)(2) only for use of CVP water. (See "Institutional Agreements, paragraph 3", of the Accord.)

Comment	Organization	Response
CVPIA goal is balance, reasonableness, and sustainability	EBMUD, BDUC, SMUD, CFBF, SWC, SCVWD	Interior agrees that one of the purposes of the CVPIA is to "achieve a reasonable balance among competing demands" for use of CVP water. One of the means by which Congress sought to achieve that balance was by dedicating the (b)(2) water to fish, wildlife and habitat purposes. Interior's decision reflects a balanced, reasonable implementation of its (b)(2) mandate, considering the significant reallocation of CVP yield that Congress enacted.
Use the contract year in accounting.	WAPA, SMUD	Interior disagrees. As indicated in the Decision, Interior cannot use the March through February accounting period and manage (b)(2) water with any degree of efficiency and accuracy. Environmental use, unlike agricultural contract use, is year round and knowledge of the hydrology well before the accounting year is over is essential. The October through September period provides this knowledge and promotes certainty. Further, the calculation in early February of the amount of (b)(2) water used for upstream actions in the winter months will be made in sufficient time for the agencies to make allocation decisions in a timely fashion.
Improperly allows diversion of (b)(2) water for consumptive purposes without making the required findings.	Environmental Groups	Interior disagrees. Water used for (b)(2) purposes, once it has fulfilled that purpose, is available for capture and reuse as described in the Interim Decision. This is consistent with the March 1999 Memorandum Opinion of the Court. That is a different situation than would occur under Section 3406(b)(2)(D) in which Interior "finds" that the water is not needed at all and not used and subsequently made available for other project purposes.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Proposed Decision reflects lack of public process and a need for cooperation and coordination.	WAPA, SMUD	Interior has hosted an extensive public process relating to the management and accounting for (b)(2) water since 1993. Many viewpoints – including most of the comments reflected herein -- have been expressed, considered and addressed. Due to the compressed schedule for developing the Interim Decision imposed by the Court, Interior waited until it could present a proposal for public consideration before inviting additional public comment. Interior will continue to engage other agencies and the public as it annually dedicates and manages the (b)(2) water, particularly through the CALFED operations group. In response to comments regarding the desire for public comment and agency coordination, Interior has set out in its Final decision its plan for the process by which (b)(2) management actions will be developed and implemented. That plan involves extensive state and federal coordination, as well as stakeholder and public participation.
Clarify whether water can be banked, transferred or exchanged during fall period.	EPA, BDUC, SDWA	The issue is clarified in the final decision. Banking, transfers, and exchanges of (b)(2) water can occur in the 10/1-1/31 period as well as in the 2/1-9/30 period, provided the water is identified for banking or transfers before it is released. Use of water for such purposes will be counted as it is released, not relying on the change in storage metric.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Water banked or transferred/exchanged under (b)(2) should not have last priority in use of storage and export facilities.	EPA	The accounting for such actions takes place at the time it is banked or transferred. Allowing the action to interfere with the storage, diversion, or delivery of water for other purposes of the CVP would cause additional impacts, which would then be subject to further accounting.
Underestimates yield, by including biological opinion for winter-run chinook salmon, modified D-1400 flows on the American River, and Clear Creek flows.	SLDMWA	Interior disagrees. Interior used the express terms of (b)(2) to determine which operational requirements applied. The winter-run salmon consultation between NMFS and Reclamation was initiated and a temporary opinion was in place before the CVPIA was enacted. Moreover, the minimum temperature was imposed by the SWRCB in 1990. As for Modified D-1400 flows, the CVP has had an agreement with the State for more than two decades to provide Modified D-1400 flows when hydrological conditions allow. Clear Creek flows similarly are consistent with historical modifications to minimum flows provided by agreement with the California Department of Fish and Game.
Yield calculation is inconsistent with previous methods of yield calculation	CCWD, SLDMWA, SWC	Interior agrees that the yield calculation is not identical to that historically performed. However, that difference is mandated by the language of the statute, which requires different methods for calculating yield for (b)(2) purposes. Interior calculated yield in accordance with the statutory definition of yield – "delivery capability" adjusted for the 1992 operating requirements.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Analysis of impacts from this proposal does not appear in CVPIA PEIS.	CCWD, WAPA, SMUD	The nature of the (b)(2) mandate does not require compliance with NEPA before implementation, as confirmed by the Ninth Circuit Court of Appeals. The draft PEIS displays the impacts of implementation of (b)(2) under scenarios contemplated at the time that draft was prepared. The PEIS is being evaluated to determine whether or not the impact analysis will need to be supplemented to display the impact of the final (b)2 accounting decision. That review is not yet complete, however.
No CVP power impacts have been evaluated.	WAPA, SMUD,	Implementation of (b)(2) is a statutory mandate that, as the Ninth Circuit Court of Appeals has affirmed, cannot and need not wait for analysis of impacts under NEPA. Nonetheless, the power impacts of (b)(2) implementation under scenarios contemplated at the time the PEIS was drafted are displayed in the draft PEIS.
Causes water supply and water quality impacts to Los Vaqueros Reservoir.	CCWD	CCWD may share in annual reductions to its CVP water supply as a result of (b)(2) actions. Patterns of pumping may also change as a result of (b)(2) actions, which may affect CCWD's separate pumping. As Interior annually dedicates and manages its (b)(2) supplies, it will work through the CALFED Ops Group to try to address CCWD's Los Vaqueros concerns.
Restricts flexibility of system, particularly in wet years.	SLDMWA, Agricultural Water Contractors, BDUC, SCVWD	The dedication of CVP yield under (b)(2) places an additional demand on the CVP. Such additional demands inherently reduce the system's flexibility. In order to maximize flexibility, within the requirements of the statute, operation of facilities, including export pumps, will be forecasted sufficiently in advance to allow for decisions about allocations and review of delivery schedules to avoid interruptions to CVP water supplies.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Interior should bank unused (b)(2) water, particularly in 1999.	Environmental Groups	Decisions as to banking (b)(2) water will consider a host of related hydrological and biological issues. Assuming the Court's Order to use precisely 800,000 AF during the March-February period remains in effect, Interior intends to use the remaining amount of 1999 (b)(2) supplies by February 29, 2000.
The (b)(2) account should get credit for pumping increases due to AFRP actions and for the additional natural inflow stored due to reservoir levels reduced by upstream releases.	Environmental Groups	CVPIA did not create a (b)(2) water account so it could build fishery restoration water resource levels. Instead, it committed a set amount of water to be used every year, unless the entire amount is not needed. Supplies for (b)(2) therefore will not generally receive increases. Moreover, the example's assumption that there is more water available due to (b)(2) releases is incorrect. The (b)(2) releases merely reduce subsequent flood control releases.
Attachment 2 needs more detail, with more scientific information and a default fishery action plan	Environmental Groups	Attachment 2 was not intended to be a comprehensive compilation of the biological background for the measures, but instead was intended to provide stakeholders with summary information about the range of fishery restoration actions for which the (b)(2) water could be used. Substantial scientific documentation for those fishery measures can be found in AFRP documents and CALFED studies. Interior does not believe it is workable to develop a "default" fishery action plan, given that the hydrologic and biological conditions in every year are different and hence the needs of the fishery will also be different. Attachment 2 now describes a coordination process where Interior will convene two public workshops (fall and winter) to present and discuss the annual (b)(2) fishery action plan.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Does not provide equal priority to other project uses, with contractors being harmed more than fishery purposes.	SLDMWA	While the CVPIA established fish and wildlife purposes on an equal footing with irrigation and domestic purposes, CVPIA's other mandates gave specific directions that were intended to balance the new fish and wildlife purposes with the well-established other project purposes.
Using all 800,000 AF when there is little or no environmental benefit from using some portion is punitive.	BDUC	Interior does not intend to act punitively. It will implement all provisions of (b)(2), including the option of allocating (b)(2) water to other Project purposes when it is not needed.
Monthly changes in the annual (b)(2) operations plan will make CVP deliveries to contractors too uncertain.	SLDMWA	Effective management of the (b)(2) supplies requires Interior to respond to changes in hydrological or biological conditions. Interior believes that it has developed a process for developing and implementing the (b)(2) plan in a manner that will allow allocation decisions to be made in a timely fashion so as to provide sufficient planning time to contractors.
Extend change-in-storage metric to entire water year.	Environmental Groups	Stopping use of the change-in-storage metric in February each year is necessary for effective management of CVP yield for (b)(2) and all its other purposes.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Change-in-storage metric means export water supplies will be reduced in wet years.	SLDMWA, Agricultural Water Contractors, BDUC, CFBF	The Decision describes the dedication and management of the 800,000 acre-feet annually, as Congress required in the CVPIA. In implementing the Decision, Interior anticipates that all 800,000 acre-feet will be dedicated each year, subject to temporary reductions during critically dry years. Interior agrees that operations in wetter hydrologies may provide the desired upstream conditions for fish. In such circumstances, additional (b)(2) water could be provided through export reductions to improve Delta habitat. Under no circumstances would the usage of (b)(2) water, accounted for pursuant to the Accounting Methodology, total more than 800,000 acre feet. The Secretary, however, may consider whether to use the (b)(2) water for other project purposes when it is not needed, as provided by the statute.
Upstream releases should not be available for export by the CVP.	CDWA	Congress dedicated the (b)(2) water for environmental restoration purposes. If FWS does not specify that the release is needed for Delta outflow and does not take measures to protect the specified flows, then there would be no identified biological basis for not allowing the water to be available for recapture and reuse by other downstream water rights holders including, but not limited to, the CVP and SWP. While Interior is committed to fully using the (b)(2) water for environmental restoration purposes, it is also committed to not administering the provision in a punitive fashion.
San Luis Reservoir water should be used for (b)(2) actions.	CDWA, SDWA	Because San Luis depends on export pumps – and not natural inflow –to increase its available water, releases for fishery actions would cause additional impacts on CVP yield, which would then be subject to accounting.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
When upstream releases can be offset by hydrology, then Interior will have to rely on greater export curtailments as the most reliable mechanism for using all the (b)(2) water.	SCVWD, SLDMWA, Agricultural Water Contractors	Exports will not be reduced based only on a need to use the entire 800,000 AF. Biological justification will be required. For example, adjusting export levels provide both direct and indirect habitat improvements and benefits to fisheries in the Delta. Export adjustments promote Delta fishery habitat and reduce entrainment at the pumps.
Export contractors reliant on Delta pumps suffer the most.	CFBF, SCVWD, Agricultural Water Contractors	Export contractors are vulnerable because deliveries to them are dependent on exports from the Delta, which is the most delicate and vulnerable part of the watershed's ecosystem. Because of the importance of the Delta ecosystem in reaching the restoration goals of the statute, many of the fishery actions are necessarily directed toward Delta habitat and fishery survival. Thus, while impacts are not intentionally directed toward the export contractors, those impacts do tend to affect the export contractors.
Protect rights of SWP and its contractors	SWC	Interior's policy is that (b)(2) actions will not be permitted to adversely affect the SWP, and that any adverse impacts will be made up. Interior will work closely with DWR and DFG as it proceeds in annually dedicating and managing the (b)(2) supplies.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Contradicts COA.	SWC, SCVWD, DWR	Interior and the State acknowledge that the COA must be renegotiated to address the new standards in the Water Quality Control Plan, Endangered Species Act biological opinions, and CVPIA. This process is expected to take a significant effort. In the interim period the agencies will seek agreement on equitable sharing of water supplies and obligations in the basin. Interior and the State of California intend to evaluate how operating in accordance with the Decision affects the sharing and what changes in the COA may need to be pursued.
Work within the CALFED process on the Delta, EWA	BDUC, SCVWD , CCWD	The provisions for water banking, transfers/exchanges are intended to increase the flexibility in meeting the objectives of a CALFED water management strategy. The (b)(2) supplies will form part of the baseline from which CALFED's Environmental Water Account and its water management strategy will be developed. In response to comments, Interior has modified the Decision to more fully describe the process for developing and implementing the annual plan for (b)(2) water, so as to include other agencies and stakeholders, in a manner that will be consistent with CALFED.
The modeling assumptions used in calculating the pre-CVPIA yield should not assume that M&I contractors could sustain shortages of 25 Percent.	CCWD	Interior disagrees. The criteria for reducing the 800,000 acre-feet is based on hydrologic conditions that occur only in the driest 10 percent of the years studied. The criteria for shortages to M&I and agricultural contractors are based on apportioning available water supplies, which are affected by other constraints in addition to hydrologic conditions.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
Operations of New Melones must abide by the Bureau of Reclamation's permit requirements.	SDWA, CDWA	Interior generally operates New Melones consistent with the terms in its permits.
The New Melones Interim Operations Plan ignores the Bureau of Reclamation's permit requirements.	SDWA	The New Melones Interim Operations Plan is not at issue in the Decision. Nonetheless, Interior disagrees that the Interim Operations plan is inconsistent with the permit requirements, and it should be noted that these requirements have been met since adoption of the Interim Operations Plan for the short-term.
There is no basis for "relaxing" the water quality standard in the baseline. Water quality is not met in over 50 percent of the years.	SDWA, CDWA	The Decision does not purport to "relax" any water quality standards. Studies of New Melones' yield, including the one attached to the Decision, show that New Melones does not have enough water to sustain all purposes – or even minimum permit requirements – at desired levels through an extended drought. In those times, Interior uses all available water for permit requirements.
1987 DFG agreement only allows for fishery releases in excess of 98.3 TAF after water quality and contractor needs are met.	SDWA	Interior is fulfilling its water quality responsibilities and attempting to satisfy contractor demands from New Melones, recognizing that (b)(2) made a significant reallocation of Project yield. The New Melones authorization statute subordinates exports to out-of-basin contractors to in-basin needs, which include Vernalis water quality and instream fishery flows in the Stanislaus River. Interior intends to develop a long-term operations plan for New Melones, with clear operating criteria for available water supplies in the Stanislaus Basin.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
The estimated needs for water quality are understated.	SDWA	Providing water quality at Vernalis and fulfilling the 1987 DFG agreement come before any use of Project water from New Melones. The needs for water quality are not addressed by this (b)(2) Decision. The implementation of the Decision in the Stanislaus Basin will be modeled as part of developing the long-term operations plan for New Melones.
Water recaptured and exported cannot be considered a decrease in yield.	SDWA	Comment noted. Measuring use of (b)(2) supplies does not necessarily require a reduction in yield. It does, however, require that 800,000 acre feet of yield be used for (b)(2) purposes.
On what basis does Interior exclude the (b)(2) releases from the export/inflow ratio?	SDWA	To assist the State in its efforts to protect the Bay/Delta and to help meet the export/inflow ratio pursuant to the WQCP requirements, the CVP will use a portion of the (b)(2) water. Additional (b)(2) releases in the February-September period are generally intended to flow through the Delta and provide additional protection and restoration for anadromous fish and other estuarine species. If the supplemental (b)(2) releases were included as inflow in the export/inflow ratio, a portion of the water could be exported and the full benefit of the outflow through the Delta would not be realized.
Clarify the reference in the first paragraph of Section IV regarding "water quality requirements."	SDWA	This refers to "water quality requirements" contained in the 1995 WQCP, and the text has been clarified.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
How can there be any New Melones yield if water quality requirements are being met in less than half the years?	SDWA	In some years of an extended drought, New Melones may provide no Project yield. In those years, without Project yield, no water from New Melones would be available for (b)(2) uses. Conversely, in many years, there is sufficient water from New Melones for both water quality and Project yield, which would include yield for (b)(2). As Interior implements the Decision and runs models in developing a New Melones long-term operations plan, this issue will receive further analysis.
Operating the CVP in an integrated manner is contrary to permit conditions.	SDWA	Congress explicitly defined CVP for CVPIA purposes, indicating that Congress supports integrated management of the CVP. To the extent that the CVP water right permits are not consistent with integrated management, Interior anticipates that those permits will be addressed by the SWRCB as part of Reclamation's petition for consolidated place and purpose of use.
Does the calculation of yield and the yield assumptions understate (b)(2) and overstate yield by assuming a 2020 level of development and full contract amounts?	SDWA	No. Using the 2020 level of development and full contract amounts accurately reflects the delivery capability of the project in light of expected changes in the coming years.
There is no basis in California water rights law for limiting (b)(2) water taken from exports to 640 TAF.	SDWA, CDWA	While the limitation is not statutorily mandated, Interior believes that placing such a limitation on exports during the "low point" for CVP storage in San Luis Reservoir is the most efficient means of managing the water supplies dedicated under (b)(2) while at the same time not affecting export contractors unnecessarily. Management of the (b)(2) water respects water rights, but water rights do not dictate how Interior manages Project supplies.

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
The 800,000 acre-feet should be put into a natural stream and allowed to flow out the Golden Gate to serve fish and wildlife.	Citizen	Some of the (b)(2) supplies will be used for this purpose. The decision regarding how the water will be managed, however, will be based on gaining the greatest biological benefit, rather than following one set management approach in all years.
Meeting Vernalis water quality standards by drawing on upstream sources other than the Stanislaus River would fulfill Congress' intent that the 800,000 acre-feet add benefits over and above those resulting from requirements.	CDWA	Some (b)(2) supplies can be used to assist the State in its efforts to protect the waters of the Bay/Delta. Use of upstream sources, including water from the Delta-Mendota Canal and/or the San Luis Reservoir, could cause additional impacts to CVP yield.
Water recaptured and exported could cause a real impact within the "areas of origin," while the south of Delta export contractors receive a windfall.	CDWA	Comment noted. Interior does not believe that water recaptured and exported would create a windfall for delta exporters. Instead, allowing such recapture and export when the water is not otherwise biologically needed is consistent with the terms of the statute and consistent with making the best use of a limited resource.
California Water Code Sections 11460, et. Seq., requires that (b)(2) water be obtained first from reduction of exports from the Delta or reduction in yield of San Luis Reservoir.	CDWA	Interior disagrees. While Interior respects California water rights law, Interior does not believe that the area of origin statutes referenced in the comment place constraints on how Interior uses its discretion in implementing (b)(2).

Response To Comments Regarding (b)(2) Implementation Decision
October 5, 1999

Comment	Organization	Response
The limitation of 640,000 acre-feet on reduction of exports from the Delta for Feb 1 to Aug 31 is an action which favors export contractors.	CDWA	Comment noted. The provision for limiting export reductions to a maximum of 640,000 AF is based on an 80%-20% ratio of unconstrained water supply capability before and after the low point. As noted above, while the limitation is not statutorily mandated, Interior believes that placing such a limitation on exports during the "low point" for CVP storage in San Luis Reservoir is the most efficient means of managing the water supplies dedicated under (b)(2) while at the same time not affecting export contractors unnecessarily.
Interior failed to comply with Administrative Procedure Act.	SWC	Interior disagrees. The Interim Decision was compiled in response to a court-imposed deadline, and hence was not subject to the APA. The Interim decision was then released for public comment, distributed widely to all interested parties, and actual notice given to affected interests. Further, the Decision interprets the statutory mandate relating to how the government manages its own assets. It does not "impinge" on DWR's water rights or purport to prohibit state exports of water. Interior recognizes that the SWP's actions are necessarily voluntary, and the Decision indicates the direction Interior will seek to pursue when it consults with DWR and DFG.
Interior should implement yield enhancement actions, as provided by CVPIA Section 3408(j).	EBMUD	Interior continues to consider ways to enhance the CVP's yield.

Comment	Organization	Response
Reclamation should reconsult with NMFS as to the 1.9 MAF carryover storage requirement, now that the Temperature Control Device is installed.	EBMUD	Comment noted. This requirement is reflected in the Decision's yield analysis as a modeling tool. Actual Shasta operations are controlled more by the 56-degree temperature requirement.
Water from San Luis Reservoir would be advantageous for providing fish flows in the San Joaquin River.	CDWA	Comment noted. However, before initiating such an approach Interior would need to determine that such water usage was biologically beneficial, and did not raise secondary impacts. To date, Interior has not felt that such use was the best approach biologically or operationally.

List of Abbreviations for Response To Comments

Agricultural Water Contractors - Panoche Water District, Plain View Water District, Pacheco Water District, Westlands Water District, James Irrigation District, Banta-Carbona Irrigation District, West Stanislaus Irrigation District, Centinella Water District, San Luis Water District (These agencies sent very similar letters with the same comments, and relied on the comments from SLDMWA.)

(b)(2) - Section 3406(b)(2) of the Central Valley Project Improvement Act (Public Law 102-575)

BDUC - Bay Delta Urban Coalition

CCWD - Contra Costa Water District

CDWA - Central Delta Water Agency

CFBF - California Farm Bureau Federation

COA – Coordinated Operating Agreement

DFG - California Department of Fish & Game

DWR - California Department of Water Resources

EBMUD - East Bay Municipal Utility District

Environmental Groups - Save San Francisco Bay Association, Environmental Defense Fund, Natural Resources Defense Council, Pacific Coast Federation of Fishermens' Associations, California Sportfishing Protection Alliance, The Bay Institute

EPA- United States Environmental Protection Agency

ESA – Endangered Species Act

SCVWD - Santa Clara Valley Water District

SMUD - Sacramento Municipal Utility District

SLDMWA - San Luis & Delta-Mendota Water Authority

SDWA - South Delta Water Agency

Smiland & Khachigian - Smiland and Khachigian law firm

SWC - State Water Contractors

SWRCB – State Water Resources Control Board

WAPA - Department of Energy, Western Area Power Administration

WQCP - 1995 Delta Water Quality Control Plan

ATTACHMENT H

ERRATA TO THE DRAFT PEIS (SEPTEMBER 1997)

Attachment H

ERRATA TO THE DRAFT PEIS (SEPTEMBER 1997)

ERRATA FOR AGRICULTURAL ECONOMICS AND LAND USE TECHNICAL APPENDIX

Page III-32, Line 45 under Table III-19

Draft PEIS

Net Revenue ($ Million)		
Sacramento River	-3	-1.0
San Joaquin River	-25	-4.0
Tulare Lake	-10	-2.0
San Felipe Division	-4.6	86.0
Total	-43	-3.0

Final PEIS

Net Revenue ($ Million)		
Sacramento River	-3	-1.0
San Joaquin River	-25	-4.0
Tulare Lake	-10	-2.0
San Felipe Division	-4.6	-86.0
Total	-43	-3.0

ERRATA FOR CVGSM METHODOLOGY/MODELING TECHNICAL APPENDIX

Page v, Line 13 under List of Abbreviations and Acronyms

Draft PEIS

Reclamation	U.S. Bureau of Reclamation
Service	U.S. Fish and Wildlife Service

Final PEIS

Reclamation	U.S. Bureau of Reclamation
SCS	U.S. Department of Agriculture, Soil Conservation Service (now known as Natural Resources Conservation District)
Service	U.S. Fish and Wildlife Service

Back to Table of Contents for Attachment H

ERRATA FOR FISHERIES TECHNICAL APPENDIX

Page I-5, Line 13 under Changes Compared to the No-Action Alternative

Draft PEIS
Stream flow improvements, due to (b)(2) Water Management, combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would improve environmental conditions such as river temperature, diversion entrainment, short-term fluctuations in river level, increased flows providing better movement and habitat quality and quantity, and food web support. These environmental conditions would benefit all life stages of representative fish species, including chinook salmon, steelhead trout, sturgeon, American shad, and striped bass.

Final PEIS
Stream flow improvements, due to (b)(2) Water Management, combined with structural and other habitat restoration actions in Clear Creek and in the Sacramento, American, and Stanislaus rivers would improve environmental conditions such as river temperature (not in Sacramento River), diversion entrainment, short-term fluctuations in river level, increased flows providing better movement and habitat quality and quantity, and food web support. These environmental conditions would benefit all life stages of representative fish species, including chinook salmon, steelhead trout, sturgeon, American shad, and striped bass.

Page I-6, Line 20 under Changes Compared to the No-Action Alternative

Draft PEIS
Actions to reduce predation at diversion facilities and limit predator habitat would improve survival of juvenile life stages of representative species in the Sacramento River and its minor tributaries and the Yuba, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, as well as in the Delta.

Final PEIS
Actions to reduce predation at diversion facilities and limit predator habitat would improve survival of juvenile life stages of representative species in the Sacramento River and its minor tributaries and the Yuba, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers, as well as in the Delta. Increased temperatures in upper Sacramento River could adversely affect winter-run chinook salmon.

Back to Table of Contents for Attachment H

Page II-4, Line 28 under San Joaquin River Region

Draft PEIS
Salmon straying into west side canals, numerous small- and medium-sized diversions, elevated water temperatures, channel dredging, waste discharges, and low dissolved oxygen are other factors adversely affecting anadromous fisheries resources. (Reynolds et al., 1993.)

Final PEIS
Salmon straying into west side canals, numerous small- and medium-sized diversions, elevated water temperatures, channel dredging, gravel recruitment, waste discharges, and low dissolved oxygen are other factors adversely affecting anadromous fisheries resources. (Reynolds et al., 1993.)

Page II-5, Line 29 under Sacramento-San Joaquin Delta Region

Draft PEIS
The Cosumnes River currently supports an average annual run of about 100 fall-run chinook salmon, and the Mokelumne River, including the Mokelumne River Fish Hatchery, supports an average run of less than 1,000 salmon.

Final PEIS
The Cosumnes River currently supports an average annual run of about 100 fall-run chinook salmon, and the Mokelumne River, including the Mokelumne River Fish Hatchery, supports an average run of only several thousand salmon.

Page II-19, Line 36 under Timeline of Major Historical Activities Affecting Fish Habitats in the Central Valley Region

Draft PEIS

1902	Union Dam completed on North Fork Stanislaus River
1912	Goodwin Dam completed on Stanislaus River

Final PEIS

1902	Union Dam completed on North Fork Stanislaus River
1910	Woodbridge Dam completed on Mokelumne River
1912	Goodwin Dam completed on Stanislaus River

Back to Table of Contents for Attachment H

Page II-20, Line 12 under Timeline of Major Historical Activities Affecting Fish Habitats in the Central Valley Region

Draft PEIS

1924	Melones Dam constructed on Stanislaus River
1925	Calaveras Dam completed on Calaveras River

Final PEIS

1924	Melones Dam constructed on Stanislaus River
1925	Fish ladders added to Woodbridge Dam on Mokelumne River
1925	Calaveras Dam completed on Calaveras River

Page II-21, Line 27 under Table II-3

Draft PEIS
1971 Tehama-Colusa Canal and Pumping Plant completed

Final PEIS
1971 Tehama-Colusa Canal completed

Page II-21 under Table II-3

Draft PEIS
N/A

Final PEIS
Add to table:
1976 First CVP water service contract deliveries to Tehama Colusa Canal

Back to Table of Contents for Attachment H

Page II-25, Line 33 under Species Introduced

Draft PEIS
Large-scale hatchery production of chinook salmon and steelhead to mitigate impacts from large dams have adversely affected the remaining wild stocks, primarily by affecting their genetic composition and facilitating high harvest rates.

Final PEIS
Large-scale hatchery production of chinook salmon and steelhead to mitigate impacts from large dams may have adversely affected the remaining wild stocks, primarily by affecting their genetic composition and facilitating high harvest rates.

Page II-26, Line 35 under Sacramento River

Draft PEIS
Construction of the RBDD was completed in 1964. The only identified mitigation requirement was to replace 3,000 fall-run chinook salmon expected to have been lost because of inundation of salmon spawning habitat in the Sacramento River by Lake Red Bluff immediately upstream of the dam.

Final PEIS
Construction of the RBDD was completed in 1964. Operation of RBDD started in 1966. The only identified mitigation requirement was to replace 3,000 fall-run chinook salmon expected to have been lost because of inundation of salmon spawning habitat in the Sacramento River by Lake Red Bluff immediately upstream of the dam.

Page II-27, Line 1 under Sacramento River

Draft PEIS
The fish facilities (i.e., dual- and single-purpose canals) failed to meet production goals and ultimately ceased operation when the RBDD was operated with its gates raised to improve salmon migration past the dam.

Final PEIS
The fish facilities (i.e., dual- and single-purpose canals) met initial production goals but not enhanced production goals. The fish facilities ceased operation when the RBDD was operated with its gates raised to improve salmon migration past the dam.

Back to Table of Contents for Attachment H

Page II-56, Line 7 under Red Bluff Diversion Dam

Draft PEIS
Reclamation is investigating alternatives that will permit the RBDD gates to be raised permanently or for longer periods (such as found in Alternative 6 [September 15 to May 14]) to provide unimpeded passage of adult and juvenile chinook salmon.

Final PEIS
Reclamation is conducting pilot studies and investigating alternatives that will permit the RBDD gates to be raised permanently or for longer periods from September 15 to May 14 to provide unimpeded passage of adult and juvenile chinook salmon.

Page II-99, Line 31 under Historical Population Trends (1850-1966)

Draft PEIS
Since 1953, fall-run chinook salmon run size has varied considerably with peak salmon abundance, generally corresponding to similar peaks in the Stanislaus, Tuolumne, and Merced rivers.

Final PEIS
Since 1953, fall-run chinook salmon run size has varied considerably with peak salmon abundance.

Page II-101, Line 12 under Current Population Trends (1967-1991)

Draft PEIS
Increased abundance during the 1980s has been attributed to increased smolt survival resulting from several high spring-runoff years and increased production of juvenile salmon at the Mokelumne River Fish Hatchery.

Final PEIS
Increased abundance during the 1980s has been attributed to increased smolt survival resulting from increased production of juvenile salmon at the Mokelumne River Fish Hatchery.

Page II-104, Line 1 under Water Temperature

Draft PEIS
Water temperatures for chinook salmon spawning in the Mokelumne River below Camanche Dam are generally not suitable until early November during a normal water year (DFG, 1991).

Final PEIS
Historic water temperatures for chinook salmon spawning in the Mokelumne River below Camanche Dam were generally not suitable until early November during a normal water year (DFG, 1991) based on operations of Mokelumne River in the 1980s.

Page II-123, Line 12 under Ongoing Monitoring, Enhancement, and Habitat Improvement Actions

Draft PEIS
The Fisheries Subcommittee of the SJRMP Advisory Council has prepared an action plan for chinook salmon in the drainage that will also aid in restoring steelhead populations if implemented. The Recent Conditions for Chinook Salmon section of this chapter provides greater detail about ongoing activities through the SJRMP.

Final PEIS
The Fisheries Subcommittee of the SJRMP Advisory Council has prepared an action plan for chinook salmon in the drainage that will also aid in restoring steelhead populations if implemented.

Page II-209, Line 42 under Spawning

Draft PEIS
Adults and larvae have been collected in Barker Slough, Lindsay Slough, Cache Slough, Georgiana Slough, Prospect Slough, Beaver Slough, Hog Slough, Sycamore Slough, the Mokelumne River, Fisherman's Cut, and False River (Wang and Brown, 1993).

Final PEIS
Adults and larvae have been collected in Barker Slough, Lindsay Slough, Cache Slough, Georgiana Slough, Prospect Slough, Beaver Slough, Hog Slough, Sycamore Slough, the lower reaches of the Mokelumne River near the confluence with the Delta, Fisherman's Cut, and False River (Wang and Brown, 1993).

Back to Table of Contents for Attachment H

Page III-7, Line 4 under Summary of CVPIA Fish Habitat Restoration Actions

Draft PEIS

Alternative	Watershed Compartment	Habitat Restoration Action
1-4	Sacramento River	Restore meander belt: Keswick to Chico
1-4	Sacramento River	Enhance spawning gravel

Final PEIS

Alternative	Watershed Compartment	Habitat Restoration Action
1-4	Sacramento River	Enhance spawning gravel

Page III-17, Line 32 under Delta Smelt, Longfin Smelt, and Sacramento Splittail

Draft PEIS

Restoring shallow water and riparian habitats in the Delta would benefit adult and juvenile delta smelt, longfin smelt, and Sacramento splittail by increasing spawning and rearing habitat availability and food web support under Alternatives 1 through 4. Restoring the meander belt on the Sacramento River would increase the availability of seasonally inundated habitat, important to splittail spawning success and potentially providing additional food web support. The cumulative flows of Sacramento River at Knights Landing and Feather River at the confluence with the Sacramento River would be similar under Alternatives 1 through 4.

Final PEIS

Restoring shallow water and riparian habitats in the Delta would benefit adult and juvenile delta smelt, longfin smelt, and Sacramento splittail by increasing spawning and rearing habitat availability and food web support under Alternatives 1 through 4. The cumulative flows of Sacramento River at Knights Landing and Feather River at the confluence with the Sacramento River would be similar under Alternatives 1 through 4.

Back to Table of Contents for Attachment H

Page III-97, Line 34 under Sacramento Splittail

Draft PEIS
Habitat restoration would increase spawning and rearing habitat availability. Restoration of the meander belt on the Sacramento River may increase the availability of seasonally inundated habitat, important to splittail spawning success and potentially providing additional food web support. Shallow water habitat restoration in the Delta and downstream shift in estuarine salinity in January through March would increase spawning and rearing habitat availability and increase food web support.

Final PEIS
Habitat restoration would increase spawning and rearing habitat availability. Shallow water habitat restoration in the Delta and downstream shift in estuarine salinity in January through March would increase spawning and rearing habitat availability and increase food web support.

Page III-99, Line 14 under Water Temperature

Draft PEIS
Riparian and meander belt restoration actions are identified for the Sacramento River, minor tributaries, Yuba River, American River, Mokelumne River, and the Delta.

Final PEIS
Riparian and meander belt restoration actions are identified for the Sacramento River minor tributaries, Yuba River, American River, Mokelumne River, and the Delta.

Page III-106, Line 28 under Sacramento River and Tributaries

Draft PEIS
Habitat availability in the Sacramento River and its tributaries would increase for a variety of reasons under Alternative 1. Restoration of spawning gravel would increase spawning habitat for chinook salmon and steelhead trout, potentially reducing mortality caused by nest superimposition. Restoration of the meander belt from Keswick Reservoir to Chico would increase habitat complexity and restore natural river processes (e.g., erosion, seasonal flooding). The meander belt would increase rearing habitat for juvenile chinook salmon (all runs), steelhead trout, American shad, and sturgeon. Meander belt restoration may also provide additional spawning and rearing habitat for Sacramento splittail.

Final PEIS
Habitat availability in the Sacramento River and its tributaries would increase for a variety of reasons under Alternative 1. Restoration of spawning gravel would increase spawning habitat for chinook salmon and steelhead trout, potentially reducing mortality caused by nest superimposition.

Back to Table of Contents for Attachment H

Page III-109, Line 28 under Sacramento and San Joaquin Rivers and Tributaries

Draft PEIS
Restoration of the meander belt from Keswick Reservoir to Chico, riparian restoration, the creation of secondary channels, termination of the program to remove woody debris, watershed improvements, restoration and protection of instream habitat, and limits on future bank protection activities would increase food web support for the representative species under Alternative 1 (see Quantity and Quality of Habitat).

Final PEIS
Restoration of riparian habitat, the creation of secondary channels, termination of the program to remove woody debris, watershed improvements, restoration and protection of instream habitat, and limits on future bank protection activities would increase food web support for the representative species under Alternative 1 (see Quantity and Quality of Habitat).

Attachment A, Line 7 under Table A-1

Draft PEIS

Feather River, February, Juvenile Migration:	● (Shaded circle -- indicates primary occurrence).
Feather River, March, Juvenile Rearing:	●
Feather River, March, Juvenile Migration:	●
Feather River, April, Juvenile Rearing:	●
Feather River, April, Juvenile Migration:	●
Feather River, May, Juvenile Rearing:	●
Feather River, May, Juvenile Migration:	●
Feather River, June, Juvenile Rearing:	●
Feather River, June, Juvenile Migration:	●

Final PEIS

Feather River, February, Juvenile Migration:	○ (Non-shaded circle -- indicates minor or potential occurrence).
Feather River, March, Juvenile Rearing:	○
Feather River, March, Juvenile Migration:	○
Feather River, April, Juvenile Rearing:	○
Feather River, April, Juvenile Migration:	○
Feather River, May, Juvenile Rearing:	○
Feather River, May, Juvenile Migration:	○
Feather River, June, Juvenile Rearing:	○
Feather River, June, Juvenile Migration:	○

Attachment A, Line 16 under Table A-1

Draft PEIS

San Joaquin River, July, Juvenile Rearing:	No circle.
San Joaquin River, August, Juvenile Rearing:	No circle.

Final PEIS

San Joaquin River, July, Juvenile Rearing:	● (Shaded circle -- indicates primary potential occurrence).
San Joaquin River, August, Juvenile Rearing:	○
San Joaquin River, September, Juvenile Rearing:	○

Attachment A, Line 7 under Table A-3

Draft PEIS

Feather River, October, Juvenile Rearing:	● (Shaded circle -- indicates primary occurrence).
Feather River, May, Juvenile Rearing:	●
Feather River, June, Juvenile Rearing:	●
Feather River, July, Juvenile Rearing:	●
Feather River, August, Juvenile Rearing:	●
Feather River, September, Juvenile Rearing:	●

Final PEIS

Feather River, October, Juvenile Rearing:	○ (Non-shaded circle -- indicates minor or potential occurrence).
Feather River, May, Juvenile Rearing:	○
Feather River, June, Juvenile Rearing:	○
Feather River, July, Juvenile Rearing:	○
Feather River, August, Juvenile Rearing:	○
Feather River, September, Juvenile Rearing:	○

Back to Table of Contents for Attachment H

Attachment A, Line 4 under Table A-5

Draft PEIS

Sacramento River, January, Spawning/Incubation:	○ (Non-shaded circle -- indicates minor or potential occurrence).
Sacramento River, May, Spawning/Incubation:	● (Shaded circle -- indicates primary occurrence).
Sacramento River, June, Spawning/Incubation:	○

Final PEIS

Sacramento River, January, Spawning/Incubation:	●
Sacramento River, May, Spawning/Incubation:	○
Sacramento River, June, Spawning/Incubation:	No circle.

Attachment A, Line 5 under Table A-5

Draft PEIS

Clear Creek, January, Spawning/Incubation:	○ (Non-shaded circle -- indicates minor or potential occurrence).
Clear Creek, May, Spawning/Incubation:	● (Shaded circle -- indicates primary occurrence).
Clear Creek, June, Spawning/Incubation:	○

Final PEIS

Clear Creek, January, Spawning/Incubation:	●
Clear Creek, May, Spawning/Incubation:	○
Clear Creek, June, Spawning/Incubation:	No circle.

Attachment A, Line 7 under Table A-5

Draft PEIS

Feather River, January, Spawning/Incubation:	○ (Non-shaded circle -- indicates minor or potential occurrence).
Feather River, May, Spawning/Incubation:	● (Shaded circle -- indicates primary occurrence).
Feather River, June, Spawning/Incubation:	○

Final PEIS

Feather River, January, Spawning/Incubation:	●
Feather River, May, Spawning/Incubation:	○
Feather River, June, Spawning/Incubation:	No circle.

Attachment A, Line 10 under Table A-5

Draft PEIS

American River, January, Spawning/Incubation:	○ (Non-shaded circle -- indicates minor or potential occurrence).
American River, May, Spawning/Incubation:	● (Shaded circle -- indicates primary occurrence).
American River, June, Spawning/Incubation:	○

Final PEIS

American River, January, Spawning/Incubation:	●
American River, May, Spawning/Incubation:	○
American River, June, Spawning/Incubation:	No circle.

Back to Table of Contents for Attachment H

ERRATA FOR GROUNDWATER TECHNICAL APPENDIX

Page II-10, Line 23 under Groundwater Levels

Draft PEIS
During the 1987-1992 drought, groundwater levels declined in Butte and Tehama counties; however, very little decline occurred in Glenn and Colusa counties (DWR, 1994).

Final PEIS
During the 1987-1992 drought, groundwater levels declined in Butte, Tehama, and western Glenn counties; however, very little decline occurred in eastern Glenn and Colusa counties (DWR, 1994).

ERRATA FOR MUNICIPAL WATER COSTS METHODOLOGY/MODELING TECHNICAL APPENDIX

Page II-2, Line 30 under Bay Area Group

Draft PEIS
Contra Costa Water District (CCWD) provides CVP municipal water in Contra Costa County for the cities of Antioch, Concord, Martinez, Pittsburg, Walnut Creek, other communities and industrial users, and in Oakley Water District. CCWD diverts its supply from the Delta and is the single largest CVP M&I project water use.

Final PEIS
Contra Costa Water District (CCWD) provides CVP municipal water in Contra Costa County for the cities of Antioch, Concord, Martinez, Pittsburg, Walnut Creek, other communities and industrial users, and in Oakley Water District (Diablo Water District). CCWD diverts its supply from the Delta and is the single largest CVP M&I project water use.

Back to Table of Contents for Attachment H

ERRATA FOR DEVELOPMENT OF THE NO-ACTION ALTERNATIVE TECHNICAL APPENDIX

Page II-3, Line 3 under Table II-2

Draft PEIS

TABLE II-2

CVP CONTRACT AMOUNT AND DIVERSION OBLIGATION ASSUMPTIONS USED IN THE PEIS ALTERNATIVES

Final PEIS

TABLE II-2

CVP CONTRACT AMOUNT AND DIVERSION OBLIGATION ASSUMPTIONS USED IN THE NO-ACTION ALTERNATIVE

ERRATA FOR PUBLIC INVOLVEMENT
TECHNICAL APPENDIX

Page iii, Line 8 under List of Abbreviations and Acronyms

Draft PEIS
IGM Interest Group

Final PEIS
IGM Interest Group Meeting

Page II-1, Paragraph 2, Line 2 under Introduction

Draft PEIS
Due to the complexity of issues involved in implementing the CVPIA, the diversity of interests with a stake in its implementation, and the large geographic area affected by the law, the Bureau of Reclamation (Reclamation) and the Fish and Wildlife Service (Service) of the U.S. Department of Interior (DOI) instituted a full-scale public involvement program that represents a broad and balanced range of interests.

Final PEIS
Due to the complexity of issues involved in implementing the CVPIA, the diversity of interests with a stake in its implementation, and the large geographic area affected by the law, the Bureau of Reclamation (Reclamation) of the U.S. Department of Interior (DOI) instituted a full-scale public involvement program that engaged a broad and balanced range of interests.

Page II-1, Paragraph 4, Line 1 under Introduction

Draft PEIS
Public involvement activities responded to the needs of the public and Reclamation and the Service, evolving as the PEIS process unfolded to maximize public education and participation.

Final PEIS
Public involvement activities responded to the needs of the public and Reclamation, evolving as the PEIS process unfolded to maximize public education and participation.

Page II-2, Paragraph 1, Line 2 under Concurrent Implementation

Draft PEIS
Experience in implementing these interim actions yielded information that affected the PEIS.

Final PEIS
Experiences gained when implementing these interim actions yielded information that ultimately affected the PEIS.

Page II-4, Paragraph 1, Line 2 under Interagency Group and Interest Group Meetings

Draft PEIS
The Interagency Group (IAG) consisted of government agency interests that would assist in or be affected by CVPIA implementation.

Final PEIS
The Interagency Group (IAG) consisted of cooperating government agencies that would assist in or be affected by CVPIA implementation.

Page II-4, Paragraph 5, Line 2 under Stakeholder Meetings

Draft PEIS
The purpose was to supplement the scoping process the alternative development process, and review impact analysis results.

Final PEIS
The purpose was to supplement the scoping process, the alternative development process, and review impact analysis results.

Back to Table of Contents for Attachment H

Page III-1, Paragraph 1, Line 1 under Interested Publics and Target Audiences

Draft PEIS
Reclamation and the Service worked to identify as many potentially affected groups and organizations as possible, and to provide them with an opportunity to participate in the PEIS process.

Final PEIS
Reclamation worked to identify as many potentially affected groups and organizations as possible, and to provide them with an opportunity to participate in the PEIS process.

Page IV-1, GRAPHIC - Phases for PEIS Process

Draft PEIS
Alternatives Refinement & Impact Analysis - February, 1997
Draft PEIS - June, 1996
Final PEIS - September, 1997

Final PEIS
Alternatives Refinement & Impact Analysis - August, 1997
Draft PEIS - September, 1997
Final PEIS - October, 1999

Page IV-1, Paragraph 1, Line 1 under Scoping Phase

Draft PEIS
Reclamation and the Service started the preparation of the PEIS during the Scoping phase.

Final PEIS
Reclamation started the preparation of the PEIS during the Scoping phase.

Back to Table of Contents for Attachment H

Page IV-2, Paragraph 3, Line 1 under Scoping Phase

Draft PEIS
At public scoping meetings held around the state in March 1993, Reclamation and the Service provided information about the PEIS process and solicited public comments, questions, and concerns.

Final PEIS
At public scoping meetings held around the state in March 1993, Reclamation provided information about the PEIS process and solicited public comments, questions, and concerns.

Page IV-3, Paragraph 1, Line 1 under Scoping Phase

Draft PEIS
Reclamation and the Service received numerous comments about issues to be considered in the PEIS and methodologies for analyzing impacts.

Final PEIS
Reclamation received numerous comments about issues to be considered in the PEIS and methodologies for analyzing impacts.

Page IV-3, Paragraph 2, Line 3 under Scoping Phase

Draft PEIS
During this phase, Reclamation and the Service also established cooperative agreements with public agencies who would assist in preparing the PEIS.

Final PEIS
During this phase, Reclamation also established cooperative agreements with public agencies who would assist in preparing the PEIS.

Back to Table of Contents for Attachment H

Page IV-3, Paragraph 1, Line 4 under Scoping Phase

Draft PEIS
They are: California Department of Fish and Game; California Department of Water Resources; California State Water Resources Control Board; National Marine Fisheries Service; U.S. Army Corps of Engineers, Sacramento District; Office of Environmental Policy & Compliance; U.S. Environmental Protection Agency; Western Area Power Administration; and, the Hoopa Valley Tribal Council. Consulting agencies included the U.S. Geological Service, the Bureau of Indian Affairs, and the Natural Resources Conservation Service.

Final PEIS
They are: California State Department of Fish and Game; California State Department of Water Resources; California State Water Resources Control Board; National Marine Fisheries Service; U.S. Army Corps of Engineers, Sacramento District: U.S. Environmental Protection Agency; Western Area Power Administration; and the Hoopa Valley Tribal Council. Consulting agencies included the U.S. Geological Service, the Bureau of Indian Affairs, and the Natural Resources Conservation Service.

Page IV-3, Paragraph 2, Line 2 under Scoping Phase

Draft PEIS
The public raised issues that were important to their various concerns and identified potential impacts to consider in the PEIS, which were considered by Reclamation and the Service in later PEIS phases.

Final PEIS
The public raised issues that were important to their various concerns and identified potential impacts to consider in the PEIS, which were considered by Reclamation in later PEIS phases.

Page IV-4, Paragraph 1, Line 1 under Project Development Phase

Draft PEIS
Developing a set of alternatives that reflected the full range of feasible options was a significant challenge for Reclamation and the Service.

Final PEIS
Developing a set of alternatives that reflected the full range of feasible options was a significant challenge for Reclamation.

Back to Table of Contents for Attachment H

Page IV-4, Paragraph 2, Line 3 under Project Development Phase

Draft PEIS
Beginning in May 1993 and continuing to January 1995, the second phase was the longest of the four phases and resulted in the largest number of comments.

Final PEIS
Beginning in May 1993 and continuing to January 1995, the Draft PEIS was developed through four separate phases. The second phase was the longest and resulted in the largest number of comments.

Page IV-4, Paragraph 3, Line 2 under Project Development Phase

Draft PEIS
Reclamation and the Service also provided background information on the Purpose and Need Statement and Existing Conditions definition, developed options for implementing CVPIA provisions, and described the role of analytical tools and how they would be used in the impact analysis process.

Final PEIS
Reclamation also provided background information on the Purpose and Need Statement and Existing Conditions definition, developed options for implementing CVPIA provisions, and described the role of analytical tools and how they would be used in the impact analysis process.

Page IV-4, Paragraph 3, Line 3 under Project Development Phase

Draft PEIS
These activities would shape the PEIS, and Reclamation and the Service recognized the importance of maximizing public understanding and involvement.

Final PEIS
These activities would shape the PEIS, and Reclamation recognized the importance of maximizing public understanding and involvement.

Back to Table of Contents for Attachment H

Page IV-6, Paragraph 2, Line 1 under Purpose and Need Statement

Draft PEIS
Reclamation and the Service responded by modifying the language in the Purpose and Need Statement.

Final PEIS
Reclamation responded by modifying the language in the Purpose and Need Statement.

Page IV-13, Paragraph 1, Line 2 & 3 under Preparation of Draft and Final PEIS Phase

Draft PEIS
This phase began in June 1996 and will continue into October 1997. The first activity was the preparation of the Draft PEIS and its supporting attachments and technical appendices.

Final PEIS
This phase began in June 1996, with the preparation of the Draft PEIS and its supporting attachments and technical appendices.

Page A-1, Line 1 under Attachment A, Meetings and Workshops by Phase, Table, Scoping

Draft PEIS

Meeting Type	Date	Location	Attendance/Participation
Stakeholder Discussions	Feb. 1993	Various locations throughout California	Interviews with representatives of approximately 25 interest groups

Final PEIS

Meeting Type	Date	Location	Attendance/Participation
Stakeholder Discussions	Jan. & Feb. 1993	Various locations throughout California	Interviews with representatives of approximately 25 interest groups

Back to Table of Contents for Attachment H

Page A-4, Line 6, 7 & 8 under Attachment A, Meetings and Workshops by Phase, Table, Preparation of Draft and Final PEIS

Draft PEIS

Meeting Type	Date	Location	Attendance/Participation
Press Conference	Sept., 1997	Sacramento	
Stakeholder Briefings	Sept.- Nov., 1997	Sacramento Central	Agricultural, Water Contractors,

Final PEIS

Meeting Type	Date	Location	Attendance/Participation
Press Conference	*	Sacramento	
Stakeholder Briefings	*	Sacramento Central	Agricultural, Water Contractors,

* Some information was planned, but the actual schedule and implementation is inaccurate. See Chapter 6/VI of FPEIS, Attachment A, for an accurate schedule of events.

Page B-5, Line 1-4 under Attachment B, Information Materials by Phase, Table, Preparation of Draft and Final PEIS

Draft PEIS

Title	Date	Distribution	Topics
Outflow Newsletter #5	Sept 1997	Project mailing list, distribution at public meetings, and available upon request	Special edition to accompany release of Draft PEIS
Information and Media	Sept 1997	Mailed to selected	Announce release of Draft PEIS,
Draft PI Technical Appendix	Sept 1997	County libraries, available on request in CD-ROM or bound report format	Complete summary report of all PI activities and information materials produced for the PEIS process
Outflow Newsletter #6	January 1998	Project mailing list,	Special edition to report on public

Final PEIS

Title	Date	Distribution	Topics
Outflow Newsletter #5	Dec 1997	Project mailing list, distribution at public meetings, and available upon request	Special edition to accompany release of Draft PEIS
Information and Media	Jan 1998	Mailed to selected	Announce release of Draft PEIS,
Draft PI Technical Appendix	Nov 1997	County libraries, available on request in CD-ROM or bound report format	Complete summary report of all PI activities and information materials produced for the PEIS process
Outflow Newsletter #6	*		

* Some information was planned, but the actual schedule and implementation is inaccurate. See Chapter 6/VI of FPEIS, Attachment A, for an accurate schedule of events.

Back to Table of Contents for Attachment H

Page B-6, Lines 1,2 & 8 under Attachment B, Information Materials by Phase, Table, Preparation of Draft and Final PEIS

Draft PEIS

INFORMATION MATERIALS
TABLE OF CONTENTS

Outflow Issue 1	Fall 1993
Outflow Issue 2	Winter 1993
Outflow Issue 3	Summer 1994
Outflow Issue 4	Winter 1995
Outflow Issue 5	Summer 1997
Outflow Issue 6	Winter 1998

Final PEIS

PUBLIC INFORMATION MATERIALS
CHRONOLOGICAL ORDER

Outflow Issue 1	Fall 1993
Outflow Issue 2	Winter 1993
Outflow Issue 3	Summer 1994
Outflow Issue 4	Winter 1995
Outflow Issue 5	Fall 1997
Outflow Issue 6	Summer 1999

Page C-1, Title under Attachment C

Draft PEIS
COOPERATING AGENCIES

Final PEIS
COOPERATING AND CONSULTING AGENCIES

Page C-1, Lines 1,2, & 9 under Attachment C, Cooperating Agencies

Draft PEIS

Cooperating Agencies
CA Dept .of Fish & Game
CA Dept. of Water Resources
CA State Water Resources Control Board
National Marine Fisheries Service
U.S. Army Corps of Engineers, Sacramento District
U.S. Environmental Protection Agency
Western Area Power Administration
Hoopa Valley Tribal Council

Final PEIS

Cooperating Agencies
CA State Department of Fish and Game
CA State Department of Water Resources
CA State Water Resources Control Board
National Marine Fisheries Service
U.S. Army Corps of Engineers, Sacramento District
U.S. Environmental Protection Agency
Western Area Power Administration
Hoopa Valley Tribal Council

Back to Table of Contents for Attachment H

ERRATA FOR SOILS AND GEOLOGY TECHNICAL APPENDIX

Global Note:

The "Soil Conservation Service" is now known as the "Natural Resources Conservation Service."

Page iv, Line 7 under List of Abbreviations and Acronyms

Draft PEIS

SCS U.S. Department of Agriculture Soil Conservation Service

Final PEIS

SCS U.S. Department of Agriculture, Soil Conservation Service (now known as Natural Resources Conservation Service)

Page IV-2 under Printed References

Draft PEIS

N/A

Final PEIS

Add to Printed References:

University of California, Division of Agriculture and Natural Resources, Publication 21511, Distribution of Saline and Alkaline Soils in the San Joaquin Valley.

Back to Table of Contents for Attachment H

ERRATA FOR SURFACE WATER SUPPLIES AND FACILITIES OPERATIONS TECHNICAL APPENDIX

Page I-3, Line 29 under Table I-1

Draft PEIS

2	Alternative 1 assumptions plus the following: Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 170,000 af/yr from willing sellers on the Stanislaus, Tuolumne, and Merced Rivers for instream and Delta fishery needs.
3	Alternative 1 assumptions plus the following: Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 800,000 af/yr from willing sellers on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba Rivers for instream fishery needs. Acquired water may be exported by the projects when it reaches the Delta.
4	Alternative 1 assumptions plus the following: Implement (b)(2) water management actions in the Delta in addition to Bay-Delta Plan Accord. Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 800,000 af/yr on Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba Rivers for instream and Delta fishery needs. Acquired water may not be exported by the projects when it reaches the Delta.

Final PEIS

2	Alternative 1 assumptions plus the following: Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 170,000 af/yr from willing sellers on the Stanislaus, Tuolumne, and Merced Rivers for instream and Delta fishery needs. Acquired water may not be exported by the projects when it reaches the Delta. Acquire undetermined amount of water on Sacramento River tributaries that support spring-run chinook salmon.
3	Alternative 1 assumptions plus the following: Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 800,000 af/yr from willing sellers on the Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba Rivers for instream fishery needs. Acquired water may be exported by the projects when it reaches the Delta. Acquire undetermined amount of water on Sacramento River tributaries that support spring-run chinook salmon.
4	Alternative 1 assumptions plus the following: Implement (b)(2) water management actions in the Delta in addition to Bay-Delta Plan Accord. Implement 3406(b)(3) water acquisition for Level 4 refuge water supplies. Acquire up to 800,000 af/yr on Stanislaus, Tuolumne, Merced, Calaveras, Mokelumne, and Yuba Rivers for instream and Delta fishery needs. Acquire undetermined amount of water on Sacramento River tributaries that support spring-run chinook salmon.

Back to Table of Contents for Attachment H

Page II-13, Line 26 under Table II-2

Draft PEIS
1971 Tehama Colusa Canal and Pumping Plant completed.

Final PEIS
1971 Tehama Colusa Canal completed.

Page II-13 under Table II-2

Draft PEIS
N/A

Final PEIS
Add to table:
1976 First CVP water service contract deliveries to Tehama Colusa Canal.

Page II-20, Line 8 under 1970 to Present

Draft PEIS
This generally includes dams 25 feet or higher, or those that create a reservoir larger than 50,000 acre-feet.

Final PEIS
This generally includes dams 25 feet or higher, or those that create a reservoir larger than 50 acre-feet.

Page II-28, Line 5 under Clear Creek

Draft PEIS
It flows southwesterly approximately 35 miles to its confluence with the Sacramento River just south of the City of Redding.

Final PEIS
It flows southeasterly approximately 35 miles to its confluence with the Sacramento River just south of the City of Redding.

Back to Table of Contents for Attachment H

Page II-35, Line 15 under Yuba River

Draft PEIS
The Yuba River is a major tributary to the Feather River, historically contributing over 40 percent of the flow, on a total annual basis, as measured at Oroville.

Final PEIS
The Yuba River is a major tributary to the Feather River, historically contributing over 40 percent of the flow, on a total annual basis with the mainstem flow being measured at Oroville.

Page II-35, Line 23 under Yuba River

Draft PEIS
This reservoir was completed in 1969 to replace the original Bullards Bar Reservoir, which had a capacity of 31,000 acre-feet per year.

Final PEIS
This reservoir was completed in 1969 to replace the original Bullards Bar Reservoir, which had a capacity of 31,000 acre-feet.

Page II-44, Line 14 under San Joaquin River Between Gravelly Ford and Fremont Ford

Draft PEIS
The Mendota Pool has a capacity of approximately 50,000 acre-feet per year and serves as a forebay for diversions to the Main and Outside canals.

Final PEIS
The Mendota Pool has a capacity of approximately 50,000 acre-feet and serves as a forebay for diversions to the Main and Outside canals.

Page II-48, Line 13 under Stanislaus River

Draft PEIS
Operations of New Melones Reservoir are affected by water rights obligations, instream fishery requirements, water quality objectives in the Stanislaus and San Joaquin rivers, and CVP contracts.

Final PEIS
Operations of New Melones Reservoir are affected by water rights obligations, instream fishery requirements, water quality objectives in the Stanislaus River and the San Joaquin River at Vernalis, and CVP contracts.

Page II-48, Line 29 under San Joaquin River at Vernalis

Draft PEIS
Average monthly flows in the San Joaquin River at Vernalis during this period are more uniform throughout the year, with maximum flows less than historical levels.

Final PEIS
Average monthly flows in the San Joaquin River at Vernalis during this period are more uniform throughout the year, with maximum flows less than historical levels and minimum flows more than historic levels.

Page II-98, Line 26 under Flood Control in the Central Valley

Draft PEIS
Figure II-18 shows the flood channel design flow capacities for various locations along rivers in the Sacramento and San Joaquin valleys. Controlled releases of stored water from upstream facilities are limited to quantities that would not cause these design capacities to be exceeded. Historically, flood channel capacities have been exceeded at several of the shown locations, as a result of uncontrolled releases from upstream facilities and local runoff.

Final PEIS
Figure II-18 shows the flood channel design flow capacities for various locations along rivers in the Sacramento and San Joaquin valleys. Historically, flood channel capacities have been exceeded at several of the shown locations, as a result of releases from upstream facilities and/or local runoff.

Back to Table of Contents for Attachment H

ERRATA FOR VEGETATION AND WILDLIFE TECHNICAL APPENDIX

Page I-3, Line 10 under Alternative 1

Draft PEIS
Implementation of AFRP physical habitat restoration actions including 50,000-acre meander belt on the upper Sacramento River.

Final PEIS
Implementation of AFRP physical habitat restoration actions.

Page I-4, Line 16 under Alternative 1

Draft PEIS
Restoration of 50,000-acre meander belt on upper Sacramento River and riparian restoration on Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species.

Final PEIS
Riparian restoration on Sacramento and San Joaquin rivers and their tributaries improves habitat for dependent special-status species and other species.

Page III-3, Line 3 under Lands Fallowed to Obtain Water

Draft PEIS
The remaining 55 percent of the parcels would be owned and managed as described under the first assumption.

Final PEIS
The remaining 55 percent of the parcels would be owned and managed as described under the first assumption. Fallowed land also could be used for non-irrigated cultivation. If this occurs, increased habitat on fallowed land would not be realized.

Back to Table of Contents for Attachment H

Page III-38, Line 18 under Effects of Restoration on Riparian Communities

Draft PEIS
Common Species. Under Alternative 1, the restoration of a meander belt along the 57 river miles of the upper Sacramento River between Keswick and Chico Landing would have a beneficial effect on the extent, diversity, and density of riparian habitat in this area.

Final PEIS
Common Species. Under Alternative 1, the restoration of riparian habitat along the upper Sacramento River would have a beneficial effect on the extent, diversity, and density of riparian habitat in this area.

Page III-57, Line 17 under Effects of Restoration on Riparian Communities

Draft PEIS
Common Species. The potential beneficial impact under Alternative 3 associated with the increase in the extent and condition of riparian habitat as a result of restoration of the meander belt on the upper Sacramento River would be similar to the potential beneficial impact described under Alternative 1.

Final PEIS
Common Species. The potential beneficial impact under Alternative 3 associated with the increase in the extent and condition of riparian habitat as a result of restoration of the upper Sacramento River would be similar to the potential beneficial impact described under Alternative 1.

Attachment J, Page 1 under Table J-1

Draft PEIS
N/A

Final PEIS
Add to table under Wildlife Species, Insects:
Trimerotropis infantilis
Zayante band-winged grasshopper
Federal Listing -- Endangered
Distribution -- San Francisco/Bay Area

Back to Table of Contents for Attachment H

Attachment J, Page 4 under Table J-1

Draft PEIS
N/A

Final PEIS
Add to table under Plant Species:
Holocarpha macradenia
Santa Cruz tarweed
Federal Listing -- Candidate
California Listing -- Endangered
Distribution -- San Francisco/Bay Area

ERRATA FOR VEGETATION AND WILDLIFE METHODOLOGY/MODELING TECHNICAL APPENDIX

Page I-4, Line 5 under Lands Fallowed to Obtain Water

Draft PEIS

- When small amounts of land are fallowed (less than 100,000 acres in a region), all the land will remain in private ownership and will be grazed or used for some other form of non-irrigated agriculture. The lands will be disked annually to discourage occupancy by special-status species. These parcels will be small and isolated, providing limited value for wildlife.

Final PEIS

- When small amounts of land are fallowed (less than 100,000 acres in a region), all the land will remain in private ownership. All fallowed land would be planted with a cover crop for the first few years to establish an annual grass or similar vegetation to reduce erosion and minimize air quality effects. These parcels would be small and isolated, providing limited value for wildlife.

Back to Table of Contents for Attachment H