Final

Environmental Assessment/Initial Study

Water Year 2010 Interim Flows Project

SAN JOAQUIN RIVER
RESTORATION PROGRAM

September 2009

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List of Abbreviations and Acronyms

ºF	degrees Fahrenheit
AAQS	ambient air quality standards
AB	Assembly Bill
Act	San Joaquin River Restoration Settlement Act
APE	area of potential effect
ARB	California Air Resources Board
Banks	Harvey O. Banks
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin river basins
Bay Area	San Francisco Bay Area
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
BNLL	blunt-nosed leopard lizard
BA	biological assessment
BO	biological opinion
Cal/EPA	California Environmental Protection Agency
CALFED	CALFED Bay-Delta Program
CALFIRE	California Department of Forestry and Fire Protection
CalIPC	California Invasive Plant Council
Caltrans	California Department of Transportation
CCID	Central California Irrigation District
CCP	comprehensive conservation plan
CCR	California Code of Regulations
CDC	Center for Disease Control and Prevention
CDFA	California Department of Food and Agriculture
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic foot per second
CH_4	methane
CHP	California Highway Patrol
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide

COA	Coordinated Operation Agreement
Court	U.S. Eastern District Court of California
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
D-1641	State Water Resources Control Board Water Right Decision 1641
dB	decibel
dBA	A-weighted decibels
DBW	California Department of Boating and Waterways
DDT	dichlorodiphenyl-trichloroethane
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
diesel PM	particulate exhaust emissions from diesel-fueled engines
DMC	Delta-Mendota Canal
DOC	dissolved organic carbon
DOGGR	Division of Oil, Gas, and Geothermal Resources
DPR	California Department of Parks and Recreation
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EA	Environmental Assessment
EA/IS	Environmental Assessment/Initial Study
Eagle Act	Bald and Golden Eagle Protection Act
EC	electrical conductivity
EDD	Employment Development Department
EFH	essential fish habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
elevation xxx	elevation in feet above mean sea level
Exhibit B	Exibit B of the Settlement
FAA	Federal Aviation Administration
Federal ESA	Federal Endangered Species Act of 1973, as amended
FEMA	Federal Emergency Management Agency
FKMCCCP	Friant-Kern Madera Canals Capacity Correction Project
FMMP	Farmland Mapping and Monitoring Program
FONSI	Finding of No Significant Impact

FPPA	Federal Farmland Protection Policy Act
FR	Federal Resister
Friant Division service area	Friant Division Water Contractors Service Areas
FWCA	Fish and Wildlife Coordination Act
FWUA	Friant Water Users Authority
GHG	greenhouse gases
GIS	geographic information system
GSA	General Services Administration
HAP	hazardous air pollutant
IS	Initial Study
Jones	C.W. "Bill" Jones
LSJLD	Lower San Joaquin Levee District
LUST	leaking underground storage tank
M&I	municipal and industrial
MAF	million acre-feet
MBTA	Migratory Bird Treaty Act of 1918
mg/L	milligrams per liter
MND	Mitigated Negative Declaration
MOU	Memorandum of Understanding
mph	mile per hour
msl	mean sea level
MT CO_2/yr	metric tons of CO_2 per year
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO	nitric oxide
NO_2	nitrogen dioxide
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NO_X	oxides of nitrogen
NRCS	National Resource Conservation Service
NRDC	Natural Resources Defense Council
NWR	National Wildlife Refuge

O&M	operation and maintenance
OCAP	Operations Criteria and Plan
OES	Office of Emergency Services
PARCS	Parks, After School, Recreation and Community Services
PCB	polychlorinated biphenyl
PEIS/R	Program Environmental Impact Statement/Report
PG&E	Pacific Gas and Electric Company
PM_{10}	particulate matter with an aerodynamic diameter of 10 micrometers or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 micrometers or less
POI	point of interest
ppm	parts per million
ppt	parts per thousand
RA	Restoration Administrator
RCRA	Resource Conservation and Recovery Act
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Area	San Joaquin River from Friant Dam to confluence with Merced River
ROD	Record of Decision
ROG	reactive organic gases
RPA	Reasonable and Prudent Alternative
RV	recreation vehicle
RWA	Recovered Water Account
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
Secretary	Secretary of the U.S. Department of the Interior
Settlement	Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*
SFPUC	San Francisco Public Utilities Commission
SHPO	State Historic Preservation Officer
SJRA	San Joaquin River Agreement
SJRGA	San Joaquin River Group Authority
SJRRP	San Joaquin River Restoration Program
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SLCC	San Luis Canal Company

SLDMWA	San Luis & Delta-Mendota Water Authority
SO_2	sulfur dioxide
SR	State Route
SRA	State Recreation Area
State	State of California
SWAMP	Surface Water Quality Monitoring Program
SWAT	Special Weapons and Tactics
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TAF	thousand acre-feet
TDS	total dissolved solids
TMDL	total maximum daily load
TPY	tons per year
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Program
VdB	vibration decibels
WA	Wildlife Area
WMA	Wildlife Management Area
WNV	West Nile virus
WY	water year
X2	distance upstream from Golden Gate Bridge where salinity equals 2 parts per thousand
µmho	micro mho

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1.0 Introduction and Statement of Purpose and Need

The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement the Stipulation of Settlement in *NRDC, et al. v. Kirk Rodgers, et al*. (Settlement). As an initial action to guide implementation of the SJRRP, the Settlement requires that the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), modify releases from Friant Dam during water year (WY) 2010 (from October 1, 2009, to September 30, 2010). This first year of releases would allow data to be collected to better evaluate flows, temperatures, fish needs, biological effects, and seepage losses, and water recirculation, recapture, and reuse opportunities. The Proposed Action is to increase the release of water from Friant Dam for 1 year (WY 2010) in accordance with the flow schedule in Exhibit B of the Settlement (Exhibit B), and in a manner consistent with Federal, State and local laws, and any agreements with downstream agencies, entities, and landowners. The Proposed Action also includes the activities necessary to convey the flows in the San Joaquin River system to the Sacramento-San Joaquin Delta (Delta), and the monitoring activities to be conducted during WY 2010 Interim Flow releases. The water released from Friant Dam before full Restoration Flows, as described in the Settlement, is called Interim Flows. Authorization for implementing the Settlement, including release of WY 2010 Interim Flows, is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11). The Settlement is provided as Appendix A of this document and the Act is provided as Appendix B.

Reclamation, as the lead agency under the National Environmental Policy Act (NEPA), and the California Department of Water Resources (DWR), as the lead agency under the California Environmental Quality Act (CEQA), are preparing this joint Draft Environmental Assessment/Initial Study (EA/IS), consistent with their lead roles in preparing the future Program Environmental Impact Statement/Report (PEIS/R) for the SJRRP. This EA/IS evaluates potential environmental consequences associated with the estimated change in flow in the San Joaquin River as a result of the Proposed Action.

WY 2010 Interim Flows in the San Joaquin River would begin on October 1, 2009, through November 20, 2009, and resume February 1, 2010, through September 30, 2010, as stipulated in Paragraph 15 of the Settlement. Also described are the potential locations and mechanisms for recapturing WY 2010 Interim Flows within the San Joaquin River from Friant Dam to the confluence of the Merced River (Restoration Area), and in the Delta. In addition, associated activities that may be undertaken to collect relevant data during WY 2010 are discussed.

1.1 Background

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging renewal of long-term water service contracts between the United States and Central Valley Project (CVP) Friant Division contractors. After more than 18 years of litigation of this lawsuit, known as *NRDC, et al., v. Kirk Rodgers, et al.*, a Settlement was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority (FWUA), and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved by the U.S. Eastern District Court of California (Court) on October 23, 2006.

The Settlement establishes two primary goals:

- **Restoration Goal –** To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management Goal –** To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The SJRRP will implement the Settlement. The "Implementing Agencies" responsible for managing and implementing the SJRRP include the U.S. Department of the Interior, through Reclamation and the U.S. Fish and Wildlife Service (USFWS), U.S. Department of Commerce through the National Marine Fisheries Service (NMFS), and the State of California (State) Natural Resources Agency through DWR, the California Department of Fish and Game (DFG), and the California Environmental Protection Agency (Cal/EPA). The Settlement also stipulates the appointment of a Restoration Administrator (RA), in consultation with a Technical Advisory Committee (TAC), to make recommendations to the Secretary of the U.S. Department of the Interior (Secretary) to help in meeting the Restoration Goal.

The Settlement identifies the releases of both Interim Flows and Restoration Flows. The Settlement stipulates the release of Interim Flows no later than October 1, 2009, and continuing until full Restoration Flows begin. The intent of the Interim Flows is to collect relevant data on flows, temperatures, fish needs, seepage losses, and water recirculation, recapture, and reuse. Full Restoration Flows are described in Exhibit B.

1.2 Purpose and Need Statement

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action" (40 Code of Federal Regulations (CFR) 1502.13). CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of the project (Guidelines Section 15124(b)).

The purpose of the Proposed Action is to implement the provisions of the Settlement pertaining to WY 2010. The need for action is to support collection of relevant data to guide future releases of Interim Flows and Restoration Flows under the SJRRP.

The two key objectives of the Proposed Action are as follows:

- Release of WY 2010 Interim Flows according to the Settlement and the Act, as limited by downstream channel capacities, and consistent with Federal, State, and local laws, and any agreements with downstream agencies and entities.

- Collect data to better evaluate flows, temperatures, fish needs, biological effects, and seepage losses, and water recirculation, recapture, and reuse opportunities for future Interim Flows and Restoration Flows.

1.3 Purpose of This Document and Regulatory Guidance

The purpose of this document is to identify and disclose potential impacts of implementing the Proposed Action, in compliance with NEPA and CEQA. Regulatory guidance on NEPA and CEQA, as it pertains to this document, is summarized below.

1.3.1 National Environmental Policy Act

Section 10006 of the Act (Public Law 111-11) states that "In undertaking the measures authorized by this part, the Secretary and the Secretary of Commerce shall comply with all applicable Federal and State laws, rules, and regulations including NEPA and the ESA, as necessary."

For the Proposed Action, as mentioned, Reclamation is the lead agency under NEPA (40 CFR 1501.5) because Reclamation has the principal Federal fiscal and management role in implementing the SJRRP. Additionally, Reclamation is responsible for operation of Friant Dam and directly controls all releases from the dam.

Reclamation will comply with NEPA and the regulations published by the Council on Environmental Quality (CEQ) (40 CFR 1500–1508), before initiating the Proposed Action. Also, this document is prepared consistent with U.S. Department of the Interior requirements specified in 43 CFR, Part 46 (U.S Department of the Interior Implementation of NEPA, Final Rule). This document serves as an Environmental Assessment (EA), prepared in accordance with NEPA and associated Federal Guidelines. This EA was prepared with input from various disciplines and interested parties, and includes sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or Finding of No Significant Impact (FONSI). As required under NEPA, this EA provides information describing the Proposed Action, alternatives, and related environmental consequences. Before making a final decision on the Proposed Action or another alternative, the EA will be available for comment to public agencies and citizens during a 30-day public review period. After public review of the EA, Reclamation intends to make a final decision regarding approval of the FONSI. Before approval of the FONSI, Reclamation will conclude consultation under Section 7 of the Federal Endangered Species Act of 1973, as amended (ESA), to prevent the Proposed Action from jeopardizing listed species or destroying or adversely modifying designated critical habitat.

1.3.2 California Environmental Quality Act

This document is a joint Initial Study (IS) prepared in accordance with CEQA, Public Resources Code Section 21000 et seq., and the State CEQA Guidelines, Title 14 of the California Code of Regulations (CCR) Section 15000 et seq. The purpose of this IS is to (1) determine whether project implementation would result in potentially significant or significant effects to the environment, and (2) to incorporate mitigation measures into the project design, as necessary, to eliminate the project's potentially significant, or significant, project effects, or reduce them to a less-than-significant level. An IS presents environmental analysis and substantial evidence supporting its conclusions regarding the significance of environmental impacts. Substantial evidence may include expert opinion based on facts, technical studies, or reasonable assumptions based on facts. An IS is not intended nor required to include the level of detail in an Environmental Impact Report (EIR).

CEQA requires that all State and local government agencies consider the environmental consequences of projects they propose to carry out, or over which they have discretionary authority, before implementing or approving those projects. As specified in State CEQA Guidelines Section 15367, the public agency with the principal responsibility for carrying out or approving a project is the lead agency for CEQA compliance. DWR is therefore the CEQA lead agency for the Proposed Action because of its overall State role for, implementing the SJRPP, and because several discretionary activities by the Lower San Joaquin River Levee District are necessary to implement WY 2010 Interim Flows. These discretionary activities include operation of structures within the Restoration Area such as the Chowchilla Bypass Bifurcation Structure, Eastside Bypass Bifurcation Structure, Mariposa Bypass Bifurcation Structure, and numerous flap gates.

As specified in State CEQA Guidelines Section 15064(a), if substantial evidence exists (such as the results of an IS) that a project, either individually or cumulatively, may have a significant effect on the environment, the lead agency must prepare an EIR. The lead agency may instead prepare a Negative Declaration if it is determined there is no substantial evidence that the project may cause a significant impact on the environment. The lead agency may prepare a Mitigated Negative Declaration (MND) if, in the course of the IS analysis, it is recognized that the project may have a significant impact on the environment but that implementing specific mitigation measures would reduce any such impacts to a less-than-significant level (State CEQA Guidelines Section 15064(f)).

DWR has prepared this IS to evaluate the potential environmental effects of the Proposed Action, and has incorporated mitigation measures to reduce or eliminate any potentially significant project-related impacts. Therefore, an MND has been separately prepared for this project.

1.3.3 Relationship to SJRRP PEIS/R and State Water Rights

Reclamation and DWR are developing this SJRRP WY 2010 Interim Flows EA/IS, concurrent with preparation of the PEIS/R, to meet the Settlement's schedule for initiating Interim Flow releases on October 1, 2009. The PEIS/R is being prepared to describe potential environmental impacts of implementing the SJRRP, including release of Interim Flows and full Restoration Flows. The Draft PEIS/R is scheduled to be released in winter 2009, and the Final PEIS/R is scheduled to be released in summer 2010. A Record of Decision (ROD) by Reclamation and Notice of Determination (NOD) by DWR are anticipated in 2010. Reclamation will petition the State Water Resources Control Board (SWRCB) for a permanent water transfer to facilitate the release and recapture of Interim Flows and full Restoration Flows (as stipulated in Paragraph 13 of the Settlement).

For the WY 2010 Interim Flows, Reclamation will submit a petition for temporary transfer of water (less than 1 year), pursuant to California Water Code Section 1725 et seq., to address the release and rediversion of WY 2010 Interim Flows. In acting on a water right petition, the SWRCB must consider potential impacts to other legal users of the water, and whether there would be any unreasonable effects from the transfer on fish, wildlife, or other instream beneficial uses. To facilitate evaluation by SWRCB, Reclamation and DWR are providing this EA/IS in advance of the PEIS/R to allow sufficient time for SWRCB to review the petition for temporary transfer of water/water rights for WY 2010 Interim Flows. The time frame for release of an EA/IS, concurrent with the 1-year petition to SWRCB for temporary transfer of water, necessarily constrains the scope of WY 2010 Interim Flows to the use of the best and currently available information.

The WY 2010 Interim Flows constitutes a complete project under NEPA because it is a demonstration project that has independent utility and provides useful information on flows, temperatures, fish needs, seepage losses, shallow groundwater conditions, and water recirculation, recapture and reuse conditions, channel capacity (high and low flows), and levee stability regardless of the future implementation of the Settlement. These data are useful independent of the SJRRP, particularly with respect to understanding the flood management system and seepage. While the Proposed Action is certainly one of the first steps in implementing the SJRRP, the Proposed Action can be implemented successfully in meeting its purpose and objectives without any subsequent SJRRP activities. The PEIS/R will evaluate all SJRRP activities, to evaluate all direct, indirect, and cumulative effects at a program level.

1.4 Implementing Agency Responsibilities

The Implementing Agencies are responsible for implementing the WY 2010 Interim Flows, and include Reclamation, USFWS, NMFS, DWR, DFG, and CalEPA. Reclamation and DWR have initiated NEPA and CEQA environmental compliance, respectively, for implementing the WY 2010 Interim Flows.

1.4.1 Federal Role in Implementing Water Year 2010 Interim Flows

The Settlement identifies the need for involvement of the Secretary through Reclamation, as the lead Federal agency responsible for implementation, and through USFWS as the lead Federal agency responsible for reintroducing spring-run and fall-run Chinook salmon. The Settlement also identifies the Secretary of the U.S. Department of Commerce, through NMFS, as a necessary participant for permitting the reintroduction of spring-run Chinook salmon.

Reclamation is responsible for implementing WY 2010 Interim Flows through reoperation of Friant Dam and the recirculation, transfer, and/or exchange of recaptured flows to Friant Division long-term contractors. Reclamation is consulting with USFWS and NMFS to determine compliance with Section 7 of the Federal ESA. Implementation of the WY 2010 Interim Flows by Federal agencies is authorized by the Act. The Act also appropriates funds necessary for implementing WY 2010 Interim Flows.

1.4.2 State Role in Implementing Water Year 2010 Interim Flows

The Settlement identifies the need for the involvement of the State of California Natural Resources Agency through DWR and DFG, and CalEPA. Implementing the WY 2010 Interim Flows also requires the involvement of the State of California Natural Resources Agency through DWR and DFG. Consistent with a Memorandum of Understanding with the Settling Parties and the State, the California Natural Resources Agency will play a major role in funding and implementing activities called for in the Settlement and in the Act. DWR, along with several other State organizations, will implement actions needed to route WY 2010 Interim Flows through the Restoration Area. Because of DWR’s greater role in the SJRRP, DWR will serve as the lead agency under CEQA. Actions by State organizations to implement WY 2010 Interim Flows would include the following:

- **DWR –** Install seals on the Chowchilla Bypass Bifurcation Structure to reduce leakage around closed radial gates.
- **DFG –** Assist with monitoring and recovery of steelhead in the San Joaquin River between Mendota Dam and the confluence with the Merced River.
- **Lower San Joaquin Levee District –** Operate, inspect, and maintain flood control facilities, including levees, channels, flap gates, and bifurcation structures. These activities may include patrolling levees to assess conditions, maintain channels, close flap gates before to release of WY 2010 Interim Flows, and operate the Chowchilla, Eastside, and Mariposa bypass bifurcation structures.
- **Central Valley Flood Protection Board –** Potentially issue an encroachment permit to use the Eastside and Mariposa bypasses for WY 2010 Interim Flows.
- **SWRCB –** Issue a (CEQA-exempt) temporary water transfer permit for the release and diversion of Interim Flows.

1.5 Study Area

The study area for the EA/IS includes areas that may be affected directly, indirectly, or cumulatively by the Proposed Action. The study area, shown in Figure 1-1, has been broadly defined to include the San Joaquin River upstream from Friant Dam, the Restoration Area, the San Joaquin River from the confluence with the Merced River to the Delta, the Delta, and CVP/State Water Project (SWP) water service areas, including the Friant Division. The Restoration Area, which is the San Joaquin River from Friant Dam to the confluence of the Merced River, is shown in Figure 1-2. The San Joaquin River and flood bypasses within the Restoration Area are described as a series of physically and operationally distinct reaches, as shown in Figure 1-2 and defined in Table 1-1. Table 1-1 also identifies the river reaches and bypasses included in the study area for this EA/IS.

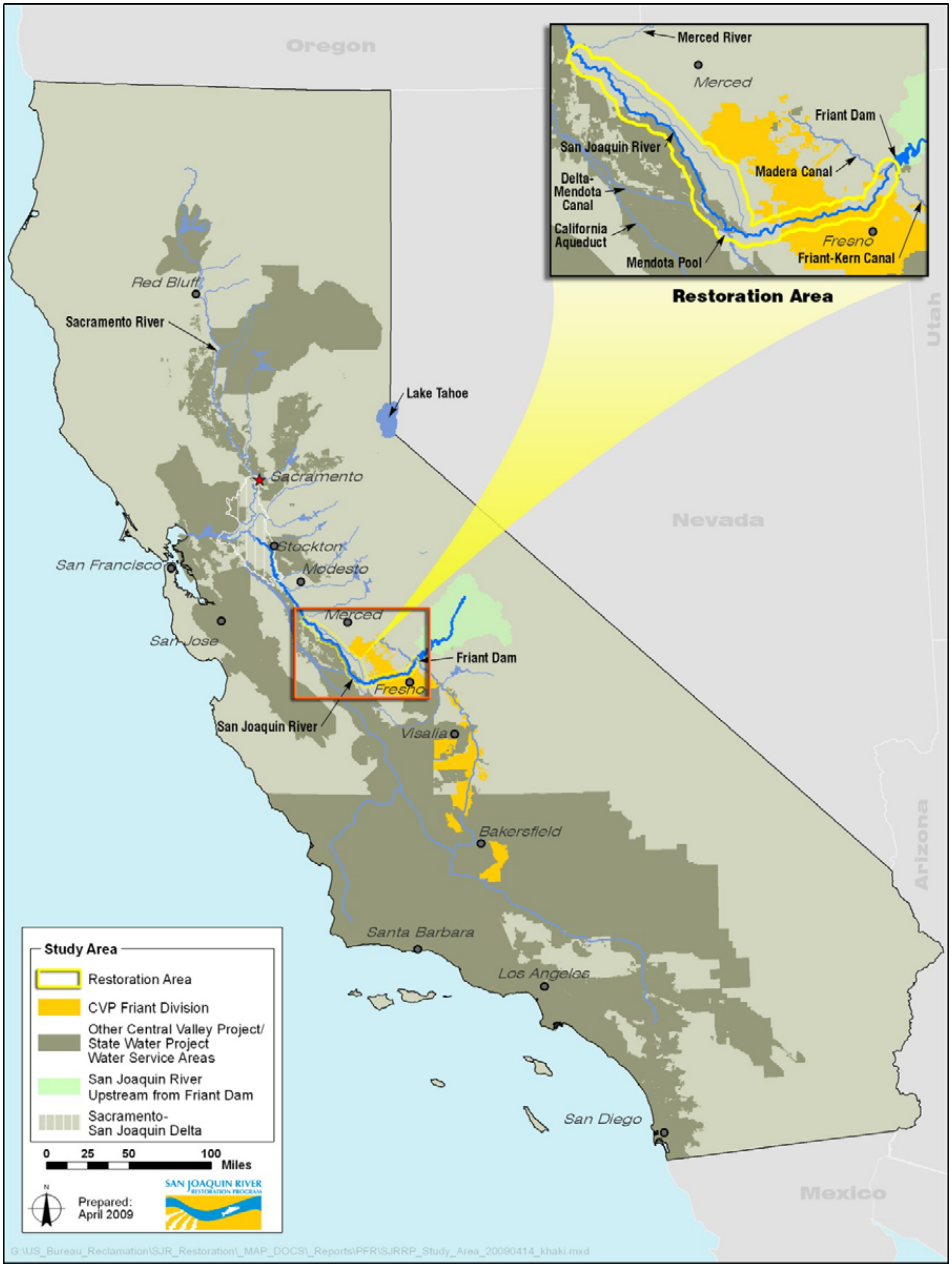

Figure 1-1.
Water Year 2010 Interim Flows Study Area

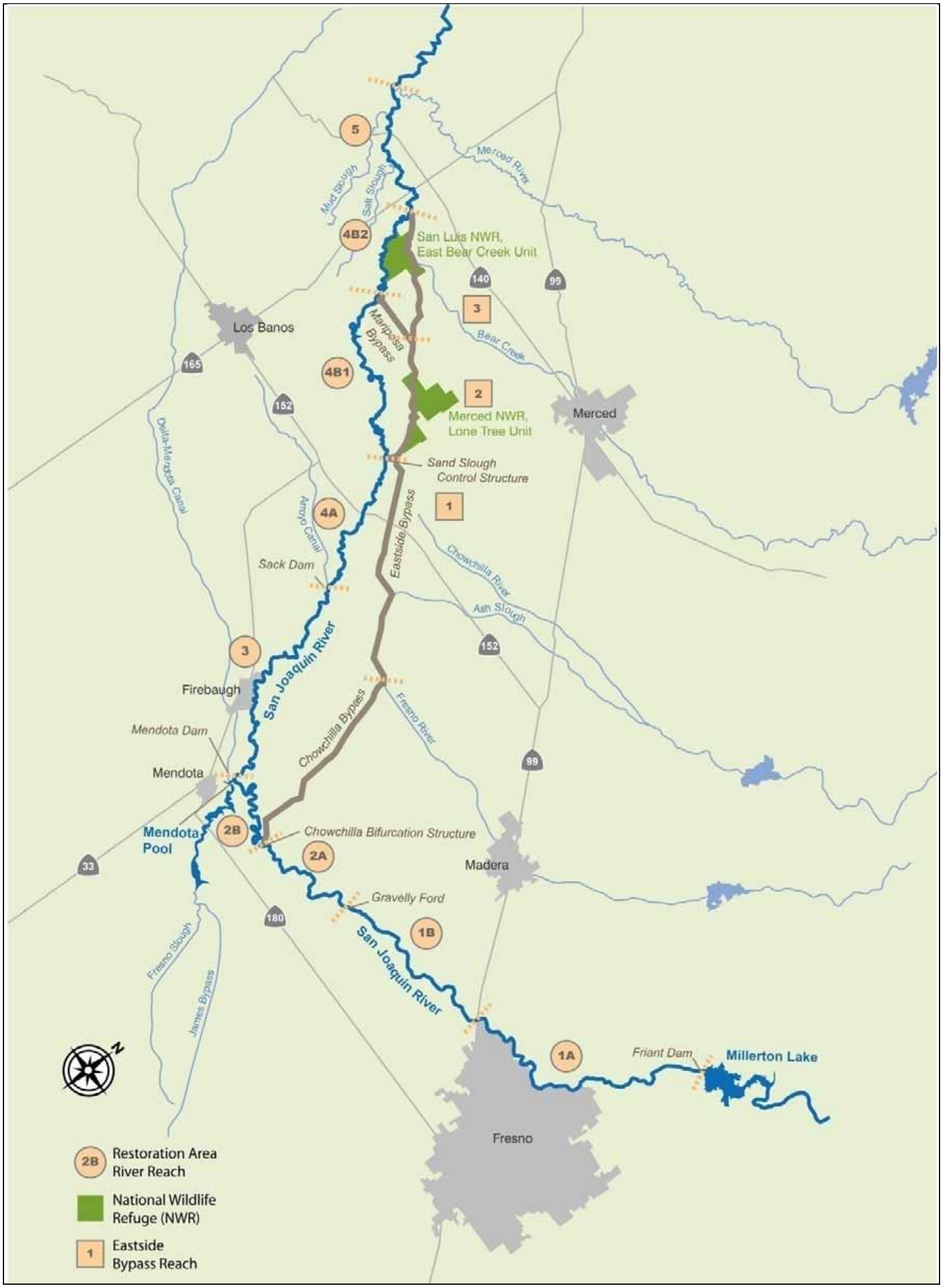

Figure 1-2.
San Joaquin River Reaches and Flood Bypass System in the Restoration Area

Table 1-1.
San Joaquin River Reaches and Flood Bypasses in Restoration Area

San Joaquin River Reaches and Flood Bypasses in Restoration Area				Restoration Area Reaches Included in Water Year 2010 Interim Flows Study Area
River or Bypass	**Reach**	**Head of Reach or Bypass**	**Downstream End of Reach or Bypass**	
San Joaquin River	**1A**	Friant Dam	State Route 99	✓
	1B	State Route 99	Gravelly Ford	✓
	2A	Gravelly Ford	Chowchilla Bypass Bifurcation Structure	✓
	2B	Chowchilla Bypass Bifurcation Structure	Mendota Dam	✓
	3	Mendota Dam	Sack Dam	✓
	4A	Sack Dam	Sand Slough Control Structure	✓
	4B1	Sand Slough Control Structure	Confluence with Mariposa Bypass	
	4B2	Confluence with Mariposa Bypass	Confluence with Bear Creek and Eastside Bypass	✓
	5	Confluence with Bear Creek and Eastside Bypass	Confluence with Merced River	✓
Chowchilla Bypass		Chowchilla Bypass Bifurcation Structure	Confluence with Fresno River and Eastside Bypass	
Eastside Bypass		Confluence with Fresno River and Chowchilla Bypass	Confluence with Bear Creek and San Joaquin River	✓
Sand Slough Bypass		Sand Slough Control Structure	Eastside Bypass	✓
Mariposa Bypass		Mariposa Bypass Bifurcation Structure	Confluence with San Joaquin River	✓

1.6 Document Organization

This document is divided into the following sections:

- **Section 1, Introduction and Statement of Purpose and Need**, introduces the Proposed Action, and provides background information; describes the purpose of and need for the Proposed Action; discusses the purpose of this document and regulatory guidance; describes Implementing Agency responsibilities; provides study area information; and describes document organization.

- **Section 2, Description of Alternatives**, describes the No-Action Alternative and Proposed Action.

- **Section 3, Affected Environment**, describes the environment and physical conditions for the resource areas that may be affected by the alternatives under consideration.

- **Section 4, Environmental Consequences**, describes the thresholds of significance and the direct, indirect, and cumulative effects of implementing the No-Action Alternative or Proposed Action.

- **Section 5, Consultation and Coordination**, lists agencies, organizations, and persons consulted during past and ongoing efforts, and describes the public involvement in the NEPA and CEQA review process for this document.

- **Section 6, Compliance with Applicable Laws, Executive Orders, and Plans**, describes Federal, State, regional, and local laws; executive orders; and plans that must be complied with to implement the project.

- **Section 7, List of Preparers**, presents agency staff and consultants directly responsible for preparing or reviewing this document.

- **Section 8, References**, lists references cited in this EA/IS.

Appendices to this EA/IS provide pertinent supporting information and data used while preparing this EA/IS, and include the following:

- **Appendix A**, Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*

- **Appendix B**, San Joaquin River Restoration Settlement Act

- **Appendix C**, Friant Dam Releases for Restoration Flows

- **Appendix D**, Seepage Monitoring and Management Plan for Water Year 2010 Interim Flows (Seepage Monitoring and Management Plan)

- **Appendix E**, Flow Monitoring and Management Plan for Water Year 2010 Interim Flows (Flow Monitoring and Management Plan)

- **Appendix F**, Invasive Species Monitoring and Management Plan for Water Year 2010 Interim Flows (Invasive Species Monitoring and Management Plan)

- **Appendix G**, Modeling

- **Appendix H**, Biological Resources

- **Appendix I**, Responses and Comments

- **Appendix J**, Landowner Outreach and Study Area Access

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2.0 Description of Alternatives

The combined NEPA/CEQA No-Action/No-Project Alternative (No-Action Alternative) and the Proposed Action are described in this section. The No-Action Alternative represents existing conditions in the San Joaquin River and existing operations at Friant Dam because of the immediate short-term nature of the Proposed Action; there are no reasonably foreseeable related projects such that the No-Action Alternative and existing conditions represent the same environmental conditions. The Proposed Action is the implementation of the WY 2010 Interim Flows, including the release and potential downstream recapture of Interim Flows, the activities necessary to convey the flows in the San Joaquin River system to the Delta, and the monitoring activities to be conducted during the WY 2010 Interim Flow releases.

2.1 No-Action Alternative

The No-Action Alternative includes the continued operation of Friant Dam under existing conditions, and would not include the release of WY 2010 Interim Flows. Reclamation would continue to release a base flow from Friant Dam to meet the existing holding contract obligations to maintain a 5-cubic-foot-per-second (cfs) flow at Gravelly Ford. Nonflood releases from Friant Dam typically range from 180 cfs to 250 cfs in summer and 40 cfs to 100 cfs in winter. Figures 2-1 and 2-2 show the average simulated end-of-month storage in Millerton Lake under the No-Action Alternative in Wet and Normal-Dry years. Average simulated daily San Joaquin River flows in Wet and Normal-Dry years, under the No-Action Alternative, including flood flows at selected locations in the San Joaquin River, are shown in Figures 2-3 through 2-6, respectively.

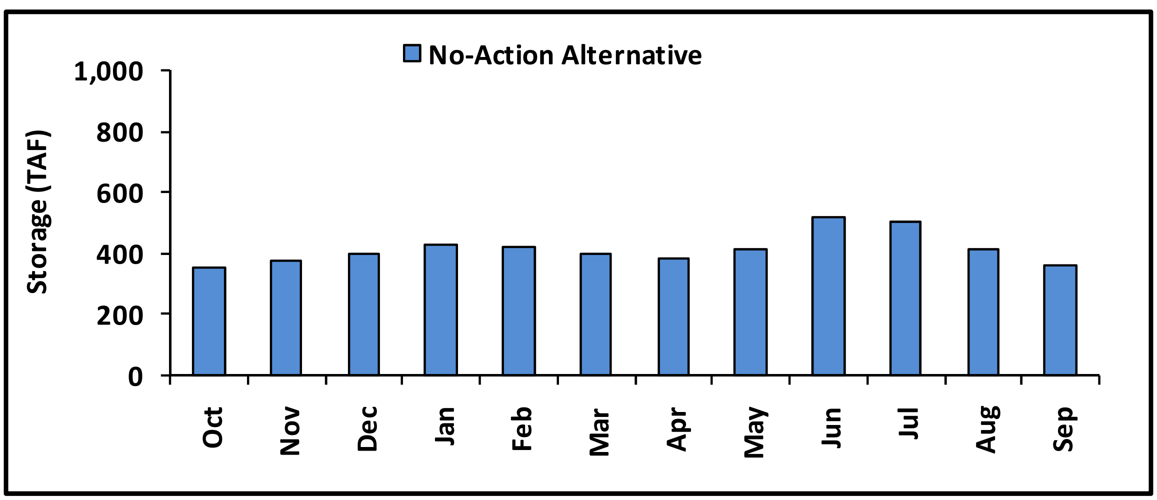


Figure 2-1.
Average Simulated End-of-Month Millerton Lake Storage in Wet Years Under the No-Action Alternative

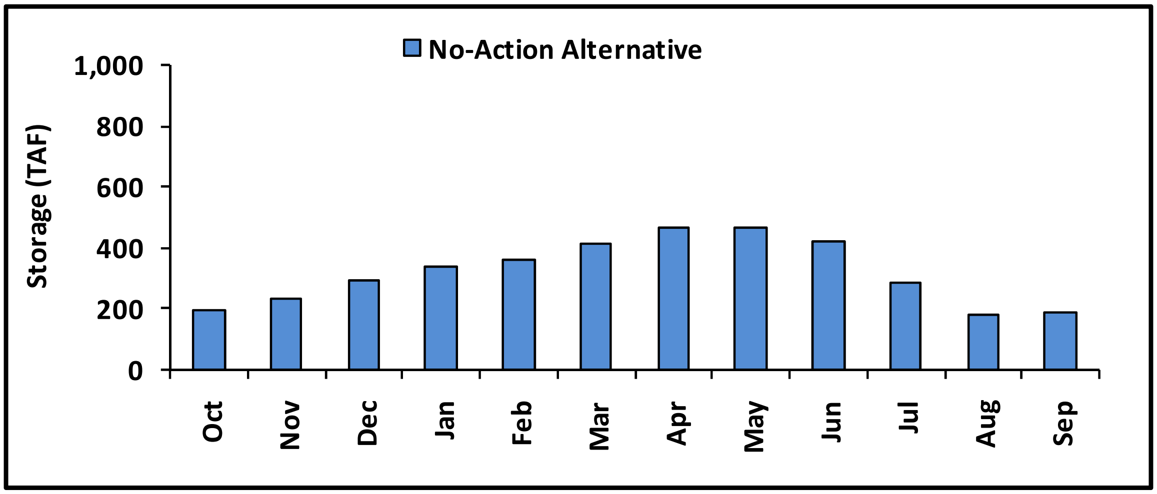


Figure 2-2.
Average Simulated End-of-Month Millerton Lake Storage in Normal-Dry Years Under the No-Action Alternative

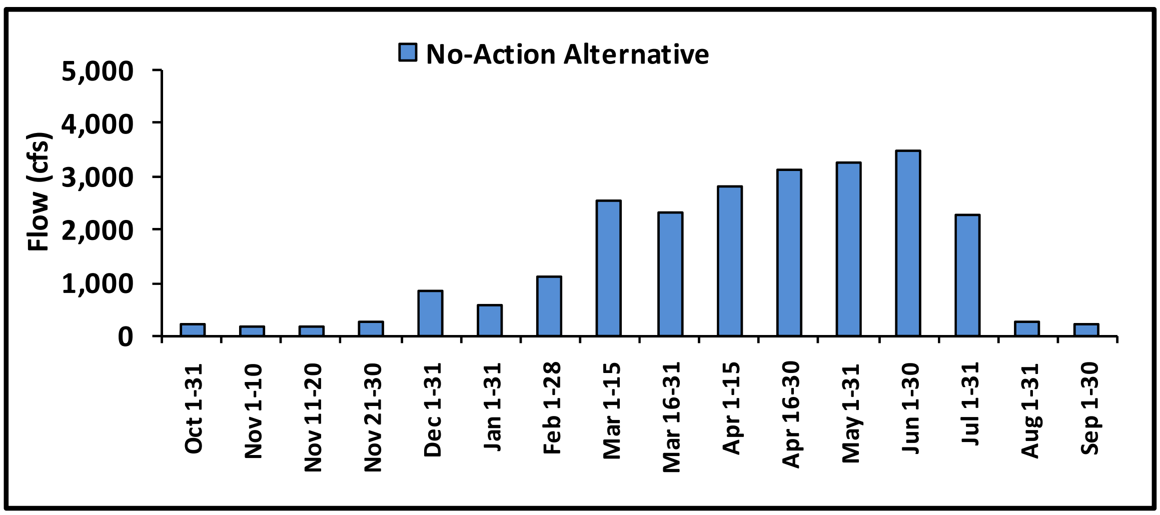


Figure 2-3.
Average San Joaquin River Simulated Daily Flows at the Head of Reach 1 in Wet Years Under the No-Action Alternative

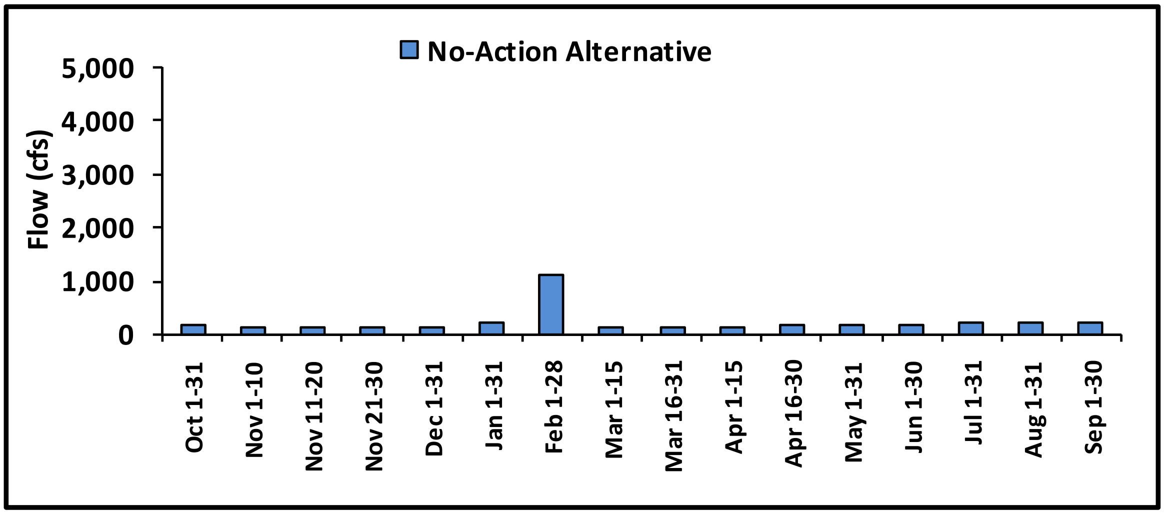


Figure 2-4.
Average Simulated San Joaquin River Daily Flows at the Head of Reach 1 in Normal-Dry Years Under the No-Action Alternative

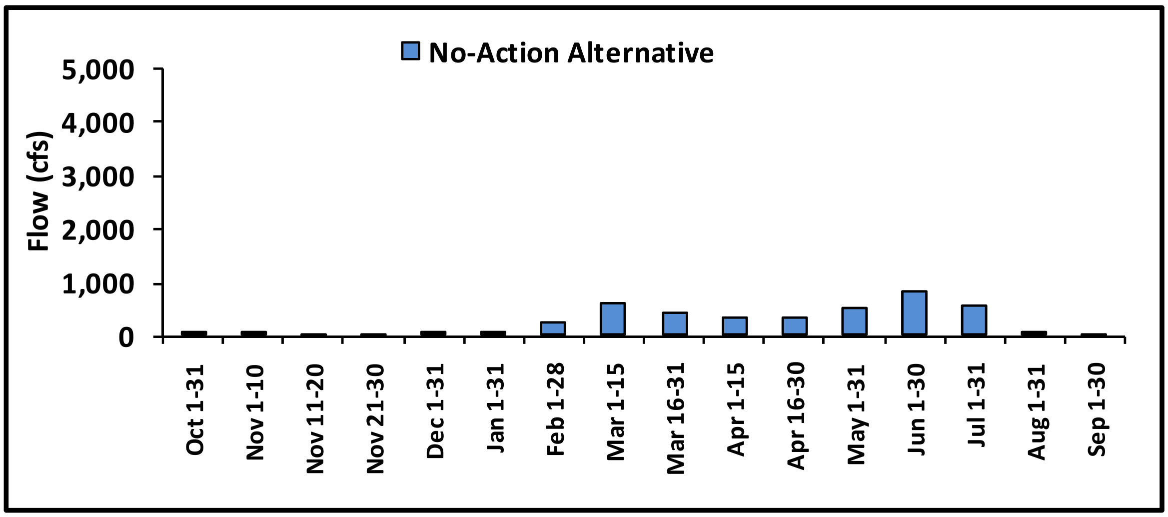


Figure 2-5.
Average Simulated San Joaquin River Daily Flows at the Head of Reach 2B in Wet Years Under the No-Action Alternative

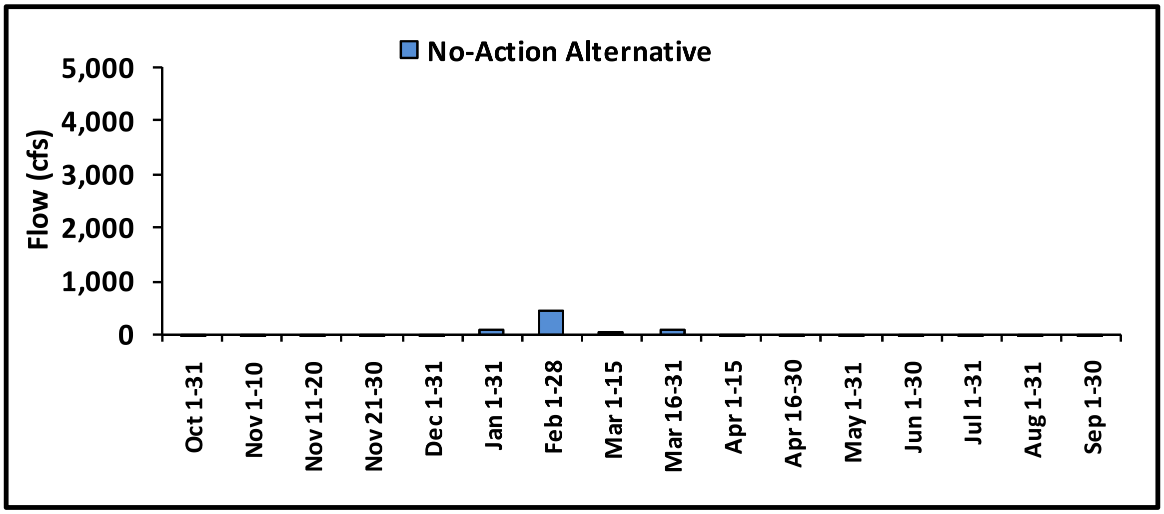


Figure 2-6.
Average Simulated San Joaquin River Daily Flows at the Head of Reach 2B in Normal-Dry Years Under the No-Action Alternative

2.2 Proposed Action

The Proposed Action is the release of WY 2010 Interim Flows according to the Settlement and the Act, as limited by downstream channel capacities and potential material adverse impacts from groundwater seepage, and consistent with Federal, State, and local laws, and any agreements with downstream agencies, entities, and landowners. Interim Flows would be released to the San Joaquin River from Friant Dam during WY 2010, from October 1, 2009, through November 20, 2009, and from February 1, 2010, through September 30, 2010, in accordance with the average flow release schedule presented in Exhibit B of the Settlement. Estimated maximum flows at locations within the Restoration Area under the Proposed Action are shown in Table 2-1. The change in estimated maximum flows under the Proposed Action from existing conditions is shown in Table 2-2. Average daily releases from Friant Dam, along with resulting flows in each reach, may be higher than the estimated maximums shown in the table depending on a variety of factors, such as infiltration losses in Reach 2B and diversions within Reach 1. Estimated maximum flows in Tables 2-1 and 2-2 represent nonflood conditions under a Wet water year type, and would vary depending on the water year type.

Figures 2-7 and 2-8 show the average simulated end-of-month storage in Millerton Lake under the No-Action Alternative and Proposed Action in Wet and Normal-Dry years, respectively. Average simulated daily San Joaquin River flows in Wet and Normal-Dry years under the No-Action Alternative, including flood flows and estimated maximum flows under the Proposed Action, at selected locations in the San Joaquin River, are shown in Figures 2-9 through 2-12.

Table 2-1.
Estimated Maximum Regulated Nonflood Flows Under the Proposed Action in a Wet Year[1]

Begin Date	End Date	Estimated Maximum Flows Consisting of Interim Flows and Water Right Flows at Locations in the Restoration Area (cubic feet per second)									
		Head of Reach 1[3]	Head of Reach 2A[4]	Head of Reach 2B[5]	Head of Reach 3[6]	Head of Reach 4A[7]	In Reach 4B1[8]	In Reach 4B2	In Bypass System[7,9]	Head of Reach 5	Merced River Confluence[10]
10/1/2009	10/31/2009	350	195	115	715	115	0	115	115	115	415
11/1/2009	11/6/2009	700	575	475	1,075	475	0	475	475	475	775
11/7/2009	11/10/2009	700	575	475	1,075	475	0	475	475	475	775
11/11/2009	11/20/2009	350	235	155	755	155	0	155	155	155	555
11/21/2009[2]	1/31/2010[2]	120	5	0	0	0	0	0	0	0	0
2/1/2010	2/28/2010	350	255	175	775	175	0	175	175	175	675
3/1/2010	3/15/2010	500	375	285	885	285	0	285	285	285	785
3/16/2010	3/31/2010	1,500	1,375	1,225	1,300	1,225	0	1,225	1,225	1,225	1,700
4/1/2010	4/15/2010	1,620	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
4/16/2010	4/30/2010	1,620	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
5/1/2010	6/30/2010	1,660	1,475	1,300	1,300	1,300	0	1,300	1,300	1,300	1,700
7/1/2010	8/31/2010	350	125	45	645	45	0	45	45	45	320
9/1/2010	9/30/2010	350	145	65	665	65	0	65	65	65	340
Estimated Maximum Total Volume (thousand acre-feet)		485	387	321	544	321	0	321	321	321	533

Notes:
1 Flows may be lower under other water year types.
2 No Water Year 2010 Interim Flows during this period.
3 Assumes up to 230 cubic feet per second diverted by instream water right holders (e.g., holding contracts), consistent with Exhibit B of the Settlement.
4 Assumes up to 200 cubic feet per second lost through infiltration, consistent with Exhibit B of the Settlement.
5 Assumes up to approximately 2,600 cubic feet per second maximum diversion capacity to water right holders in the Mendota Pool. Estimated maximum Water Year 2010 Interim Flows at the head of Reach 2B account for seepage losses experienced in Reach 2A, consistent with Exhibit B of the Settlement.
6 Assumes up to 600 cubic feet per second released to Reach 3 from the Mendota Pool for diversions at Sack Dam into the Arroyo Canal.
7 Assumes up to 25 percent of flow lost through infiltration downstream from Sack Dam, and up to 80 cubic feet per second diverted at wildlife refuges.
8 The Proposed Action does not include any activity in Reach 4B1.
9 Includes Eastside and Mariposa bypasses.
10 Assumes accretions from Mud and Salt sloughs in Reach 5, consistent with Exhibit B of the Settlement.

Table 2-2. Change in Estimated Maximum Regulated Nonflood Flows Under the Proposed Action from No-Action Alternative/Existing Conditions in Wet Years[1]

Begin Date	End Date	Change in Estimated Maximum Flows Under the Proposed Action at Locations in the Restoration Area (cubic feet per second)									
		Head of Reach 1[3]	Head of Reach 2A[4]	Head of Reach 2B[5]	Head of Reach 3[6]	Head of Reach 4A[7]	In Reach 4B1[8]	In Reach 4B2	In Bypass System[7,9]	Head of Reach 5	Merced River Confluence[10]
10/1/2009	10/31/2009	190	190	115	115	115	0	115	115	115	115
11/1/2009	11/6/2009	570	570	475	475	475	0	475	475	475	475
11/7/2009	11/10/2009	570	570	475	475	475	0	475	475	475	475
11/11/2009	11/20/2009	230	230	155	155	155	0	155	155	155	155
11/21/2009[2]	1/31/2010[2]	0	0	600	0	0	0	0	0	0	400
2/1/2010	2/28/2010	250	250	175	175	175	0	175	175	175	175
3/1/2010	3/15/2010	370	370	285	285	285	0	285	285	285	285
3/16/2010	3/31/2010	1,370	1,370	1,225	700	1,225	0	1,225	1,225	1,225	1,225
4/1/2010	4/15/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
4/16/2010	4/30/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
5/1/2010	6/30/2010	1,470	1,470	1,300	700	1,300	0	1,300	1,300	1,300	1,300
7/1/2010	8/31/2010	120	120	45	45	45	0	45	45	45	45
9/1/2010	9/30/2010	140	140	65	65	65	0	65	65	65	65
Estimated Maximum Total Volume (thousand acre-feet)		384	384	321	196	321	0	321	321	321	321

Notes:

[1] Flows may be lower under other water year types.

[2] No Water Year 2010 Interim Flows during this period.

[3] Assumes up to 230 cubic feet per second diverted by instream water right holders (e.g., holding contracts), consistent with Exhibit B of the Settlement.

[4] Assumes up to 200 cubic feet per second lost through infiltration, consistent with Exhibit B of the Settlement.

[5] Assumes up to approximately 2,600 cubic feet per second maximum diversion capacity to water right holders in the Mendota Pool. Estimated maximum Water Year 2010 Interim Flows at the head of Reach 2B account for seepage losses experienced in Reach 2A, consistent with Exhibit B of the Settlement.

[6] Assumes up to 600 cubic feet per second released to Reach 3 from the Mendota Pool for diversions at Sack Dam into the Arroyo Canal.

[7] Assumes up to 25 percent of flow lost through infiltration downstream from Sack Dam, and up to 80 cubic feet per second diverted at wildlife refuges.

[8] The Proposed Action does not include any activity in Reach 4B1.

[9] Includes Eastside and Mariposa bypasses.

[10] Assumes accretions from Mud and Salt sloughs in Reach 5, consistent with Exhibit B of the Settlement.

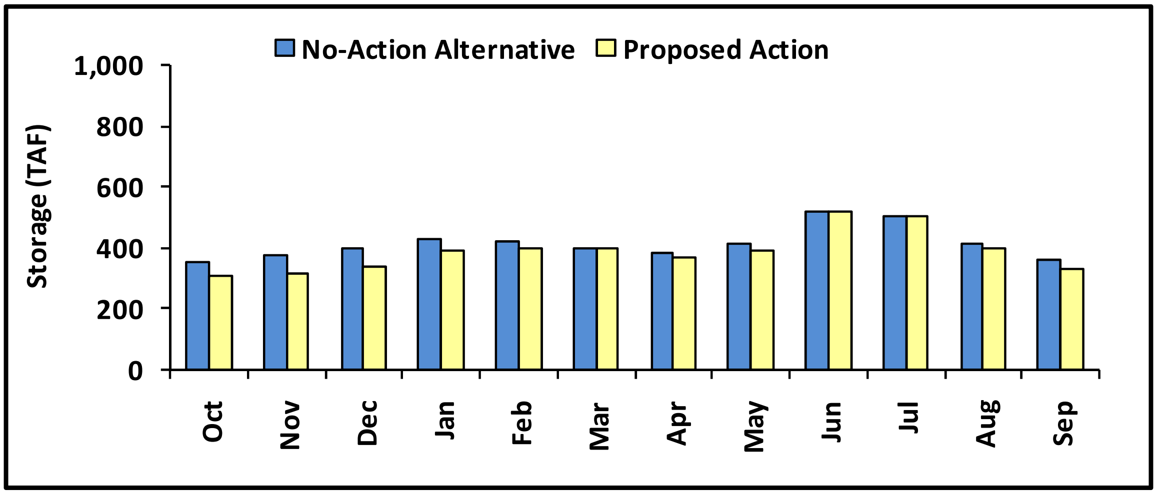


Figure 2-7.
Average Simulated End-of-Month Millerton Lake Storage in Wet Years Under the No-Action Alternative and Proposed Action

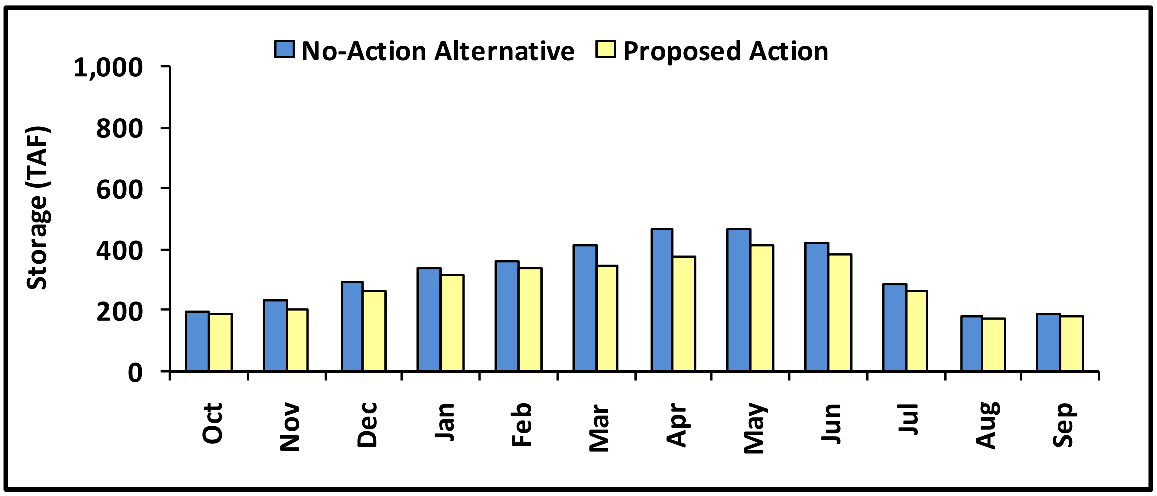


Figure 2-8.
Average Simulated End-of-Month Millerton Lake Storage in Normal-Dry Years Under the No-Action Alternative and Proposed Action

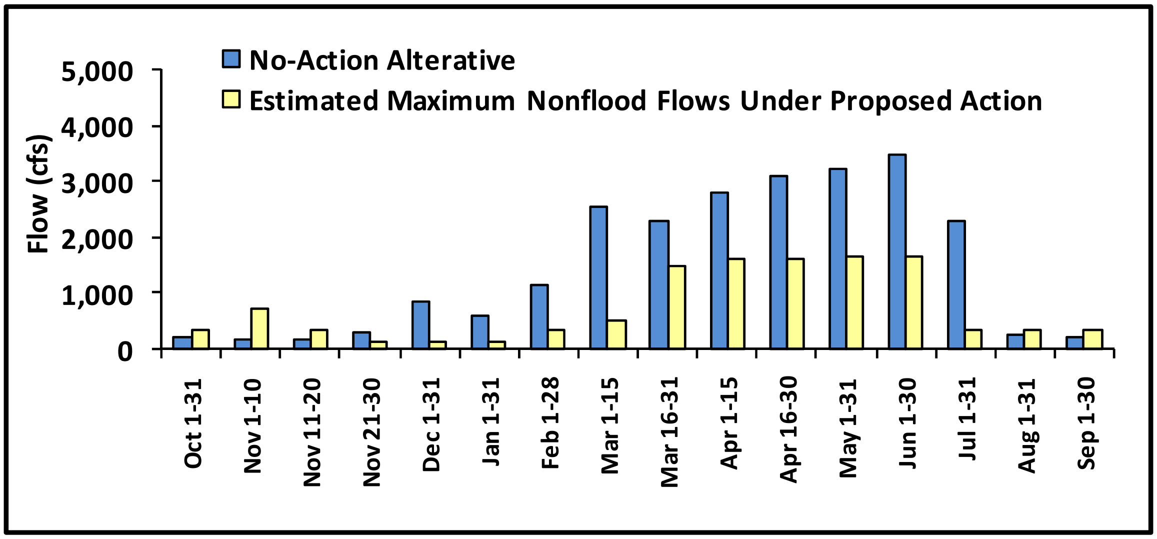


Figure 2-9.
Average Simulated No-Action Alternative and Estimated Maximum San Joaquin River Daily Flows Under the Proposed Action at the Head of Reach 1 in Wet Years

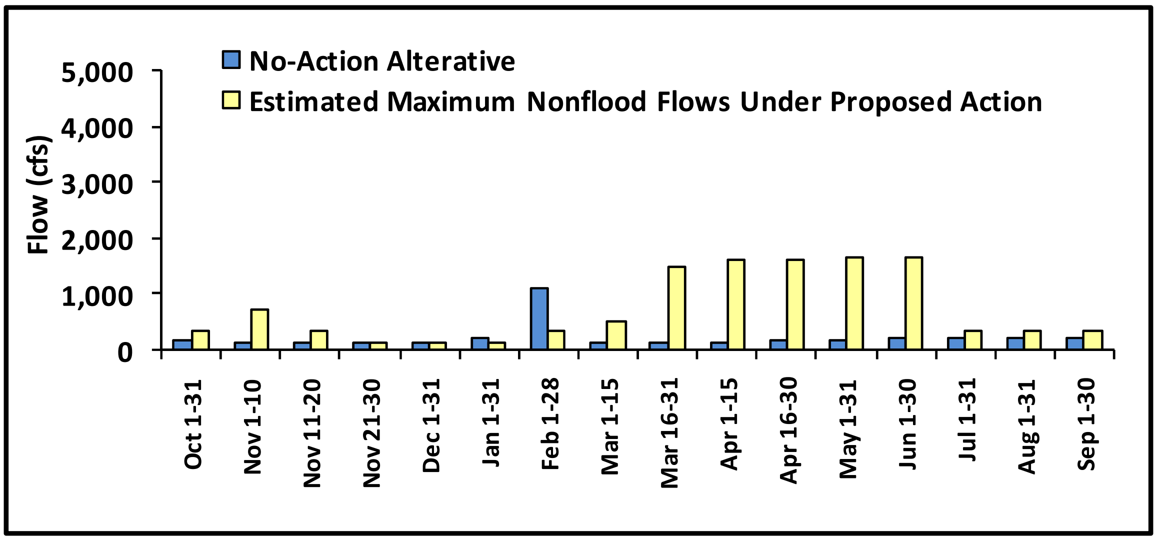


Figure 2-10.
Average Simulated No-Action Alternative and Estimated Maximum San Joaquin River Daily Flows Under the Proposed Action at the Head of Reach 1 in Normal-Dry Years

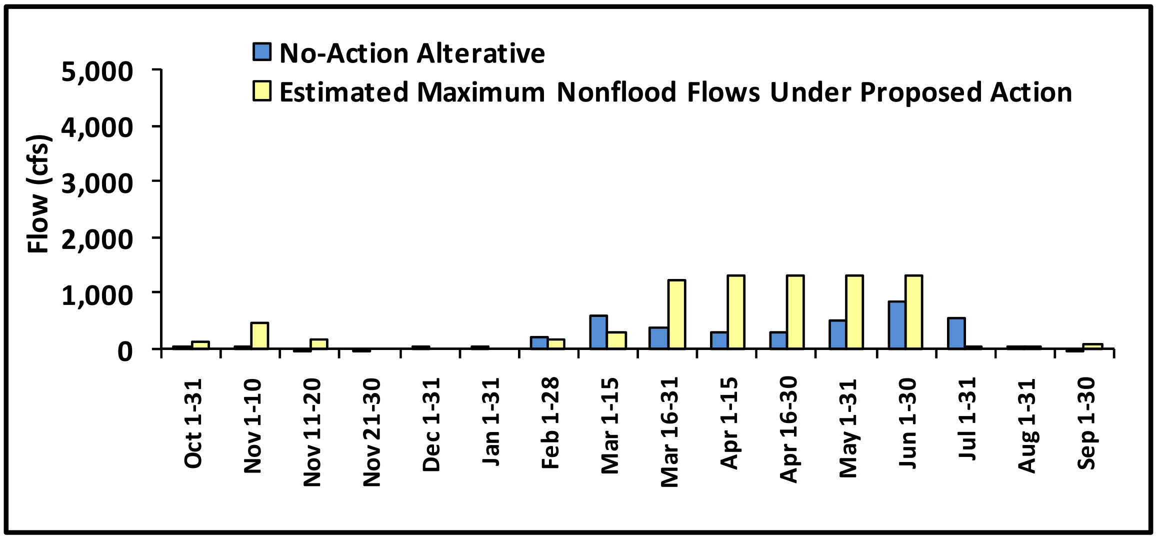


Figure 2-11.
Average Simulated No-Action Alternative and Estimated Maximum San Joaquin River Daily Flows Under the Proposed Action at the Head of Reach 2B in Wet Years

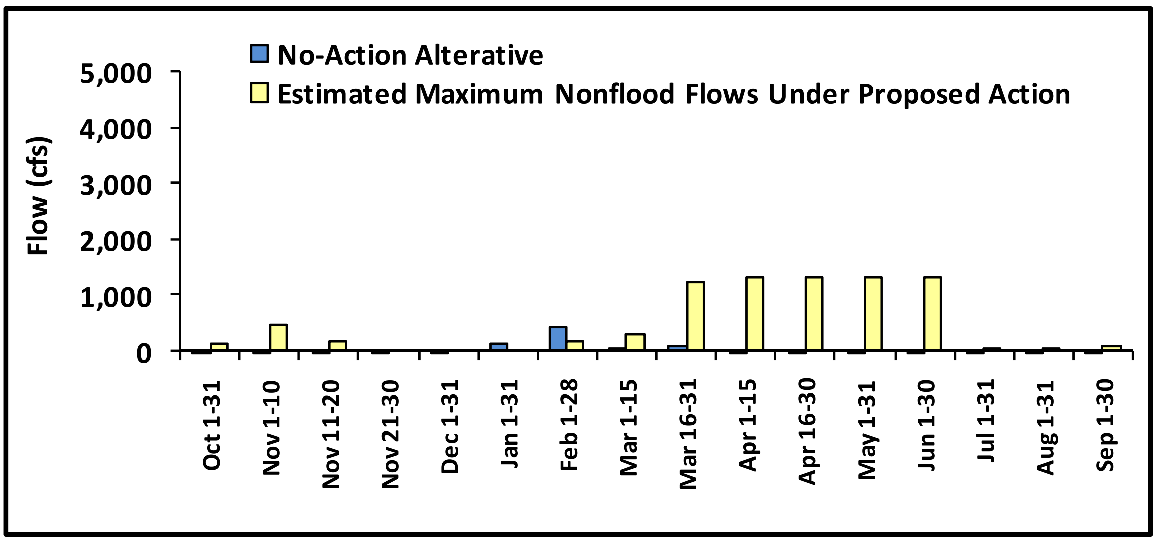


Figure 2-12.
Average Simulated No-Action Alternative and Estimated Maximum San Joaquin River Daily Flows Under the Proposed Action at the Head of Reach 2B in Normal-Dry Years

The Proposed Action includes, to the estimated maximum extent possible, recapturing WY 2010 Interim Flows at locations along the San Joaquin River and/or in the Delta. WY 2010 Interim Flows would be recaptured to the maximum extent possible, consistent with and limited by existing operating criteria, prevailing and relevant laws, regulations, biological opinions (BO), and court orders in place at the time the water is recaptured. The estimated maximum water released for WY 2010 Interim Flows that could be available for transfer under the Proposed Action is shown in Table 2-3. The estimated maximum downstream extent of WY 2010 Interim Flows that could be recaptured would be at the C.W. "Bill" Jones (Jones) and Harvey O. Banks (Banks) pumping plants.

Table 2-3.
Estimated Maximum Water Available for Transfer Under the Proposed Action

Begin Date	End Date	Releases from Friant Dam (cfs)	Reach 1 Holding Contract Releases (cfs)	Friant Dam Releases Minus Reach 1 Holding Contract Releases (cfs)
10/1/2009	10/31/2009	350	160	190
11/1/2009	11/6/2009	700	130	570
11/7/2009	11/10/2009	700	130	570
11/11/2009	11/20/2009	350	120	230
11/21/2009	1/31/2009	*No WY 2010 Interim Flows released during this period*		
2/1/2010	2/28/2010	350	100	250
3/1/2010	3/15/2010	500	130	370
3/16/2010	3/31/2010	1500	130	1,370
4/1/2010	4/15/2010	1,620	150	1,470
4/16/2010	4/30/2010	1,620	150	1,470
5/1/2010	6/30/2010	1,660	190	1,470
7/1/2010	8/31/2010	350	230	120
9/1/2010	9/30/2010	350	210	140
Total flows released (TAF)		**485**	**Total available for temporary transfer (TAF)**	**384**

Key:
cfs = cubic feet per second
TAF = thousand acre-feet
WY = Water Year

The Proposed Action includes potential recapture of Interim Flows at several diversion locations, including existing facilities in the Delta, the Mendota Pool at the downstream end of Reach 2B, the Lone Tree Unit of the Merced National Wildlife Refuge (NWR) (Lone Tree Unit) in Eastside Bypass Reach 2, and the East Bear Creek Unit of the San Luis NWR (East Bear Creek Unit) in Eastside Bypass Reach 3. WY 2010 Interim Flows recaptured along the San Joaquin River may provide deliveries in lieu of Delta-Mendota Canal (DMC) supplies. Recirculation would be subject to available capacity within CVP/SWP storage and conveyance facilities, as shown in Figure 2-13, including the Jones and Banks pumping plants, California Aqueduct, DMC, San Luis Reservoir and related pumping facilities, and other facilities of CVP/SWP contractors. Available capacity is capacity that is available after all statutory and contractual obligations are satisfied to existing water service or supply contracts, exchange contracts, settlement contracts, transfers, or other agreements involving or intended to benefit CVP/SWP contractors served water through CVP/SWP facilities.

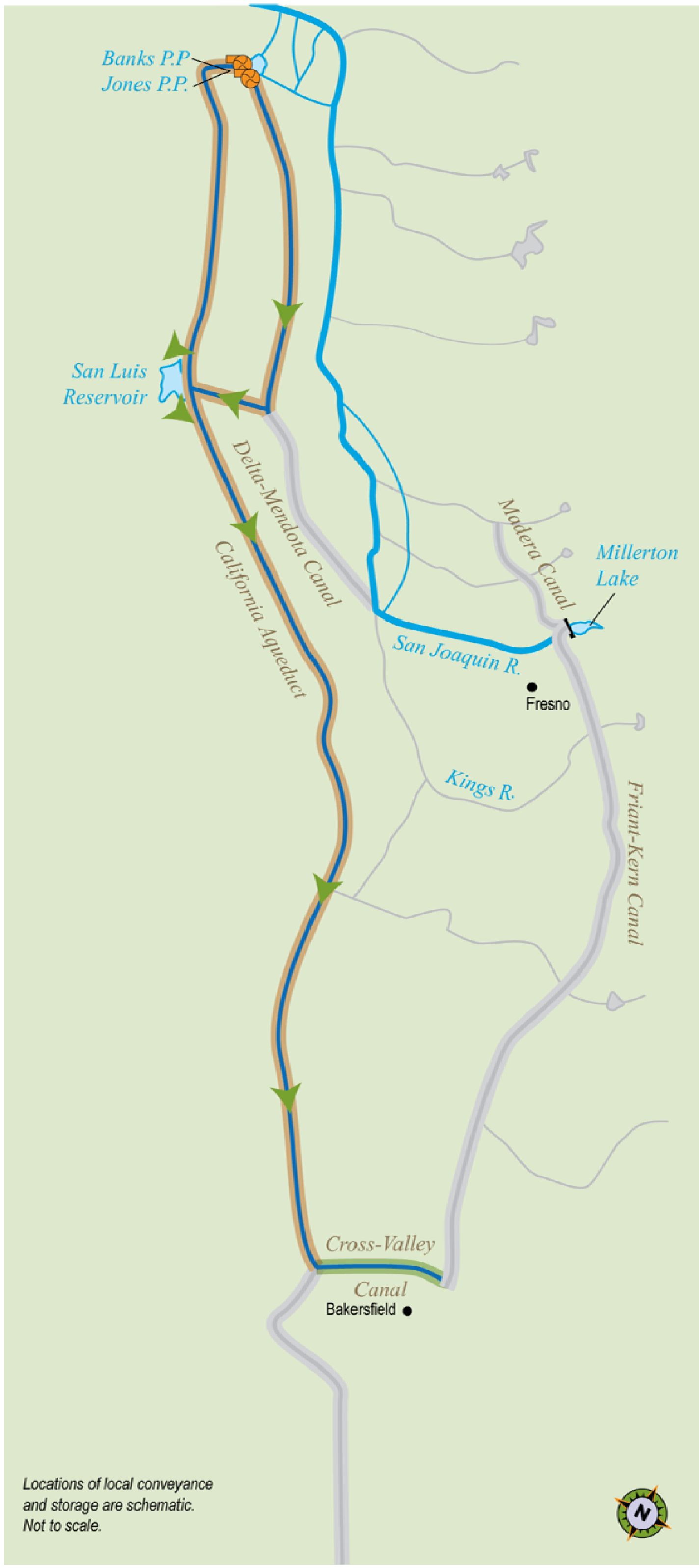


Figure 2-13.
Major Central Valley Project/State Water Project Storage and Conveyance Facilities That Could Convey Water to the Friant Division

Implementing the Proposed Action could increase flows entering the Delta from the San Joaquin River. Delta export facilities would continue to operate consistent with existing operating criteria, and prevailing and relevant laws, regulations, BOs, and court orders in place at the time the water is recaptured. Up to the amount of additional exported water could be available for recirculation to the Friant Division using south-of-Delta facilities. No additional agreements would be required to recapture flows in the Restoration Area. However, recirculation of recaptured water to the Friant Division could require mutual agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors. Reclamation would assist in developing these agreements. As previously described, recirculation would be subject to available capacity within CVP/SWP storage and conveyance. Additional implementation considerations that could constrain the release of WY 2010 Interim Flows include water supply demand; Mendota Dam operations; Sack Dam operations; any agreements with landowners or other Federal, State, and local agencies; special-status species; and potential for seepage. Each of these topics is discussed in further detail in Section 2.2.3.

Recaptured water available for transfer to Friant Division long-term contractors would range from zero to the full quantity released and would vary based upon the year type. During a Critical-Low year, the water available for recapture and transfer to the Friant Division long-term contractors would be zero, because there are no WY 2010 Interim Flow releases under this year type. During Critical-High years, Dry years, Normal-Dry years, Normal-Wet, and Wet years, the water available for recapture and transfer to the Friant Division long-term contractors would range between zero and 70 TAF, zero and 147 TAF, zero and 185 TAF, zero and 223 TAF, and zero and 384 TAF (as shown in Table 2-3), respectively. Reclamation would identify actual delivery reductions to Friant Division long-term contractors associated with the release of WY 2010 Interim Flows.

2.2.1 Settlement Flow Schedules

The quantity of water to be released from Friant Dam as WY 2010 Interim Flows in the Proposed Action is defined by the hydrologic year type classifications provided in Exhibit B, consistent with the Restoration Flow Guidelines (see Appendix C). The allocated annual quantity will be applied to the hydrographs in Exhibit B and reduced, as appropriate, within the limits of channel capacity (see Table 2-4), anticipated infiltration losses, and diversion capacities. Additional reductions in flow could be made, in consideration of water supply demands, presence of special-status species, and potential seepage effects, as described in Sections 2.2.2 and 2.2.3 and in the Seepage Monitoring and Management Plan (Appendix D). The resulting hydrograph would be subject to the application of flexible flow provisions described in Exhibit B, as recommended by the RA. For the reasons described in this EA/IS, Settlement provisions related to buffer flow and purchased water provisions are not being considered for WY 2010 Interim Flows, and therefore are not included in the Proposed Action. The timing and magnitude of flow releases, as well as additional flow modifications, would be further defined under guidance provided in the Settlement.

Table 2-4.
Estimated Maximum Water Year 2010 Interim Flows by Reach

Reach	Estimated Deliveries[1] (cfs)	Infiltration Losses[1] (cfs)	Estimated Existing Channel Capacity[2] (cfs)	Estimated Maximum Flow in Reach[3,4] (cfs)
1	230	0	8,000	1,660
2A	0	200	8,000	1,475
2B	0	0	1,300	1,300
3	0	0	1,300	1,300[6]
4A	0	0	4,500	1,300
4B1[5]	0	0	0	0
4B2	0	0	4,500	1,300
5	0	0	26,000	1,775[7]
Mariposa Bypass	0	0	8,500	1,300
Eastside Bypass Reach 1	0	0	10,000	1,300
Eastside Bypass Reach 2	0	0	16,500	1,300
Eastside Bypass Reach 3	0	0	12,000	1,300

Sources: McBain and Trush 2002; Resource Management Coalition 2003, 2007

Notes:

[1] Loss estimates incorporated into flow targets, as defined in Exhibit B of the Settlement. Includes infiltration losses in Reach 2, and water right diversions in Reach 1.

[2] Estimated existing nondamaging channel capacity is based on best available information and may be revised as new information becomes available as part of the SJRRP.

[3] Nonflood conditions.

[4] Does not include potential discontinuous local flow such as agricultural and natural drainage.

[5] The Proposed Action does not include any activity in Reach 4B1.

[6] Maximum flow in Reach 3 includes both Water Year 2010 Interim Flows and irrigation delivery flows to Arroyo Canal.

[7] Includes existing inflow from Mud and Salt sloughs of up to 500 cfs, as defined in Exhibit B.

Key:

cfs = cubic foot per second

Restoration Year type Classification

Exhibit B of the Settlement identified water year types based on the percentages of years from 1922 through 2005 with relative inflows. The SJRRP has developed a correlation between these data and the complete range of potential unimpaired inflow to Millerton Lake, as shown in Table 2-5. The need for and continued development of the year type classification system is described in Appendix C.

Table 2-5.
Restoration Year types

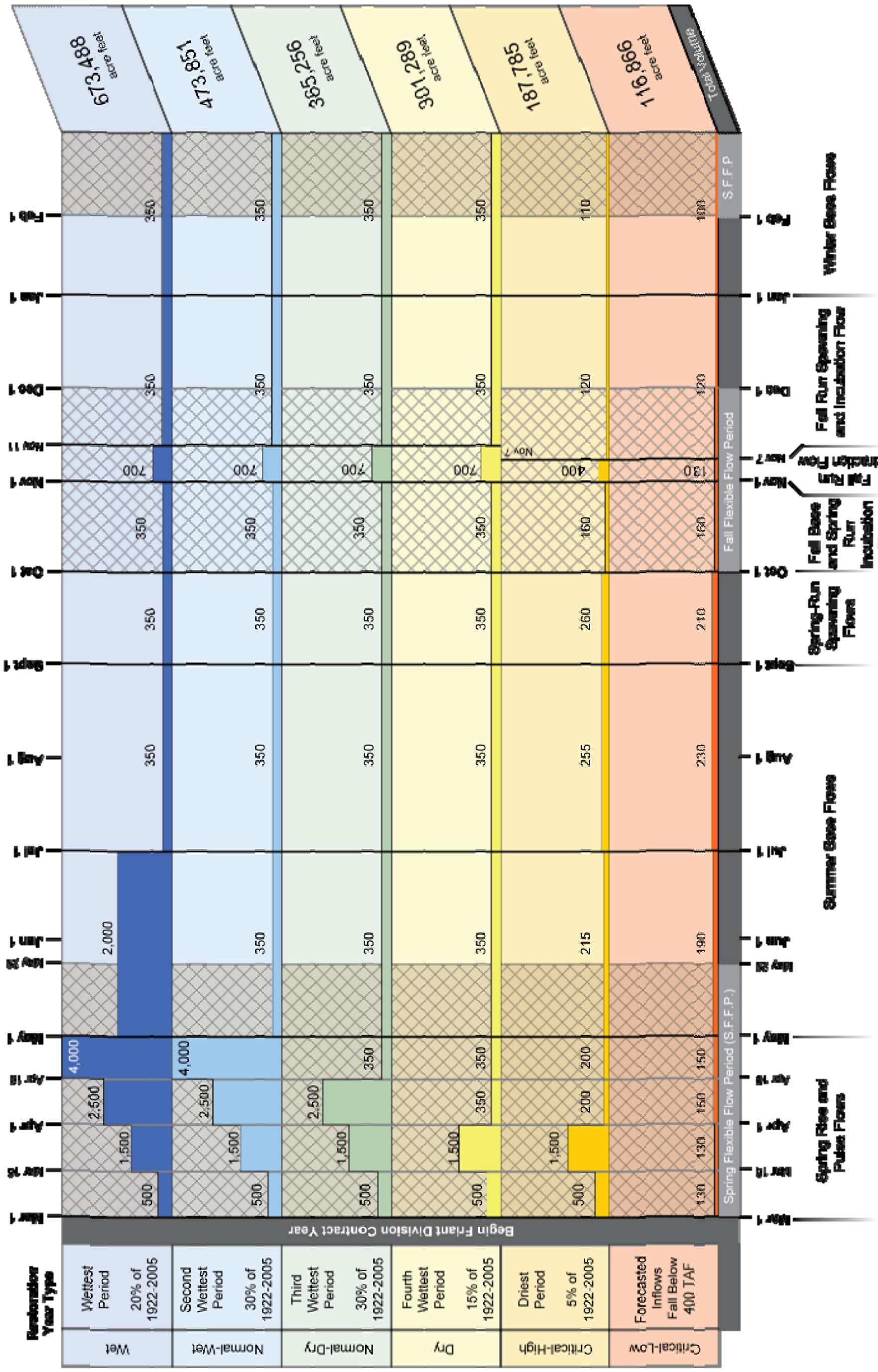
Restoration Year Type[1]	Range of Unimpaired Inflow to Millerton Lake (acre-feet per year)	Percentage of Years from 1922 Through 2005[2]
Wet	Greater than 2,500,000	20 percent
Normal-Wet	Greater than 1,450,000 to 2,500,000	30 percent
Normal-Dry	Greater than 930,000 to 1,450,000	30 percent
Dry	Greater than 670,000 to 930,000	15 percent
Critical-High	400,000 up to 670,000	5 percent
Critical-Low	Less than 400,000	

Notes:
[1] A Restoration year begins October 1 and ends September 30 of the following calendar year.
[2] The year types in Exhibit B of the Settlement were identified based on these data. The SJRRP has developed a correlation between these data and the range of unimpaired inflow to Millerton Lake, as shown in the table.

The Restoration year type for Interim Flow releases in 2009 and 2010 would be determined using information considered in making water supply allocations, including the DWR *Bulletin 120* forecast (finalized in May 2009 and to be finalized in May 2010). The Restoration year type for releases in 2009 would be a Normal-Dry year; the Restoration year type for Interim Flows releases in 2010 would be finalized in June 2010. Releases before June 2010 would be based on information considered in making water supply allocations, including the DWR *Bulletin 120* forecast, as described above.

Timing and Magnitude of Restoration Flow Releases

The RA may recommend additional changes in specific release schedules, such as ramping rates, to smooth the transition through the hydrograph. Implementing these recommended changes would be considered to the extent that they would not alter the total amount of water required to be released pursuant to the applicable hydrograph; would not result in additional water delivery reductions to Friant Division long-term contractors; and could be accomplished consistent with channel capacity limitations, measures to reduce or avoid seepage to adjacent lands, and any agreements established to support implementation of the Proposed Action. Alternative release schedules considered to date are described in Appendix C and shown in Figure 2-14. The Wet year flow schedule, shown in Figure 2-15, identifies the estimated maximum effects associated with WY 2010 Interim Flow releases, but would be reduced, as appropriate, by the limits of channel capacity and other factors such as monitoring, to reduce or avoid seepage to adjacent lands. This flow schedule is used to determine potential impacts in this EA/IS.



Notes:
All values in cfs unless otherwise noted

Figure 2-14.
Restoration Flow Schedules by Restoration Year type, as Specified in Exhibit B of the Settlement

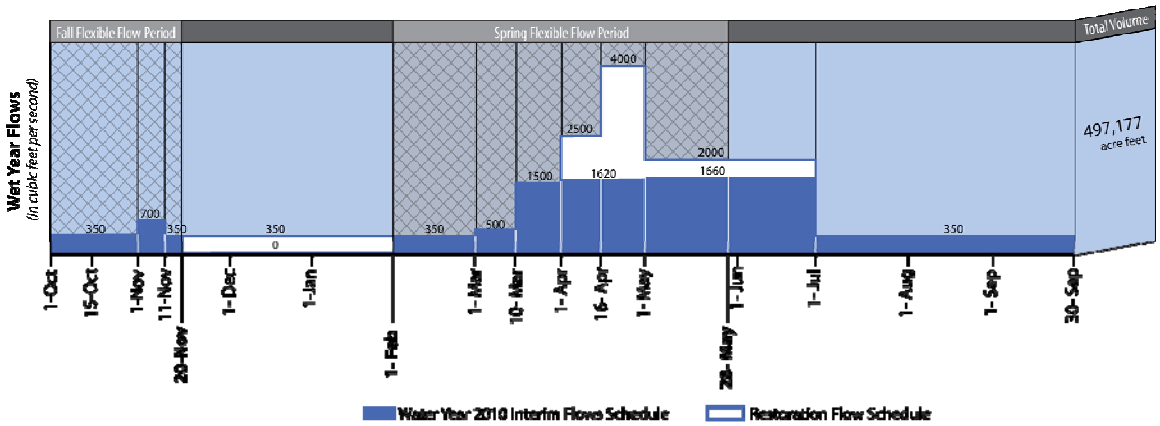


Figure 2-15.
Estimated Maximum Average Water Year 2010 Interim Flows from Friant Dam Assuming a Wet Year

Flow Modifications

The Settlement defines several potential modifications to flow schedules to help achieve the Restoration Goal. These modifications include flexible flow periods, a spring pulse, buffer flows, and the acquisition and release of additional water. Because Chinook salmon will not be reintroduced to the river during WY 2010, and because the purpose of WY 2010 Interim Flows is to collect relevant data, WY 2010 Interim Flows would not include applying buffer flows or releasing additional water.

WY 2010 Interim Flow releases would be less than full Restoration Flows identified in Exhibit B of the Settlement because of limited downstream channel capacities; potential material adverse effects from groundwater seepage; requirements of Federal, State, and local laws; and potential conditions in any agreements with downstream agencies, entities, and landowners. WY 2010 Interim Flows could include applying flexible flow periods to create additional data collection opportunities. Applying flexible flow periods would be considered to the extent that they would not alter the total amount of water required to be released pursuant to the applicable hydrograph, and would not result in additional water delivery reductions to Friant Division long-term contractors. The volume of Restoration Flows above the estimated maximum WY 2010 Interim Flows would not be applied earlier or later within the flexible flow period to increase the total allocation made for the appropriate year type, as illustrated in Figure 2-15.

As described in the Settlement, the RA will recommend the shape (ramping schedule and maximum flows) and timing of flows subject to flood control needs, channel conveyance capacity, Settlement stipulations, and permit requirements. The Proposed Action includes a spring pulse consistent with the Settlement flow schedule, as constrained by existing channel capacity. The spring pulse, as presented in Exhibit B of the Settlement, could be scheduled within the spring flexible flow period (February 1 and May 28, 2010), and provides up to 270 TAF (in a Wet year) of water released from Friant Dam. Total spring pulse volumes depend on the water year type; drier years have lower allocated spring pulse volumes.

2.2.2 Flow Considerations by Reach

The river reaches and flood bypasses within the Restoration Area are described as a series of physically and operationally distinct reaches, with channel capacity constraints, estimated gains, and estimated infiltration losses, as defined in the following sections. Considerations within each reach and below the Merced River confluence are described below.

Under existing nonflood conditions, most reaches of the San Joaquin River and the associated bypass system within the Restoration Area convey local agricultural return flows and runoff. Under flood conditions, seepage through levees has been observed. The release of WY 2010 Interim Flows would increase gradually and incrementally from base flows to up to 350 cubic feet per second (cfs). Flows would gradually and incrementally be increased above 350 cfs according to the Exhibit B flows schedules, and consistent with recommendations of the Restoration Administrator (RA). The maximum release for WY 2010 Interim Flows in fall 2009 would be 700 cfs between November 1 and November 11. Flows would not be released between November 20, 2009, and January 31, 2010.

Beginning February 1, 2010, Interim Flows would begin again and flows would be gradually increased from typical releases from Friant Dam. During this spring period, flows would be gradually and incrementally increased based on the information collected on channel capacities and changes in the shallow groundwater elevations during the fall release period and consistent with Exhibit B of the Settlement and the recommendations of the RA.

The release of WY 2010 Interim Flows would be managed to avoid interfering with operations of the San Joaquin River Flood Control Project. This includes operations of the Chowchilla Bypass Bifurcation Structure, Sand Slough Control Structure, Eastside Bypass Bifurcation Structure, and Mariposa Bypass Bifurcation Structure, as well as San Joaquin River Flood Control Project levee maintenance. Specifically, under the Proposed Action, no change in flood operations at the Chowchilla Bypass Bifurcation Structure would occur. Releases of flood flows to the San Joaquin River would be unchanged from existing operations, which are based on the estimated capacity of the portion of Reach 2B below the Chowchilla Bypass Bifurcation Structure. In periods when flood flows would satisfy part or all of the flow targets identified in Exhibit B of the Settlement (as modified by channel capacity), WY 2010 Interim Flows would not be released in addition to flood flows. Also, the release and conveyance of flood flows would have a higher priority over WY 2010 Interim Flows to channel capacity in all reaches. The Lower San Joaquin Levee District regularly conducts operation and maintenance (O&M) activities to maintain channel capacity within the San Joaquin River Flood Control Project. These O&M activities would continue under the Proposed Action, and could occur more frequently.

Reach 1

Channel capacity in Reach 1 is approximately 8,000 cfs, which exceeds the estimated maximum potential flow releases from Friant Dam under the WY 2010 Interim Flows. Therefore, channel capacity would not limit WY 2010 Interim Flows in Reach 1. The

Exhibit B flow schedules include assumed Holding Contract Releases to Reach 1, as shown in Table 2-6 and Figure 2-16. Estimated maximum flows under the Proposed Action, as shown in Table 2-1, include releases to meet these diversions. Because this channel carries continuous flow under existing conditions, losses of WY 2010 Interim Flows in Reach 1 are not expected to exceed those that occur to satisify Reach 1 Holding Contract diversions. Figure 2-9 shows the Exhibit B estimated maximum San Joaquin River flows in Reach 1 for Wet years under the Proposed Action, compared with Wet years under the No-Action Alternative. Figure 2-10 shows the Exhibit B estimated maximum San Joaquin River flows in Reach 1 for Normal-Dry years under the Proposed Action, compared with Normal-Dry years under the No-Action Alternative.

Table 2-6.
Riparian Releases Identified in Reach 1 in Exhibit B of the Settlement

WY 2010 Interim Flow Dates		Reach 1 Riparian Releases (cfs)
Begin Date	End Date	
10/1/2009	10/31/2009	160
11/1/2009	11/6/2009	130
11/7/2009	11/10/2009	130
11/11/2009	11/20/2009	120
11/21/2009	1/31/2010	120
2/1/2010	2/28/2010	100
3/1/2010	3/15/2010	130
3/16/2010	3/31/2010	130
4/1/2010	4/15/2010	150
4/16/2010	4/30/2010	150
5/1/2010	6/30/2010	190
7/1/2010	8/31/2010	230
9/1/2010	9/30/2010	210

Key:
cfs = cubic feet per second
WY = water year

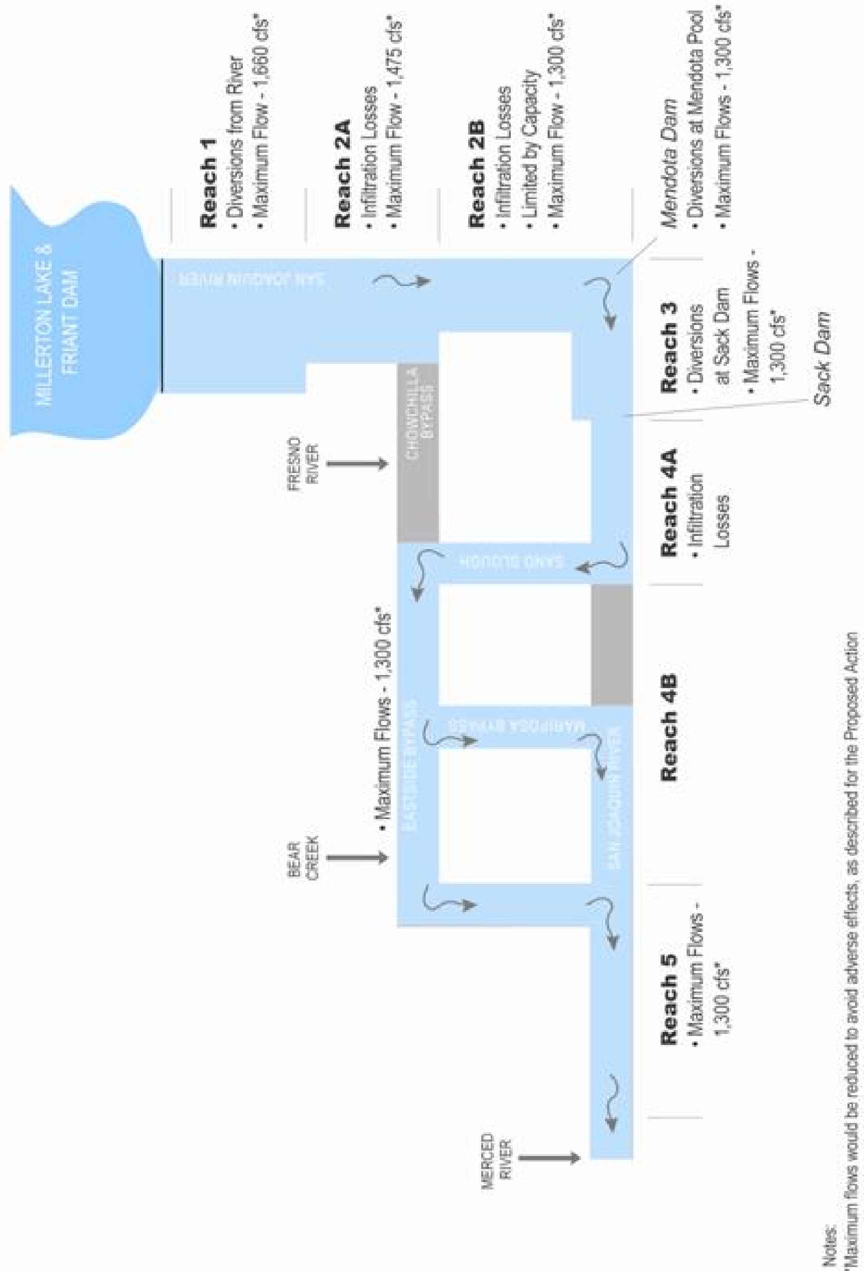


Figure 2-16.
Interim Flows, Water Deliveries, Diversions, and Infiltration Losses in the Restoration Area

Reach 2

Estimated maximum WY 2010 Interim Flows would be constrained by the existing channel capacity of Reach 2B. DWR has estimated the channel capacity in Reach 2B to be 1,500 cfs. Local landowners have stated that the conveyance capacity of Reach 2B is approximately 1,300 cfs (RMC 2007). In addition, some landowners provided comments to the Draft EA/IS that indications of possible seepage and other related impacts could become evident in Reaches 2 through 4A when flows in Reaches 2B or 3 exceed 475 cfs and 1,300 cfs. Therefore, the Proposed Action includes increased monitoring of levee conditions when WY 2010 Interim Flows exceed 475 cfs in Reaches 2B or 3 (as described in Section 2.2.5 and in the Seepage Monitoring and Management Plan (Appendix D)). Until additional information can be collected to better understand the channel capacity in Reach 2B, estimated maximum WY 2010 Interim Flows would not exceed a flow of 1,300 cfs in Reach 2B (Figure 2-11 shows the estimated maximum flows at the head of Reach 2B in Wet years). To accommodate this presumed capacity limitation, WY 2010 Interim Flow releases at Friant Dam would be less than the quantity included in the Exhibit B flow schedules from April 1 to June 30 of 2010, if the year type is determined to be Normal-Dry, Normal-Wet, or Wet. Table 2-4 shows the capacity restrictions on estimated maximum flows, reflecting nonflood conditions in a wet year.

The Exhibit B flow schedules include assumptions about infiltration losses in Reach 2A, as shown in Table 2-7. Estimated maximum flows under the Proposed Action, as shown in Table 2-4, include these losses.

Table 2-7.
Assumed Infiltration Losses Identified for Reach 2A and in Exhibit B

Dates of Interim Flow Release		Infiltration Losses in Reach 2A by Year type (cfs)					
Begin Date	**End Date**	**Critical-Low**	**Critical-High**	**Dry**	**Normal-Dry**	**Normal-Wet**	**Wet**
10/1/2009	10/31/2009	80	80	80	80	80	80
11/1/2009	11/6/2009	100	100	100	100	100	100
11/7/2009	11/10/2009	80	80	100	100	100	100
11/11/2009	11/20/2009	80	80	80	80	80	80
11/21/2009	1/31/2010	*No WY 2010 Interim Flows released during this period*					
2/1/2010	2/28/2010	80	80	80	80	80	80
3/1/2010	3/15/2010	90	90	90	90	90	90
3/16/2010	3/31/2010	150	150	150	150	150	150
4/1/2010	4/15/2010	80	80	80	175	175	175
4/16/2010	4/30/2010	80	80	80	80	200	200
5/1/2010	6/30/2010	80	80	80	80	80	165
7/1/2010	8/31/2010	80	80	80	80	80	80
9/1/2010	9/30/2010	80	80	80	80	80	80

Key:
cfs = cubic feet per second
WY = water year

WY 2010 Interim Flows would flow through Reach 2 and the Mendota Pool, unless downstream considerations (such as channel capacity or presence of special-status species) require that less (or no) Interim Flows enter Reach 3. Reclamation delivers water to the San Joaquin River Exchange Contractors at the Mendota Pool via the DMC under the San Joaquin River Exchange Contract. Under this contract, Reclamation can deliver water to Mendota Pool to fulfill contract obligations through the DMC or through the San Joaquin River at its discretion. Typically, all deliveries to the San Joaquin River Exchange Contractors in excess of flood flows are made via the DMC. If Reclamation must make deliveries to the San Joaquin River Exchange Contractors via the San Joaquin River, these water deliveries would have a higher priority over WY 2010 Interim Flows to channel capacity. No agreements are needed for Reclamation to provide San Joaquin River water to the Mendota Pool to meet Exchange Contract demands.

Under the Proposed Action, WY 2010 Interim Flows could be diverted from the Mendota Pool to the extent that these flows would meet demands, replacing CVP water supplies that would otherwise be delivered via the DMC. The DMC carries water from the Delta to the Mendota Pool, where the water is diverted through several existing pumps and canals with a combined capacity that exceeds upstream channel capacity. WY 2010 Interim Flows diverted by CVP contractors at the Mendota Pool would be in lieu of supplies typically delivered via the DMC. Therefore, CVP water supplies that would have been delivered via the DMC would be made available for delivery to the Friant Division, subject to existing contractual obligations and existing and any future agreements.

Central California Irrigation District (CCID) operates and maintains Mendota Dam under a very narrow operating range, and provides no operational storage for water supply operations (RMC 2003). The San Luis & Delta-Mendota Water Authority (SLDMWA) operates and maintains the Mendota Pool on behalf of Reclamation. The Mendota Pool is held at a fairly constant elevation, between 14.2 feet above mean sea level (msl) (elevation 14.2) and elevation 14.5, to maintain water deliveries to water users in the upper end of the Mendota Pool/Fresno Slough areas (RMC 2003). To maintain this constant elevation, releases from Mendota Dam need to be made via the gates and with boards at the dam in place. The gates have a release capacity of approximately 1,500 cfs. Under the Proposed Action, operations at the Mendota Pool would continue to maintain water surface elevations within the range of existing operations.

Federal Actions to Be Completed for Release of WY 2010 Interim Flows to the Mendota Pool. Several actions would be completed by Reclamation before and during the release of flows from Friant Dam to the Mendota Pool. Actions that would be completed include the following:

1. Estimate anticipated water supply demands at Mendota Pool
2. Identify limitations on the maximum possible flows for Reaches 1, 2A, and 2B based on nondamaging channel capacity and water supply demand
3. Allocate water supply for WY 2010 Interim Flows based on hydrology and channel capacities
4. Receive fall and spring WY 2010 Interim Flow schedule recommendations from RA

5. Verify WY 2010 Interim Flow schedule recommendations for consistency with the Settlement, the analysis in this Final EA/IS, Federal and State law, and system capacity

6. Implement recreation outreach in Reach 1, as described in Section 2.2.4

7. Release allocated water from Friant Dam to the San Joaquin River consistent with items 2, 4, and 5, above.

8. Implement physical parameters monitoring program actions (including the Seepage Monitoring and Management Plan and the Flow Monitoring and Management Plan) (see Appendices D and E, respectively), in coordination with State agencies, to monitor the response of the physical system to the release of WY 2010 Interim Flows

9. Reduce flows or redirect flows, if necessary, to avoid seepage conditions, as described in the Seepage Monitoring and Management Plan

10. Account for diversions of WY 2010 Interim Flows at the Mendota Pool to satisfy Exchange Contracts and other CVP delivery obligations

11. Deliver water to Friant Division long-term contractors that would otherwise be exported from the Delta for Exchange Contracts up to the quantity of WY 2010 Interim Flows diverted for these purposes

State Actions to Be Completed for Release of WY 2010 Interim Flows to the Mendota Pool. Several actions would be completed by DWR, or other State organizations identified in Section 1.4.2, before and during the release of WY 2010 Interim Flows for diversion at the Mendota Pool. Actions that would be completed include the following:

1. Install water seals on the Chowchilla Bypass Bifurcation Structure to minimize leakage to the Chowchilla Bypass

2. Operate Chowchilla Bypass Bifurcation Structure to route WY 2010 Interim Flows to Reach 2B, consistent with Federal action 9, above

3. Implement physical parameters monitoring program actions (including the Seepage Monitoring and Management Plan and the Flow Monitoring and Management Plan), in coordination with Reclamation (see Appendices D and E, respectively) to monitor the response of the physical system to the release of WY 2010 Interim Flows

Reach 3

Reach 3 currently conveys flows from Mendota Dam to the Arroyo Canal at Sack Dam for diversion. Any necessary agreements for releases below Mendota Dam in excess of downstream diversions would be in place before operating these facilities for these purposes (as described in Section 2.2.3). Diversions to the Arroyo Canal can range from zero to 800 cfs, and typically do not exceed 600 cfs. Flows in Reach 3 vary based on the time of year, water demands, and available water supplies. The San Joaquin River Resource Management Coalition (RMC) has reported that Reach 3 conveys up to 800 cfs of water for irrigation diversions at Sack Dam, and that higher flows (less than 4,500 cfs) can cause seepage impacts and levee stability problems in this reach (2007). In April 2006, during flood conditions, the U.S. Geological Survey (USGS) recorded a mean maximum daily discharge of 4,590 cfs for 2 days; DWR reported that seepage occurred on lands in and adjacent to the floodway during this time. DWR has estimated the capacity of interior levees in this reach to be approximately 1,300 cfs with 3 feet of freeboard (see Appendix C). WY 2010 Interim Flow releases from Mendota Dam would be reduced in proportion to releases from Mendota Dam by the San Joaquin River Exchange Contractors for diversion at the Arroyo Canal, such that the combined WY 2010 Interim Flows and irrigation supply flows would not exceed an estimated maximum of 1,300 cfs. In addition, some landowners provided comments to the Draft EA/IS that indications of possible seepage and other related impacts could become evident at flows between 475 cfs and 1,300 cfs. Therefore, the Proposed Action includes increased monitoring of levee conditions when WY 2010 Interim Flows exceed 475 cfs in Reaches 2B or 3 (as described in Section 2.2.5 and in the Seepage Monitoring and Management Plan (Appendix D)). Because Reach 3 currently conveys flow, it is assumed that infiltration losses related to WY 2010 Interim Flows in Reach 3 would be negligible. However, implementation of the Flow Monitoring and Management Plan, as part of the Proposed Action, will contribute to better understanding of potential unforeseen infiltration losses in Reach 3.

WY 2010 Interim Flows would flow through Reach 3 and over Sack Dam to Reach 4A, unless downstream considerations (such as channel capacity or potentially adverse effects) require that less flow enters downstream reaches, as described above in the discussion of Reach 2.

Reach 4A

The estimated maximum flow in Reach 4A under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream constraints described above for Reach 2B. In addition, some landowners provided comments to the Draft EA/IS that indications of possible seepage and other related impacts could become evident at flows less than 1,300 cfs. Therefore, until additional information can be collected to better understand the channel capacity in Reach 4A, estimated maximum WY 2010 Interim Flows would not exceed a flow of 1,300 cfs in Reach 4A. Any necessary agreements for releases below Mendota Dam in excess of downstream diversions would be in place before operating these facilities for these purposes (as described in Section 2.2.3).

The flow schedule in Exhibit B of the Settlement acknowledges that seasonal flow losses can occur in Reach 4A; however, these losses are not specified. Because Reach 4A conveys no flow in most months of most years (i.e., is a dry channel), some initial infiltration losses are anticipated in this reach under WY 2010 Interim Flows. Flows would be monitored at the locations identified in the Settlement and in Appendix E to provide relevant information regarding infiltration losses.

WY 2010 Interim Flows at the downstream end of Reach 4A would be conveyed through Sand Slough to the Eastside Bypass. These flows would not be conveyed into Reach 4B1 because the capacity of Reach 4B1 is not currently known, and may be zero at some locations.

Eastside and Mariposa Bypasses

The estimated maximum WY 2010 Interim Flows conveyed to the Eastside and Mariposa bypasses would be 1,300 cfs because of upstream capacity constraints in Reach 2B, as described above. WY 2010 Interim Flows would enter Eastside Bypass Reach 2 via Sand Slough. Flows would either be routed through the Mariposa Bypass back to the San Joaquin River at the head of Reach 4B2, or through Eastside Bypass Reach 3 back to the San Joaquin River at the head of Reach 5.

Conveyance of WY 2010 Interim Flows through the Eastside and Mariposa bypasses would be limited, as necessary, by biological requirements determined through currently ongoing field surveys for listed species. In addition, Reclamation is currently identifying lands that may be subject to agreements with Eastside Bypass landowners to allow conveyance of WY 2010 Interim Flows. WY 2010 Interim Flows would not be released until any such necessary agreements are in place. WY 2010 Interim Flows would be conveyed through the bypasses to Reaches 4B2 and 5, unless downstream considerations (such as channel capacity or potential take of listed species that could not be avoided) require that less (or no) flow enter these downstream reaches. Flow considerations in Eastside Bypass Reaches 2 and 3, and in the Mariposa Bypass, are discussed below.

The operating rule for the Mariposa Bypass is to divert all flows to the San Joaquin River when flows in the Eastside Bypass above the Mariposa Bypass are less than 8,500 cfs, with flows greater than 8,500 cfs remaining in the Eastside Bypass, eventually discharging back into the San Joaquin River at the Bear Creek Confluence at the end of San Joaquin River Reach 4B. However, actual operations have deviated from this rule, flows of up to 2,000 cfs to 3,000 cfs have historically remained in the Eastside Bypass, and approximately one-quarter to one-third of the additional flows are released to the Mariposa Bypass (McBain and Trush 2002).

Diversion of WY 2010 Interim Flows to the Mariposa Bypass is at the discretion of the Lower San Joaquin Levee District, however, it is anticipated that WY 2010 Interim Flows would remain in the Eastside Bypass, consistent with recent historical routing of flows below 2,000 cfs to 3,000 cfs.

Eastside Bypass Reach 2. If downstream considerations (such as channel capacity or potentially adverse effects) require that less (or no) flow enters reaches downstream from Eastside Bypass Reach 2, WY 2010 Interim Flows could be diverted in Eastside Bypass Reach 2 to the Lone Tree Unit (up to 20 cfs), to the extent that these flows would meet water supply demands, replacing other water supplies, including Merced Irrigation District deliveries.

The Lone Tree Unit has historically diverted water from Eastside Bypass Reach 2 using a 25-horsepower permanent lift station last operated in 1997 (Forrest, pers. comm., 2009). The Lone Tree Unit currently diverts water from the Eastside Bypass using a 350-horsepower portable pump. The pumps are ordinarily operated in conjunction with weirs that back up water in the bypass to provide temporary habitat for waterfowl. To maintain suitable conditions within the ponded water, flow-through is maintained past the weirs.

Eastside Bypass Reach 3. If considerations in Mariposa Bypass and Reach 4B2 or in downstream reaches (such as channel capacity or potential take of listed species that could not be avoided) require that less (or no) flow enters those reaches, WY 2010 Interim Flows could be diverted to the East Bear Creek Unit in Eastside Bypass Reach 3, to the extent that these flows would meet water supply demands.

The East Bear Creek Unit has a pump lift station in the Eastside Bypass with a diversion capacity of 60 cfs. This pump stations includes a 48-inch-diameter intake structure and four 125-horsepower electric motors driving 15 cfs pumps. Deliveries of WY 2010 Interim Flows to the East Bear Creek Unit would be further constrained by actual demand for water supplies at the East Bear Creek Unit.

Mariposa Bypass. The estimated maximum flow in the Mariposa Bypass under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream capacity constraints described above for Reach 2B. Conveyance of WY 2010 Interim Flows through the Mariposa Bypass would be limited, as described above, by biological requirements determined through field surveys for listed species. If downstream considerations require that less (or no) flow enters those reaches, WY 2010 Interim Flows would be diverted in upstream reaches, as described above.

Federal Actions to Be Completed for Release of WY 2010 Interim Flows to the Restoration Area Downstream from Sack Dam. Several actions would be completed by Reclamation before and during the release of WY 2010 Interim Flows for conveyance of WY 2010 Interim Flows in the Restoration Area downstream from Sack Dam, in addition to those identified previously for the release of WY 2010 Interim Flows for diversion at the Mendota Pool. Actions that would be completed include the following:

1. Estimate anticipated water supply demands at the Lone Tree and East Bear Creek units

2. Identify Mendota Dam operating conditions that would not increase risk to dam stability, inundate surrounding lands, or adversely affect diversions from the Mendota Pool

3. Establish maximum possible flows for Reaches 3 and 4A, and Eastside Bypass Reaches 2 and 3 based on nondamaging channel capacity, Mendota Dam operating conditions, and water supply demand

4. Complete blunt-nosed leopard lizard (BNLL) preflow release surveys in Eastside Bypass Reaches 2 and 3, as described in Section 2.2.3

5. Implement the vehicular traffic detour plan, as described in Section 2.2.4
6. Reduce flows or redirect flows, if necessary, to avoid take of Federally listed or State-listed species, as described in Section 2.2.3

State Actions to Be Completed for Release of WY 2010 Interim Flows to the Restoration Area Downstream from Sack Dam. In addition to those State actions previously identified for the release of WY 2010 Interim Flows for diversion at the Mendota Pool, DWR, or other State organizations identified in Section 1.4.2, would close flap gates within Eastside Bypass Reaches 2 and 3 before release of WY 2010 Interim Flows through this reach, as needed.

Reach 4B2

The Proposed Action does not include conveyance of WY 2010 Interim Flows through Reach 4B1. WY 2010 Interim Flows could be routed through Eastside Bypass Reach 2 and the Mariposa Bypass and conveyed to Reach 4B2, as shown in Figure 2-16. No factors were identified in Reach 4B2 that would reduce or otherwise constrain WY 2010 Interim Flows. Because of upstream capacity constraints in Reach 2B, as described above, the estimated maximum WY 2010 Interim Flows conveyed to Reach 4B2 would be 1,300 cfs.

The flow schedule in Exhibit B of the Settlement acknowledges that seasonal flow losses can occur in Reach 4B, which is likely a gaining reach, but additional flows gained are not quantified in the Exhibit B flow schedules. The additional flows occur under the Existing Condition and under the Proposed Action, but are not reflected in the estimated maximum flows shown in Tables 2-1 and 2-2.

Reach 5

The estimated maximum flow at the head of Reach 5 under the Proposed Action (nonflood conditions) would be 1,300 cfs because of upstream capacity constraints described above for Reach 2B. No factors were identified in Reach 5 that would reduce or otherwise constrain WY 2010 Interim Flows.

Accretions in Reach 5 of up to 500 cfs from Mud and Salt sloughs assumed in the flow schedules presented in Exhibit B of the Settlement are reflected in the estimated maximum flows under the Proposed Action shown in Table 2-1. Exhibit B acknowledges that Reach 5 gains additional flows of up to 50 cfs from other sources, but these are not incorporated in the Exhibit B flow schedules. These flows occur under the Existing Condition and under the Proposed Action, but are not reflected in the estimated maximum flows shown in Tables 2-1 and 2-2.

San Joaquin River Downstream from the Merced River Confluence

WY 2010 Interim Flows reaching the confluence of the Merced River could increase San Joaquin River flows by up to 1,300 cfs. The Merced, Tuolumne, and Stanislaus rivers are the three main tributaries to the San Joaquin River. Releases from major reservoirs on these tributaries are made in response to multiple operational objectives, including flood management, downstream diversions, instream fisheries flows, instream water quality flows, and releases to meet water quality and flow objectives at Vernalis as part of requirements under Water Right Decision 1641 (D-1641) including Vernalis Adaptive Management Program (VAMP). VAMP is an experimental program to determine how salmon survival rates change in response to alterations in flow releases (primarily from tributary reservoirs), and alterations in CVP/SWP export levels that are based on flow conditions in the San Joaquin River at Vernalis.

VAMP was established as a 12-year program to protect juvenile Chinook salmon emigrating through the San Joaquin River and the Delta, and to evaluate how Chinook salmon survival rates change in response to alterations in San Joaquin River flows and exports at the CVP and SWP facilities in the south Delta when the Head of Old River Barrier is installed.

VAMP includes a 31-day pulse flow period in April and May of up to 110 TAF depending on the flow conditions. Water needed to create the pulse flow is obtained by Reclamation through performance-based agreements that require the release of water or reduction of delivery from reservoirs on the Merced, Stanislaus, and Tuolumne rivers and from the Exchange Contractors at Mendota Pool, to meet the flow target requirements. The San Joaquin River Agreement (SJRA) establishes the structure for VAMP by identifying where water to support VAMP flow objectives would be obtained, specifically from the San Joaquin River Group Authority (SJRGA), whose members make water available. The SJRA precludes the use of water released from Friant Dam that is otherwise intended for use within the Friant Division of the CVP, other than water acquired from willing sellers. As part of the Central Valley Project Improvement Act (CVPIA) (Reclamation 1997), Reclamation leads the VAMP planning process, setting VAMP targets and flow conditions in coordination with SWRCB and other agencies. Although the SJRA identifies general parameters for VAMP experiments, in past years, the participating entities have adapted the specific experimental design to accommodate real-time conditions, applying mutually agreed-on flexibility for the experimental program. The current agreement for the VAMP experiments expires in December 2009. The future of VAMP is uncertain, and Reclamation and SJRA participants are discussing the future approach for VAMP; however, no decisions on the future of VAMP had been made at the time of publication of this EA/IS.

In response to WY 2010 Interim Flows, tributary releases to meet VAMP water quality objectives at Vernalis could be affected (further description of the effects on VAMP is included in Section 4). Releases from major reservoirs on the tributaries are made in response to multiple operational objectives that would not be affected by WY 2010 Interim Flows, including flood management, downstream diversions, instream fisheries flows, and instream water quality flows. These operational objectives are in addition to VAMP.

The Settlement does not provide guidance on coordination with VAMP flows. However, flows for both the VAMP and the SJRRP would occur during similar times of the year and have the potential to overlap in time. For WY 2010 Interim Flows, the SJRRP would meet flow targets at Vernalis under the existing VAMP agreement by contributing to the baseline that determines tributary contributions. Tributary releases to meet VAMP and water quality objectives at Vernalis would be affected in one of two ways. In conditions where WY 2010 Interim Flows contribute toward meeting the same VAMP flow threshold that would have otherwise been in place, required releases from tributary reservoirs could be reduced. In conditions where WY 2010 Interim Flows cause a higher VAMP flow threshold than would have otherwise been in place, required releases from tributary reservoirs would be made to achieve the higher threshold. As a result, tributary flows would increase in some years and decrease in other years. Changes in VAMP contribution releases from tributary reservoirs would not affect the ability to meet instream fish and water quality minimum flow requirements in the Merced, Tuolumne, Stanislaus, or mainstem San Joaquin rivers. However, it is possible that flows in the tributaries could be less because of VAMP operations with WY 2010 Interim Flows than they would be without the WY 2010 Interim Flows.

The Vernalis water quality requirement is an electrical conductivity (EC) requirement of 700 and 1000 micromhos/cm for the irrigation (April to August) and non-irrigation (September to March) seasons, respectively. This is modeled in CalSim by estimating the water quality at Vernalis using a link-node salinity algorithm, consisting of a series of EC mass balance equations, covering the San Joaquin River from Lander Avenue to Vernalis. The computed EC from an upstream node is used as the input EC of a downstream node. Flow-EC regressions are used for the San Joaquin River at Lander Avenue, Merced River near Stevinson, and the Tuolumne River near Modesto. Mud and Salt sloughs, both return flow and accretion EC, use monthly average values. If the estimated EC does not meet the standard at Vernalis, higher quality releases are made from New Melones Reservoir on the Stanislaus River to mix with the San Joaquin River to meet the standard.

Sacramento-San Joaquin Delta

WY 2010 Interim Flows reaching the Delta, which would not exceed 1,300 cfs, could be rediverted at existing CVP and SWP export facilities operated under existing regulatory requirements and institutional agreements subject to a 1725 temporary permit that would provide for rediversion of Friant Division CVP water and storage at San Luis Reservoir. Such rediversion would in all events be limited to flows directly attributable to WY 2010 Interim Flows. Available capacity within CVP/SWP storage and conveyance facilities could be used to facilitate exchanges, and conveyance of water to the Friant Division, by using recaptured Delta water supplies. In addition, even if Interim Flows are not exported from the Delta, they would contribute to meeting regulatory requirements in the Delta that could indirectly reduce the quantity of water released from upstream reservoirs to meet regulatory requirements. Recirculation would be subject to available capacity within CVP/SWP storage and conveyance facilities shown in Figure 2-13, including the Jones and Banks pumping plants, California Aqueduct, DMC, San Luis Reservoir and related pumping facilities, and other facilities of CVP/SWP contractors. Recirculation could also require mutual agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors, as described in Section 2.2.3.

Evaluations of surface water resources and interrelated resources (e.g., water quality, fisheries, groundwater, socioeconomics) for this Draft EA/IS are based on a CalSim representation prepared in 2005 that reflects coordinated CVP/SWP long-term operations

BOs in place at that time. USFWS issued a new long-term operations BO on delta smelt in 2008 (USFWS 2008b), and NMFS issued a new long-term operations BO on listed Chinook salmon, steelhead, and green sturgeon in June 2009 (NMFS 2009). Because representations of the 2008 USFWS BO Reasonable and Prudent Alternative (RPA) within numerical modeling tools are under development, the 2005 BO representation within CalSim was used for comparison purposes at this time. Further, the Proposed Action would continue to be in compliance with current or future long-term operations BOs.

Federal Actions to Be Completed for Release of WY 2010 Interim Flows to the San Joaquin River Downstream from the Merced River Confluence and Delta
Several actions would be completed by Reclamation before and during the release of WY 2010 Interim Flows for diversion in the Delta, in addition to those identified previously for the release of WY 2010 Interim Flows for diversion at the Mendota Pool and the wildlife refuges. Actions that would be completed include the following:

1. Establish maximum possible flows for Mariposa Bypass and Reaches 4B2 and 5 based on nondamaging channel capacity, Mendota Dam operating conditions, and water supply demand

2. Complete BNLL preflow release surveys in the Mariposa Bypass, as described in Section 2.2.3

3. Reduce flows or redirect flows, if necessary, to avoid take of Federally listed or State-listed species, as described in Section 2.2.3

State Actions to Be Completed for Release of WY 2010 Interim Flows to the San Joaquin River Downstream from the Merced River Confluence and Delta
Several actions would be implemented by DWR, or other State organizations identified in Section 1.4.2, before and during the release of WY 2010 Interim Flows for diversion at the East Bear Creek Unit, in addition to those identified previously for the release of WY 2010 Interim Flows for diversion at the Mendota Pool and the wildlife refuges. Additional actions that would be completed include the following:

1. Close flap gates within Mariposa Bypass before release of WY 2010 Interim Flows through this reach, as needed

2. Operate the Eastside and Mariposa bypass bifurcation structures to route WY 2010 Interim Flows to the Mariposa Bypass

2.2.3 Additional Implementation Considerations

Additional implementation considerations, such as potential environmental, regulatory, or legal issues, could further limit the release of WY 2010 Interim Flows, as identified previously in Section 2.2.2, and summarized below.

Implementation Coordination

Implementing the WY 2010 Interim Flows would require coordination with Federal, State, and/or local agencies, as well as landowners, for the release and conveyance of flows through some reaches of the San Joaquin River and bypass system, and/or the potential diversion of flows. WY 2010 Interim Flows would be constrained by any agreements in place at the time of release. Reclamation has initiated discussions with numerous entities that would be involved, through coordination, in implementing the Proposed Action. Anticipated coordination, to be accomplished as part of the Proposed Action, includes the following:

- **Central California Irrigation District –** As described above, CCID operates and maintains Mendota Dam. As part of normal operations, CCID generally dewaters the Mendota Pool approximately once every other year between November 25 and January 15 (RMC 2003) to conduct California Division of Safety of Dams inspections. The Mendota Pool is scheduled to be dewatered from November 26, 2009 through the end of the year. This period coincides with no release of flows under the Proposed Action. Reclamation will coordinate with CCID regarding this dewatering to the extent necessary; however, the dewatering is not expected to be affected by or affect the Proposed Action. Reclamation would also coordinate with CCID, as necessary, to route WY 2010 Interim Flows over Mendota Dam in addition to routine coordination for the delivery of water supplies to the Mendota Pool to satisfy the exchange contracts.

- **San Luis & Delta-Mendota Water Authority –** SLDMWA operates and maintains the Mendota Pool. Reclamation would coordinate with SLDMWA, as necessary, to route WY 2010 Interim Flows through the Mendota Pool in addition to routine coordination for delivery of water supplies to the Mendota Pool to satisfy the exchange contracts.

- **San Luis Canal Company –** The San Luis Canal Company (SLCC) owns and operates Sack Dam at the end of Reach 3. Sack Dam is a 5-foot-high concrete and wood diversion structure delivering water to the Arroyo Canal on the west side of the San Joaquin River. Under typical baseflow conditions, all water reaching Sack Dam is diverted to the Arroyo Canal. Flows greater than those required for diversion, including flood flows, spill over Sack Dam into the San Joaquin River. Reclamation would coordinate with SLCC, as necessary, to route WY 2010 Interim Flows over Sack Dam.

- **Lower San Joaquin Levee District –** The Lower San Joaquin Levee District is required to operate, inspect, and maintain flood control facilities including levees, channels, flap gates, and bifurcation structures associated with the Lower San Joaquin River Flood Control Project. In response to implementing the Proposed Action, the Lower San Joaquin Levee District may be required to undertake routine O&M activities, including patrolling levees to assess conditions, maintaining channels, closing flap gates, and operating the Chowchilla, Eastside, and Mariposa bypass bifurcation structures. Reclamation is in the process of developing and intends to execute the agreement regarding potential changes in O&M as a result of the Proposed Action.

- **U.S. Army Corps of Engineers –** Reclamation is currently coordinating with the U.S. Army Corps of Engineers (USACE) for the release of WY 2010 Interim Flows from Friant Dam.

- **Central Valley Flood Protection Board –** Reclamation will coordinate with the Central Valley Flood Protection Board, if necessary, for the conveyance of WY 2010 Interim Flows through the Eastside Bypass.

- **Landowners in the Eastside and Mariposa Bypasses –** Currently, the State holds flood flowage easements on lands within portions of the Eastside Bypass and all of the Mariposa Bypass. Reclamation is currently identifying lands that may be subject to agreements with Eastside Bypass landowners to allow conveyance of WY 2010 Interim Flows. WY 2010 Interim Flows would not be released until any such necessary agreements are in place.

Reclamation would coordinate with CCID, SLCC, and the Lower San Joaquin Levee District during implementation of WY 2010 Interim Flows. When WY 2010 Interim Flows are or are anticipated to be flowing into Mendota Pool, Reclamation would communicate with CCID as the owner/operator of Mendota Dam at least once daily via telephone, e-mail, or other written communication. This daily communication would identify, for the following 24 hours: (1) how much water is expected as inflow into the Mendota Pool for the purposes of the Interim Flows; (2) how much water is to be exchanged to satisfy the Exchange Contract at Mendota Pool; and (3) how much water is to be released below Mendota Dam for the WY 2010 Interim Flows. Reclamation would communicate with SLCC as the owner/operator of Sack Dam at least once daily via telephone, e-mail, or other written communication when WY 2010 Interim Flows are being released from Mendota Dam. This daily communication would identify, for the following 24 hours: (1) how much water is expected as inflow into Reach 3 below Mendota Pool for the purposes of the Interim Flows; (2) how much water is to be exchanged to satisfy water delivery contracts at the Arroyo Canal; and (3) how much water is to be released below Sack Dam for the Interim Flows. Reclamation would communicate with the Lower San Joaquin Levee District as necessary to facilitate the Lower San Joaquin Levee District in performing O&M activities during implementation of WY 2010 Interim Flows.

Special-Status Species

The presence of certain special-status species in the study area may determine specific quantities and routing of instream flows, as discussed below.

Blunt-Nosed Leopard Lizard Preflow Release Surveys. In the absence of avoidance measures, BNLL could be adversely affected in the Eastside and Mariposa bypasses. Because BNLL is a fully protected species under the California Fish and Game Code (F&GC 5050 et seq.), DFG cannot authorize any type of take of BNLL. Reclamation, in coordination with USFWS and DFG, is determining the presence of BNLL based on the results of preflow release surveys of the Eastside and Mariposa bypasses conducted by qualified biologists, in accordance with USFWS and DFG survey methodologies for BNLL developed specific to the SJRRP. Surveys were conducted for 12 days during the adult optimal survey period (April 15 to July 15, 2009). In addition, surveys were conducted for 5 days during the hatchling optimal survey period (August 1 to September 15, 2009).

Survey results did not document the presence of BNLL in areas that would likely be inundated by WY 2010 Interim Flows. Survey results are being reviewed to identify the potential presence of suitable BNLL habitat that was not surveyed. If the survey results suggest that areas not surveyed in the Eastside Bypass may contain suitable habitat for BNLL that would likely be inundated by WY 2010 Interim Flows, then WY 2010 Interim Flows would not be released into the bypass. DFG has indicated that no mitigation is available for this fully protected species. No measures to avoid take of BNLL have been identified beyond withholding flows from reaches with identified habitat. Based on information gathered during BNLL surveys, avoidance measures would be identified as needed. If these avoidance measures are agreed on during consultation with USFWS and DFG, and implemented to fully avoid take of BNLL, WY 2010 Interim Flows could still be routed through areas with known BNLL habitat. If the survey results reveal presence of BNLL habitat, and no avoidance measures can be identified, agreed on, or implemented, WY 2010 Interim Flows would be reduced to not inundate these areas.

Vernal Pool, Delta Button-Celery, and Alkali Sink Avoidance in Eastside and Mariposa Bypasses. The release of WY 2010 Interim Flows into the Eastside and/or Mariposa bypasses would depend on the ability to determine that flows would remain within the existing low-flow channel in the bypasses or otherwise would avoid inundating vernal pools, floodplain habitat occupied by Delta button-celery, or alkali sink habitat potentially suitable for palmate-bracted bird's-beak. Seepage and vegetation monitoring surveys during WY 2010 Interim Flow releases would be used to determine whether Interim Flows need to be reduced to avoid impacts to these species' habitats.

Fish Species. Ongoing consultations on Delta fish species with USFWS, NMFS, and DFG are occurring to comply with the Federal ESA; consultation is required to implement the Proposed Action. The maximum downstream extent of WY 2010 Interim Flows that could be recaptured would be at the Jones and Banks pumping plants. Recapture of WY 2010 Interim Flows at the Jones and Banks pumping plants would be subject to existing or future regulatory requirements and would comply with existing or future long-term operations BOs. Reclamation will implement a program to monitor water temperatures on the Merced River near the San Joaquin River confluence, on the San Joaquin River south of the Merced River confluence, and on the San Joaquin River north of the Merced River confluence. Reclamation would coordinate with NMFS on a weekly basis when WY 2010 Interim Flows reach the Merced River confluence. If WY 2010 Interim Flows have potential to result in substantially negative effects to temperatures in the Merced River or in the San Joaquin River north of the Merced River confluence, Reclamation would reduce WY 2010 Interim Flow releases from Friant Dam or otherwise recapture the flows before they reach the Merced River confluence.

Reclamation will coordinate with NMFS to ensure that potential adverse effects on listed species will be minimized. This will be accomplished by providing and discussing weekly streamflow and water quality data summaries. During periods when WY 2010

Interim Flows pass the confluence of the Merced River, specific streamflow and water quality measurements that will be reviewed will include dissolved oxygen, water temperature, pH, turbidity, streamflow, and specific conductivity at locations on the San Joaquin River just upstream and downstream from the confluence with the Merced River and in the Merced River. Additional constituents available every 2 to 4 weeks including selenium, ammonia, and boron will be reviewed when available. Sources of these data are identified in the Draft Monitoring Plan for Physical Parameters Technical Memorandum (TM) (SJRRP 2008a), Surface Water Ambient Monitoring Program (SWAMP) as described in Section 3, and the Grassland Bypass Project as described in Section 3. In the event that WY 2010 Interim Flows cause impacts that are greater than anticipated in the Biological Assessment (BA) and in consultation with NMFS, Reclamation will work with NMFS to modify WY 2010 Interim Flow releases as needed. Possible modifications include reducing flow releases, upstream diversions of flows to avoid downstream impacts, or constraining flows to the upper San Joaquin River (upstream of the confluence with the Merced River). This weekly coordination with NMFS and Reclamation's commitment to modify flows based on real time conditions would ensure that the impacts of the WY 2010 Interim Flows would remain at levels that may affect but not likely adversely affect listed species.

2.2.4 Environmental Commitments

Environmental commitments provided below outline planning and programs that would be conducted in coordination with WY 2010 Interim Flows implementation to avoid any potentially adverse environmental consequences.

Vehicular Traffic Detour Plan

Convenient and parallel vehicular traffic detours would be provided for public routes that would be closed because of inundation by WY 2010 Interim Flows (including Dan McNamara Road in Eastside Bypass Reach 2). A detour plan would be prepared and implemented in accordance with current California Department of Transportation Standard Plans and Specifications. The detour plan would be prepared and implemented before roadway inundation. If the detour plan identifies substantial increases in miles travelled on unpaved roads as compared to the original route, the plan would identify measures to comply with all applicable SJVAPCD regulations regarding unpaved roadways.

Recreation Outreach Program

A recreation outreach program would be conducted before and during implementation of the Proposed Action, beginning in summer 2009 and extending through the WY 2010 Interim Flows period, ending in September 2010. The purpose of the recreation outreach program would be to inform recreating public, as well as agencies and organizations that serve the recreating public, of changes in river flows that would occur as a result of the Proposed Action, and of the potential effects associated with those changes, including recreational boating, swimming/wading, and fishing hazards. Signage to advise boaters of hazardous conditions and alternative locations for boating would comply with waterway marker requirements contained in Title 14 of the California Code of Regulations, Sections 7000 through 7007, under the authority of the California Department of Boating and Waterways (DBW). The program would also inform the public of similar alternative river boating and fishing opportunities in the area, such as those available on the lower Kings River below Pine Flat Lake and alternative swimming/wading opportunities, such as those available at Millerton Lake.

The outreach program would employ a variety of methods and media to share information with the recreating public, such as messages posted on the SJRRP Web site and Web sites of agencies and organizations providing recreation access, facilities, and services in Reach 1; signage at public and private access points and facilities in Reach 1; and verbal messages delivered as part of regular recreation programs offered by agencies and organizations, such as the Public Canoe Program conducted by the San Joaquin River Parkway and Conservation Trust. Additional means of disseminating information as part of the outreach program would include the attendance of a SJRRP representative at selected public events focused on San Joaquin River recreation, or the display and distribution of printed materials at such events.

Outreach would target both English-speaking and non-English-speaking residents. Additional measures, such as roving contacts and other methods that agencies may suggest, could be used to target audiences that may not be reached by other means, such as young adults and those recreating on the river in undeveloped areas.

Central to the outreach program would be coordination with agencies and organizations that provide recreation access, facilities, and services in Reach 1, where most recreation in the Restoration Area takes place. Specifically, this would include coordinating with the following public and nonprofit agencies and organizations: the San Joaquin River Parkway and Conservation Trust; San Joaquin River Conservancy; Fresno County; City of Fresno Parks, After School, Recreation and Community Services (PARCS) Department (City of Fresno 2008); and DFG. Coordination would also include private entities that provide public recreation access and facilities at a few locations in Reach 1.

Reclamation would also coordinate outreach that would extend to emergency response and law enforcement agencies to help continue protection of public safety in response to new hazards and new recreation use patterns that could result from the Proposed Action.

2.2.5 Water Year 2010 Interim Flows Seepage Monitoring and Management Plan

The Act (see Appendix B) requires that a seepage monitoring program be prepared before releasing Interim Flows. The Seepage Monitoring and Management Plan (Appendix D) describes the monitoring and management guidelines included in the Proposed Action, as related to groundwater or levee seepage. Some portions of the Restoration Area have historically experienced groundwater seepage to adjacent lands associated with elevated flows. Groundwater seepage has the potential to cause waterlogging of crops and salt mobilization in the crop root zone. Similarly, some portions of the Restoration Area have experienced levee instability resulting from through-levee and under-levee seepage during periods of elevated flows. The Seepage Monitoring and Management Plan (Appendix D) includes flow monitoring, groundwater elevation monitoring, levee patrols, and landowner contact. The frequency of evaluation of monitoring information would be increased when releases from Friant Dam would be expected to result in WY 2010

Interim Flows of 475 cfs or greater in Reaches 2B and 3, consistent with reported seepage potential in these reaches (as previously described).

Since 2007, Reclamation has actively pursued agreements to access private lands for site-specific data collection on geologic conditions related to seepage and other physical parameters. However, landowners have actively denied access to their property for this purpose. A summary of coordination efforts regarding land access for data collection is provided in Appendix J. As part of the SJRRP, monitoring wells are being permitted and installed on public lands at several transects along the San Joaquin River in the Restoration Area to identify groundwater level responses to river flows. Reclamation and DWR would monitor groundwater levels in installed wells. Groundwater levels observed in these and other wells monitored by Reclamation, DWR, and local districts would be used in determining when to reduce flow releases from Friant Dam, as required by the Act. Following installation of each monitoring well, groundwater elevations thresholds would be developed in consideration of nearby land uses, known groundwater and subsurface conditions, and other information available or provided by landowners.

In general, groundwater depth thresholds would be classified in three ranges, as illustrated in Figure 2-17. These include an acceptable level at which groundwater levels are not expected to affect agricultural production; a potential buffer zone indicating an increased likelihood that seepage could affect agricultural production without flow modification; and a threat zone representing groundwater levels that affect agricultural production. The threat zone would be determined based in part on the rooting depth associated with any crops located near the monitoring well. Maximum rooting depths of crops commonly found in the Restoration Area are shown in Table 2-8. The Proposed Action includes flow reductions in response to groundwater levels observed in the buffer or threat zones. If groundwater levels at a monitoring well exceed an identified threshold, WY 2010 Interim Flows would be reduced or diverted.

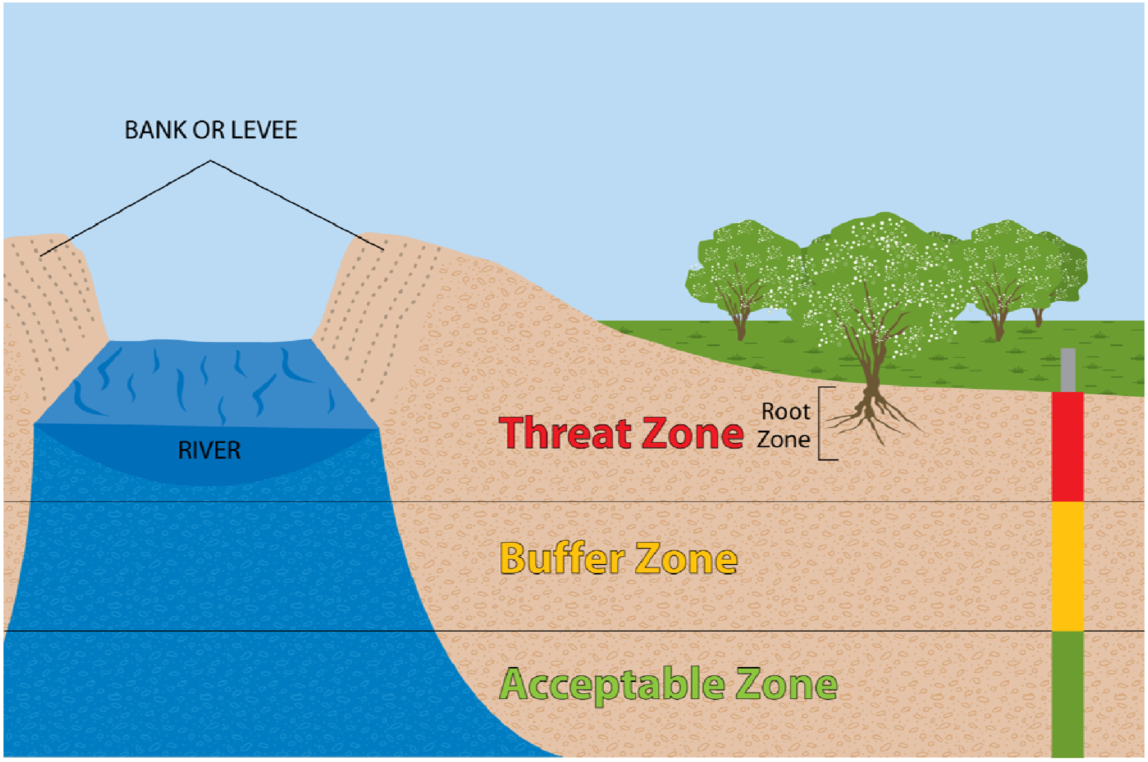


Figure 2-17.
Potential Groundwater Seepage Threshold Zones

Table 2-8.
Maximum Rooting Depth of Crops Commonly Found in the Restoration Area

Crop	Maximum Root Depth (feet)
Alfalfa[1]	6
Almonds[1]	6-9
Grape[2]	3-6
Pistachio[2]	3-5
Tomato[1]	5-6
Melon[1]	5-6
Cotton[1]	5-6

Notes:
[1] Westlands Water District 2009
[2] Allen et al. 1998

Other potential thresholds that would be used to identify the need for action include the following:

- Surface water stage corresponding to known or observed levee stability problems and lateral seepage
- Visual observation of boils or piping
- Landowner communication of observed seepage problems

Outreach to landowners adjacent to the San Joaquin River would be conducted to assist in identifying potential adverse effects to third parties from groundwater seepage. Landowners would be able to report observed conditions through the SJRRP Web site or through a toll-free number. If groundwater levels at a monitoring well exceed an established threshold, WY 2010 Interim Flows would be reduced or diverted. Flow Monitoring

The Act (see Appendix B) requires that a flow monitoring program be prepared before releasing Interim Flows. The Flow Monitoring and Management Plan (Appendix E) describes management objectives for WY 2010 Interim Flows, methods for measuring WY 2010 Interim Flows, conditions indicating that management objectives have been attained, and potential actions that could be taken to address nonattainment of the WY 2010 Interim Flow objectives. The Flow Monitoring and Management Plan will include measurement of streamflows at seven locations within the Restoration Area, including the following:

- Below Friant Dam
- At Gravelly Ford
- Below Chowchilla Bypass Bifurcation Structure
- Below Sack Dam
- At the head of Reach 4B1
- Above the Merced River confluence
- At the head of the Sand Slough Bypass

2.2.6 Water Quality Monitoring

For the duration of the Water Year 2010 Interim Flow releases, Reclamation would monitor water quality at the following locations:

- below Friant Dam (river mile 267)
- Gravelly Ford (river mile 228)
- below Chowchilla Bifurcation (river mile 216)
- below Sack Dam (river mile 182)
- top of Reach 4B (river mile 172)
- Hills Ferry above the Merced River confluence (river mile 118)

Water quality monitoring would begin at least one week before WY 2010 Interim Flows reach the respective monitoring station to capture baseline data. Reclamation would measure the following constituents at the above locations with in-situ sondes: pH, temperature, electrical conductivity, turbidity, chlorophyll, and dissolved oxygen. Continuous measurements would be taken and preliminary data would be posted on a publically-available website on at least a weekly basis.

Reclamation would implement a sediment and water quality monitoring program to monitor for transport of constituents of concern that are not addressed above. For this effort, Reclamation would collect samples of bed sediment at the following locations: below Friant Dam; at Highway 99; at Gravelly Ford; and in the Mendota Pool. A sample would be collected at least one week before WY 2010 Interim Flows reach the respective monitoring station to capture baseline data. Approximately one week after WY 2010 Interim Flows reach the respective monitoring station, a water sample would be collected. This initial monitoring would be conducted at the beginning of the fall 2009 flow period and the spring 2010 flow period. Samples would analyzed for organic and inorganic water quality parameters.

By February 1, 2010, Reclamation would complete and submit a Water Quality Monitoring and Quality Assurance Plan (Plan) for the overall Interim Flows Program (for flows through December 31, 2013). The Plan would describe the water quality monitoring activities proposed during the Interim Flow period and a method to ensure quality of the data collected. The Plan would be prepared with input from the Program's Implementing Agencies (USFWS, NMFS, CDFG, and DWR) and with input from the Central Valley Regional Water Quality Control Board.

2.2.7 Hills Ferry Barrier

The current Hills Ferry Barrier is a type of resistance weir commonly used to exclude and/or trap anadromous fish in rivers. This barrier consists of panels aligned perpendicular to the flow of the river with evenly spaced pipes that allow water, small fish, and particles to pass but prevent larger fish such as adult Chinook salmon from passing upstream. Operated by DFG since 1992, the Hills Ferry Barrier is typically installed on the San Joaquin River in mid-September and operated until it is removed in early December. DFG currently operates the Hills Ferry Barrier near the town of Newman, approximately 300 feet upstream from the confluence with the Merced River (in Reach 5).

The barrier's main purpose is to redirect upstream-migrating adult fall-run Chinook salmon into suitable spawning habitat in the Merced River and prevent migration into the mainstem San Joaquin River upstream, where conditions are currently considered unsuitable for Chinook salmon and Central Valley steelhead. The adult Central Valley steelhead migration period overlaps with fall-run Chinook salmon, and typically occurs between October and December in the San Joaquin River basin. Because they have a body type similar to salmon, Central Valley steelhead would be expected to be redirected by the barrier in a similarly effective manner. Maintenance of the Hills Ferry Barrier would continue for the purpose of redirecting Chinook salmon and, incidentally, Central Valley steelhead during the fall WY 2010 Interim Flows period.

NMFS permits the take of Federally listed threatened species for rescue and salvage by various State and nongovernmental agencies through the ESA Section 10a(1)A and 4(d) rules. In the unlikely event that ESA-listed anadromous fish, including Central Valley steelhead, stray into San Joaquin River reaches above the Merced River, these fish could be salvaged under these authorities. Additionally, DFG applies annually for an ESA Section 4(d) research permit and accompanying take limit for Central Valley steelhead from NMFS for operation of the barrier. In 2008, DFG was allowed to take up to five Central Valley steelhead. DFG was issued a permit for 2009 (expires on December 31, 2009) with a take limit of 10 Central Valley steelhead. In addition, the 2009 permit authorizes the taking of fin clippings. If Central Valley steelhead are encountered at or above the Hills Ferry Barrier during fall WY 2010 Interim Flows, the Central Valley steelhead would be released downstream in suitable reaches, as required by the permit.

It is not anticipated that WY 2010 Interim Flows will affect the migratory behavior of steelhead. Historic streamflow conditions upstream from the Merced River confluence during the spring averaged 119 cfs to 13,050 cfs, with peak flows reaching 59,000 cfs in 1997 under flood conditions, when flood flows were released from Friant Dam. During nonflood conditions in WY 2010, Interim Flows could increase flows by an average of up to 220 cfs at this location beginning on February 1, 2010. The average annual flows under the Proposed Action are within 7 percent of the average flow expected at this time and location under existing conditions. This small increase is not anticipated to trigger any change to Central Valley steelhead migration patterns in the San Joaquin River basin. Also, WY 2010 Interim Flows would not be released if natural flows approach channel capacity. The Proposed Action includes preparation of a monitoring plan before February 1, 2010, to describe how the presence of Central Valley steelhead in the Restoration Area would be identified during spring WY 2010 Interim Flows. If steelhead are encountered in the Restoration Area, NMFS will be notified immediately. In addition, steelhead straying upstream from Hills Ferry Barrier as a result of implementing the Proposed Action would be recovered and returned downstream in an appropriate location designated by DFG and/or NMFS.

2.3 Other Alternatives

No other feasible or practicable alternatives are available to meet the project purpose and need, and objectives. To meet the Settlement requirements, Interim Flows must be released under a specific schedule to the extent feasible. The Proposed Action is the only action alternative that is available to meet the project purpose and need, and objectives.

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3.0 Affected Environment

This section provides an overview of the physical environment and existing conditions that could be affected by the Proposed Action consistent with NEPA and CEQA guidelines. The magnitude of potential effects of the No-Action Alternative and Proposed Action, and whether the resulting effects are potentially significant, influences the level of specificity at which each resource is addressed in this section. The baseline environmental conditions assumed in this EA/IS consist of the existing physical environment as of October 2008, when the environmental process and analysis for the EA/IS was initiated. Even though this section is titled “Affected Environment” for the purposes of NEPA, it also constitutes the “Environmental Setting” required under CEQA.

3.1 Considerations for Describing the Affected Environment

The study area is broadly defined to evaluate potential environmental effects of the Proposed Action. The areas where effects may occur differ according to resource area; therefore, the geographic areas described vary by resource. Within the affected environment description for each resource, subsections are organized geographically by up to five subareas, as appropriate: the San Joaquin River upstream from Friant Dam; the San Joaquin River from Friant Dam to the confluence with the Merced River (Restoration Area), including bypasses and tributaries; the San Joaquin River downstream from the confluence with the Merced River to the Delta; the Delta; and CVP/SWP water service areas. The affected environment descriptions do not address geographic subareas in which a resource would not be affected.

Information is provided in the affected environment subsections to the extent necessary for understanding the extent of anticipated impacts, in particular any anticipated impacts that may be significant. Consequently, more detailed information is provided for resources that have greater potential for significant effects, such as hydrology/water quality and biological resources; less information is provided for other resource areas.

Information used to develop the affected environment sections included published environmental and planning documents, books, journals, articles, Web sites, field surveys, and communications with technical experts and agencies. Information developed from the Settlement or in the planning stages of the SJRRP was also used extensively.

3.1.1 NEPA Requirements

CEQ regulations for implementing NEPA specify that environmental documents must succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than necessary to understand the effects of the alternatives. Data and analyses must be commensurate with the importance of an impact, with less important material summarized, consolidated, or simply referenced (40 CFR 1502.15).

3.1.2 CEQA Requirements

Section 15125(a) of the Guidelines for Implementing CEQA states that an environmental document must include a description of the physical environment conditions in the vicinity of a project, as they exist at the time that the Notice of Preparation (NOP) is published, or if no NOP is published, at the time the environmental analysis commences, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which the lead agency determines whether an impact is significant.

3.2 Aesthetics

The existing visual environment in the SJRRP study area is described in this section in terms of landform (topographic relief) and land cover (vegetation, water, or built environment). The overall visual quality of the study area was assessed qualitatively. The visual quality of the study area landscapes is described as "high," "moderate," or "low," using the following qualitative terms:

- **Vividness** describes the presence of distinctive landscape features, such as topographic relief, geologic formations, color, or patterns that combine to form a striking or memorable visual pattern.

- **Intactness** describes the integrity of a landscape and the degree to which it is free from incongruous or out-of-place features that detract from the visual pattern.

- **Unity** describes the appearance of the landscape as a whole and the degree to which the visual elements maintain a coherent visual pattern.

Visual resources are described below for the San Joaquin River upstream from Friant Dam; the Restoration Area; and the San Joaquin River from Merced River to the Delta. There would be no project-related effects on aesthetic resources in the Delta and CVP/SWP water service areas; therefore, these geographic subareas are not discussed below.

3.2.1 San Joaquin River System Upstream from Friant Dam

The regional landform upstream from Friant Dam is characterized by relatively steep slopes and ravines, transitioning to rolling foothill terrain in the lower elevations. In the 9-mile reach of the San Joaquin River between Kerckhoff Dam and Millerton Lake, several small, ephemeral streams enter the San Joaquin River. San Joaquin River flow is diverted at Kerckhoff Dam through tunnels to the Pacific Gas and Electric Company (PG&E) Kerckhoff and Kerckhoff No. 2 powerhouses, situated on the San Joaquin River upstream from Millerton Lake.

Predominant land cover in this portion of the study area ranges from high alpine vegetation near the crest of the Sierra Nevada, through coniferous forest, mixed coniferous forest, oak woodlands and oak savannah, and grasslands in the lower elevations in the vicinity of Millerton Lake. Surface water is present in artificial impoundments, such as Millerton Lake; small natural lakes and ponds; rivers; and tributary streams. The built environment consists of roadways, small communities with low-density development, roadside businesses, diversion dams, powerhouses and associated high-voltage electrical transmission lines, and recreational facilities of the Millerton Lake State Recreation Area (SRA).

The scenic qualities of vividness, intactness, and unity in the upper reaches of the San Joaquin River watershed are generally high, especially in areas where there is limited built environment to intrude on views. The varied topography and geologic formations of the crest of the Sierra Nevada provide for striking views in the upper watershed. In the lower elevations, nearer to Millerton Lake, the human-built environment becomes more dominant and detracts from views of the natural landscape. No officially designated State scenic highways are located in or immediately adjacent to the Restoration Area.

Land cover surrounding Millerton Lake consists of grassland with scattered oak trees. The vividness of views of the lake surrounded by low-lying hills is moderate because of the increasing presence of the built environment. Millerton Lake typically fills during late spring and early summer, when San Joaquin River flows are high because of snowmelt in the upper watershed. During late winter and spring, surrounding hillsides are green and often covered with wildflowers, creating views with moderate to high vividness. Annual water allocations and release schedules typically result in drawing reservoir storage to near minimum levels by the end of September. The intactness of the views is moderate because this drawdown of the water level creates a “bathtub ring” effect that degrades the views of the lake by exposing barren shoreline during late summer and fall. Unity of the views of the lake is moderate because the degraded shoreline and recreational facilities create a sharp contrast to the surrounding natural landscape. The overall visual quality of the Millerton Lake area is moderate.

3.2.2 San Joaquin River from Friant Dam to Merced River

Visual resources of the Restoration Area are described in the following sections.

Reach 1

Observers in or adjacent to the river in Reach 1 would see a river channel and adjacent vegetated banks and bluffs with views having moderate vividness; however, the concrete structures of Friant Dam and associated diversion structures and canals, buildings, parking lots, and a fish hatchery visible above the river at the upper end of Reach 1A detract from the views. Downstream from Friant Dam, views are of naturally vegetated open space interspersed with golf courses, instream and offstream gravel operations, orchards, and row crops. Intactness of the views ranges from low in areas of gravel mining operations to moderate in areas where the riparian corridor and adjacent lands are relatively undisturbed. Unity of the views ranges from low in areas where adjacent land uses produce sharp visual contrasts (disturbed lands adjacent to natural areas) to moderate where land use types have softer edges (riparian corridor adjacent to natural or park lands). The overall visual quality in Reach 1A is low to moderate.

Observers adjacent to the river in Reach 1B would experience views with low vividness because of the lack of distinctive landscape features and the disturbed riparian corridor. Intactness of the views is somewhat degraded by the limited riparian vegetation coverage, disturbance resulting from gravel mining operations, and the contrasting managed agricultural landscape; intactness is low to moderate. Overall unity is low to moderate. The overall visual quality in Reach 1B is low.

The *San Joaquin River Parkway Plan* is a conceptual, long-range planning document intended to help preserve, enhance, and provide for enjoyment of the natural landscape of the San Joaquin River corridor (San Joaquin River Conservancy 2000). The San Joaquin River and land on both sides of the river in Reach 1 of the Restoration Area are included in the proposed parkway area.

Reach 2

The topography in Reach 2 is characterized by a sandy, meandering channel. Observers adjacent to the river in Reach 2 would experience views with low vividness because this reach lacks distinctive landscape features, including the Mendota Pool, which is sparsely vegetated. Features of the Mendota Pool include several pumps and canals to divert flows for meeting demands. Other features of this reach include the San Mateo Road crossing and the Chowchilla Bypass Bifurcation Structure, which is a major intrusive element. Therefore, intactness of this reach is considered low to moderate. Unity is low to moderate also because of intrusion of artificial structures and the contrast between the managed agricultural landscape and the meandering, sparsely vegetated stream channel in this reach. The overall visual quality in this reach is low.

Reach 3

The topography in Reach 3 is characterized by a sandy, meandering channel. This reach conveys perennial flows of Delta water released from the Mendota Pool to Sack Dam, where flows are diverted to the Arroyo Canal. The channel meanders approximately 23 miles through a predominantly agricultural area except where the City of Firebaugh borders the river's west bank for 3 miles. One bridge crosses the river in this reach. A narrow, nearly continuous band of riparian vegetation consisting primarily of cottonwood riparian forest is present on at least one side of the channel, and several pump facilities and Arroyo Canal occur along this reach.

Observers adjacent to the river in Reach 3 would experience views with low vividness because of a lack of distinctive landscape features. Intactness of the views is low to moderate because of the presence of dams, diversion structures, and urban development, which intrude on views of the river corridor and adjacent agricultural landscape. Overall, the unity of the views is low in the vicinity of the diversion structures and moderate where the distinctive riparian corridor meanders through the more managed agricultural landscape. The overall visual quality in this reach is moderate.

Reach 4

Observers adjacent to the river in Reach 4A would experience views with low vividness because of the lack of distinctive landscape features. Intactness of the views in this reach is low because of the presence of intruding artificial structures and the degraded condition of the riparian corridor. Unity is low because of the sharp contrast between the degraded riparian area and the adjacent managed agricultural landscape. The overall visual quality in this reach is low.

Observers adjacent to the river in Reach 4B1 would experience views with low vividness because of the lack of distinctive landscape features. Intactness of the views is generally low because of the degraded condition of the riparian area. Unity is low because of the sharp contrast between the vegetation-choked river channel and wildlife refuge landscape on one side of the river and the managed agricultural landscape on the opposite side of the river. The overall visual quality in this subreach is low.

Observers adjacent to the river in Reach 4B2 would experience views with moderate vividness because of the wider floodplain with surrounding natural vegetation, and intactness is moderate because of the limited number of artificial structures that intrude on the views. Unity is moderate also because of the wider riparian corridor and adjacent areas of natural habitat. The overall visual quality in this subreach is moderate.

Reach 5

Observers adjacent to the river in Reach 5 would experience views with moderate vividness because of the views of the wider floodplain, with the meandering riparian corridors and expanses of surrounding naturally vegetated uplands. Intactness of the views is moderate because of the uninterrupted expanses of natural habitat and the limited number of artificial structures that intrude on the views. Unity of the views is moderate because the natural features of the landscape lack abrupt contrasts or changes. The overall visual quality in this reach is moderate.

Chowchilla Bypass and Tributaries

Observers in or adjacent to the bypass would experience views with low vividness because of the flat terrain and sparse vegetation, which are lacking in distinctive landscape features. The bifurcation structure, levees, and barren ground detract from the intactness of the views. Unity is low because the disparate landscape features do not form a coherent visual pattern. The overall visual quality of the bypass area is low. Visual qualities of the tributaries are similar to those of the bypass, with low vividness, low intactness, and low unity. Overall, visual qualities along these tributaries are low.

Eastside Bypass, Mariposa Bypass, and Tributaries

Observers in or adjacent to the Eastside and Mariposa bypasses would experience views with low vividness because of flat terrain and sparse vegetation lacking in distinctive landscape features. The intactness of the views is moderate because of the limited number of artificial structures that intrude on the views. Unity is low because the disparate landscape features do not form a coherent visual pattern. The overall visual quality of the bypass area is low. Visual qualities of the Eastside Bypass tributaries, including Deadman, Owens, and Bear creeks, are similar to those of the bypass, with low vividness, low intactness, and low unity. Overall, visual qualities along these tributaries are low.

3.2.3 San Joaquin River from Merced River to the Delta

Observers adjacent to the San Joaquin River in this portion of the study area would experience views with moderate vividness because of the wider floodplain with its meandering riparian corridors. Intactness of the views is moderate because of the limited number of artificial structures that intrude on the views. Unity of the views is moderate because the natural features of the landscape lack abrupt contrasts or changes. The overall visual quality in this reach is moderate. No officially designated State scenic highways are located along the San Joaquin River downstream from its confluence with the Merced River to the Delta.

3.3 Land Use/Planning and Agricultural Resources

The following sections summarize existing land uses and agricultural resources in the study area.

3.3.1 San Joaquin River Upstream from Friant Dam

California State Parks has an operating agreement with Reclamation to manage Millerton Lake as an SRA. Recreation is the primary land use along the shorelines of Millerton Lake.

3.3.2 San Joaquin River from Friant Dam to Merced River

The following subsections describe existing land uses in the Restoration Area, as well as agricultural resources, including Williamson Act lands.

Existing Land Uses

Land uses within the Restoration Area were identified and inventoried and placed into the following broad land use categories: agricultural, open space, and urban. Most of the land along the San Joaquin River downstream from Friant Dam is privately owned. Primary land uses are open space and agriculture. The acreage of open space areas (e.g., idle land, native vegetation, and aquatic environments, including open water) is shown in Table 3-1 and described after the table. Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River. Table 3-1 shows the approximate acreages for each land use category along the San Joaquin River, by reach, and for the bypass areas.

Table 3-1.
Acreage of Land Uses Along the San Joaquin River in Restoration Area

River Reach	Land Use (acres)			
	Agricultural	Open Space	Urban	Total
Reach 1	9,436	4,480	1,916	15,832
Reach 2	6,068	3,009	96	9,173
Reach 3	6,150	1517	389	8,056
Reach 4	9,514	4901	24	14,439
Reach 5	821	4,615	26	5,460
Bypass Areas	10,235	9,341	47	19,623
Total	42,224	27,863	2,498	72,581
Percentage	58%	38%	4%	100%

Note: Acreage numbers have been rounded.

Agricultural land uses include a variety of different crop types and specific annual and permanent crops, although they are not separated for this analysis. These crops include, but are not limited to, the following examples:

- **Annual crops**, which comprise field crops (cotton, sweet corn, sugar beets, dry beans, and safflower); truck, nursery, and berry crops (lettuce, bell peppers, strawberries, melons, nursery products, eggplant, garlic, onions, asparagus, squash, broccoli, peas, and tomatoes); grain and hay crops (alfalfa, barley, wheat, oats, and other mixed grain and hay); and rice.

- **Vineyards**, which include a variety of grape types that may be used as table grapes or raisins or for wine.

- **Orchards**, which include citrus and subtropical crops (kiwifruit, lemons, nectarines, olives, and oranges), and deciduous fruit and nut crops (almonds, apples, sweet cherries, dried figs, peaches, persimmons, pistachios, plums, pomegranates, and walnuts).

- **Semiagricultural and incidental to agriculture**, which comprise apiary products, cattle, poultry, dairy, and wool. This category also includes other agriculture-related infrastructure, such as agricultural disposal areas, equipment maintenance areas, and storage areas.

Open space lands include the following categories, which are not separated:

- **Idle land** is cropland that is fallow but has been farmed within the past 3 years, or land that is being prepared for agricultural production. This also includes passive agriculture such as pasture (forage, irrigated, and range lands, and may include alfalfa, clover, and other native or mixed pasture plant species), and land which is not farmed because of proximity to the San Joaquin River floodplain.

- **Native vegetation** is composed of wetland/marsh, grassland, shrub/brush, and forest plant communities.

- **Aquatic environments** are lakes, reservoirs, rivers, and canals, and open water created by mining operations.

Urban land uses fall into a variety of categories, including residential, commercial/ industrial, and landscaped properties, such as golf courses, parks, and other uses. However, for purposes of this analysis, urban land uses were not separated. The following sections describe land use and ownership in the Restoration Area by reach. Figure 3-1 shows wildlife refuges, wildlife areas, ecological reserves, wildlife management areas, and state parks in the vicinity of the Restoration Area. There are approximately 195,260 acres of wildlife refuges, wildlife areas, ecological reserves, wildlife management areas, and parks (city, county, and State) in and adjacent to the Restoration Area: 2,175 acres in Reach 1; 85 acres in Reaches 2 and 3; 33,000 acres in Reach 4; and 160,000 acres in Reach 5. Uses in these public wildlife areas and parklands are described by reach in Section 3.14, "Recreation."

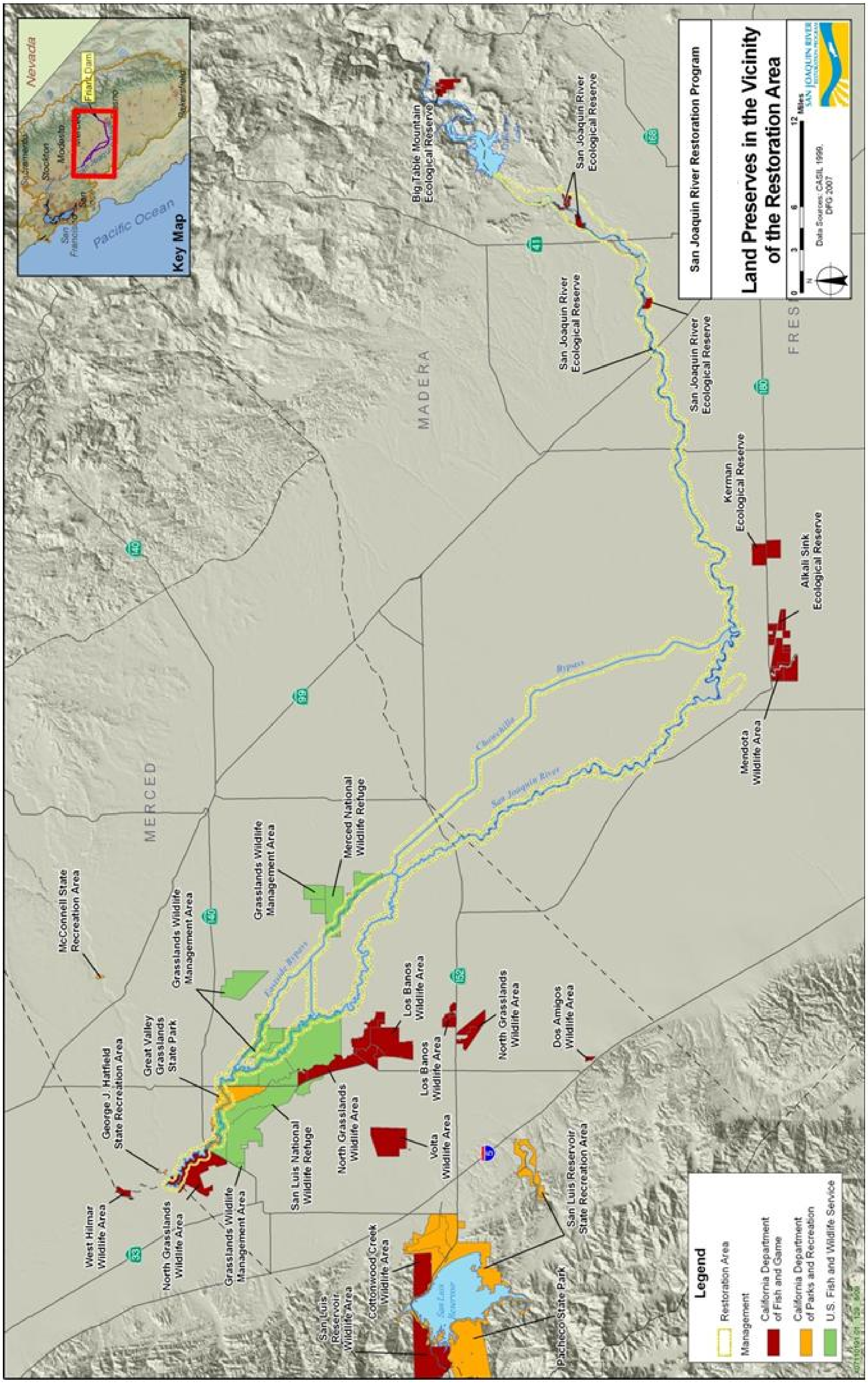


Figure 3-1.
Wildlife Refuges, Wildlife Areas, Ecological Reserves, Wildlife Management Areas, and State Parks in and adjacent to the Restoration Area

Reach 1. Reach 1 includes the City of Fresno, the town of Friant, and the unincorporated communities of Rolling Hills, Herndon, and Biola. The primary land use category of Reach 1 is agriculture (60 percent), followed by open space (28 percent) and urban land uses (12 percent). Approximately 93.8 percent of lands found in Reach 1 are privately owned.

The primary nonurban land uses along the remaining areas of Reach 1 are gravel mining, agriculture, and recreation/open space. Several active gravel quarries, and related roads and other infrastructure, are located adjacent to the river. Agricultural land uses include vineyards, annual crops, and orchards. Several recreation areas are located along Reach 1A.

Reach 2. All lands found in Reach 2 are privately owned. Similar to other reaches, the primary agricultural land uses along this reach are annual crops, vineyards, and orchards. Open space is the primary nonagricultural land use along Reach 2B, although there are no designated protected areas or recreation sites.

Reach 3. The primary land use in this reach is agriculture (76 percent). Annual crops account for most agricultural land uses in this reach. Open space is the primary nonagricultural land use, although there are no designated protected areas or recreation sites. The City of Firebaugh and associated connecting roads, located between the San Joaquin River and Helm Canal, are the only urban land uses found in Reach 3.

Reach 4. Most lands in this reach are either agricultural (66 percent) or open space (34 percent). Approximately 5 percent of land found in Reach 4 is categorized as urban. In the San Luis NWR, the Grasslands Wildlife Management Area (WMA) constitutes approximately 30 percent of the remaining wetlands in the Central Valley, a portion of which are in the Restoration Area.

Reach 5. This reach has the highest percentage of open space lands (85 percent) of the five reaches. Most of the remaining lands found in Reach 5 are categorized as agricultural (13 percent). Urban lands account for approximately 2 percent of lands in this reach. Reach 5 also has the lowest percentage of private lands (22 percent) of the five reaches. Public lands account for approximately 78 percent of lands in this reach.

There are no designated communities in this reach, and most of the lands adjacent to the San Joaquin River are considered rural and provide important open space and wildlife values to Merced County. Open space is the primary land use in this reach and is protected in the San Luis NWR, Great Valley Grasslands State Park, and George J. Hatfield SRA.

Chowchilla Bypass and Tributaries. The primary land use along the Chowchilla Bypass is agriculture; irrigated fields are located along both sides of the bypass. The bypass is also used for livestock grazing. Several roads parallel the bypass, and four roadway crossings provide access across it. Few other urban areas are located along the Chowchilla Bypass.

Eastside and Mariposa Bypasses and Tributaries. The primary land uses along the Eastside Bypass are agriculture and open space. The bypass is also used for livestock grazing. In general, irrigated crops are prevalent south of the Mariposa Bypass, whereas open space is the principal land use north of the Mariposa Bypass between the Eastside Bypass and the San Joaquin River. The Merced NWR is also located along the Eastside Bypass, south of West Sandy Mush Road between the start of the bypass and the Mariposa Bypass diversion. Several access roads parallel the Eastside Bypass south of the Mariposa Bypass, and 11 bridges provide access across the bypass. Grazing is prevalent along the Eastside and Mariposa Bypasses; exceptions are refuge-designated areas (i.e., the Lone Tree Unit of the Merced NWR).

Agricultural Resources, Including Williamson Act Lands

The State has developed processes to discourage continued conversion of agricultural land to nonagricultural uses. The use of Williamson Act contracts and Farmland Security Zones (also known as Super Williamson Act lands) enables local governments to provide private landowners with tax incentives to continue agricultural or related open space uses. Table 3-2 shows Williamson Act lands, including "Lands in Nonrenewal," which will not be continued as Williamson Act lands.

Table 3-2.
Acreage of Williamson Act Lands in the Restoration Area

River Reach	Williamson Act Lands[1] (acres)	Lands in Nonrenewal (acres)	Total (acres)
Reach 1	4,201	475	4,676
Reach 2	6,756	0	3,527
Reach 3	5,664	0	5,664
Reach 4	8,010	0	8,010
Reach 5	1,441	0	1,441
Bypasses	8,828	0	8,828
Total	34,902	475	35,377

Sources: California Department of Conservation 2004a, 2005, 2006; Madera County 2008.
Note:
[1] These acreages include Farmland Security Zone lands.

The State of California Farmland Mapping and Monitoring Program (FMMP) classifies agricultural lands. The following Important Farmland classifications are used in the FMMP (California Department of Conservation 2004b):

- **Prime Farmland** – Farmland with the best combination of physical and chemical features able to sustain long-term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the 4 years before the mapping date.

- **Farmland of Statewide Importance** – Farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the 4 years before the mapping date.

- **Unique Farmland** – Farmland of lesser quality soils used for the production of the State's leading agricultural crops. This land is usually irrigated but may include nonirrigated orchards or vineyards, as found in some climatic zones in California. Land must have been cropped at some time during the 4 years before the mapping date.

- **Farmland of Local Importance –** Land of importance to the local agricultural economy, as determined by each county's board of supervisors and a local advisory committee.

Acreages associated with the four categories of agricultural land that make up the Important Farmland classification are presented in Table 3-3.

Table 3-3.
Acreage of Agricultural Lands in the Restoration Area

River Reach	Prime Farmland	Farmland of Statewide Importance	Unique Farmland	Farmland of Local Importance
Reach 1	2,395	892	301	104
Reach 2	3,541	1,715	500	991
Reach 3	5,005	635	333	44
Reach 4	7,199	1,389	716	32
Reach 5	101	194	43	3,421
Bypasses	1,582	947	4,761	1,246
Total	19,822	5,772	6,654	2,471

Sources: California Department of Conservation 2004a, 2006

3.3.3 San Joaquin River from Merced River to the Delta

Downstream from the Restoration Area, the San Joaquin River traverses primarily agricultural land, including annual and permanent cropland. In a few locations, urban uses, including a wastewater treatment plant and small, unincorporated towns, are located adjacent to the river. Various State and county highways are located near or across the river.

3.3.4 Central Valley Project/State Water Project Water Service Areas

Discussion in this section emphasizes land uses in the CVP Friant Division because land use effects are not anticipated outside this area. Table 3-4 shows the acreages of land use by Friant Division contractor. The 28 contractors include both agricultural and municipal and industrial (M&I) contractors. Locations of the Friant Division contractors are shown in Figure 3-2.

Table 3-4.
Existing Land Uses in Friant Division

Water Users	Land Uses (acres)		
	Agricultural	Open Space	Urban
Arvin-Edison WSD	128,941	220	3,691
Chowchilla WD	85,869	0	2,250
City of Fresno Service Area[1]	85,869	0	2,250
City of Lindsay	415	0	1113
City of Orange Cove	286	0	674
Delano-Earlimart ID	56,264	0	353
Exeter ID	14,078	0	1,136
Fresno County Waterworks No. 18	251	2	0
Fresno ID[1]	187,489	64	60,336
Garfield WD	1,813	0	0
Gravelly Ford WD	8,431	0	0
International WD	724	0	0
Ivanhoe ID	10,983	0	0
Lewis Creek WD	1,297	0	0
Lindmore ID	27,483	0	214
Lindsay-Strathmore ID	15,628	0	492
Lower Tule River ID	102,159	932	185
Madera County[2]	365,436	986,084	26,014
Madera ID	123,830	1	6,882
Orange Cove ID	29,163	0	116
Porterville ID	15,842	0	1,194
Saucelito ID	19,826	0	0
Shafter-Wasco ID	36042	0	2952
Southern San Joaquin MUD	56,233	79	5,308
Stone Corral ID	6,882	0	0
Tea Pot Dome WD	3,581	0	0
Terra Bella ID	13,642	0	272
Tulare ID	69,293	0	4,220

Notes:
Table based on digitized geographic information system data. Some water user polygons overlap; therefore, acreage will be higher than actual footprint.
[1] Acreages shown for the City of Fresno Service Area and Fresno Irrigation District are inflated because more than 70,000 acres of land uses in these two service areas overlap.
[2] Land use data available for Madera County included categories not reflected in the three land use categories shown in this table. The additional acreage—from the water (6,055.25 acres), rural residential/vacant (38,952.74 acres), and not mapped (primarily the Sierra National Forest) (516,494.54 acres) categories—is included in the calculation shown for open space.
Key:
ID = irrigation district
MUD = municipal utilities district
WD = water district
WSD = water storage district

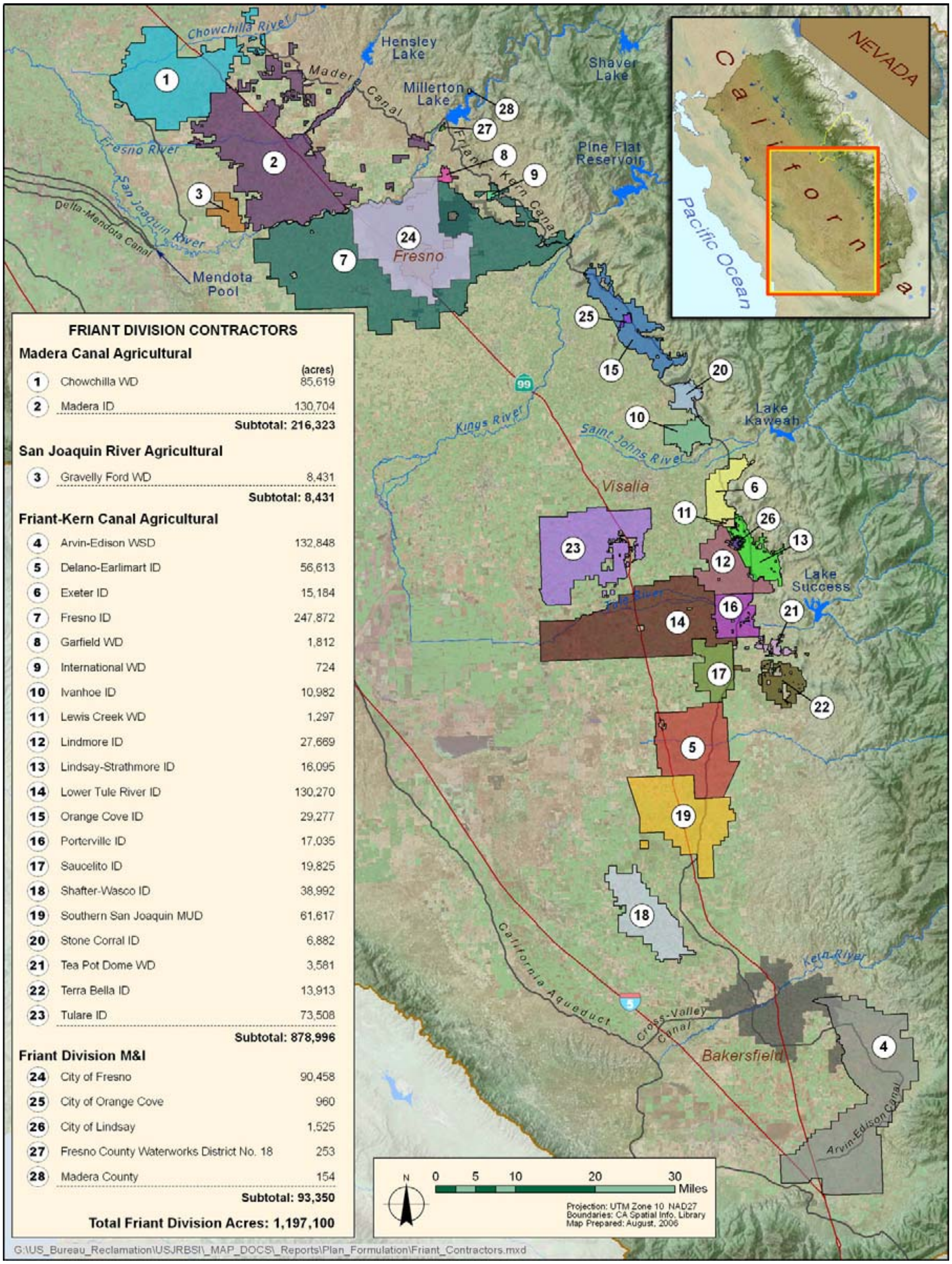


Figure 3-2.
Friant Division Long-Term Contractors

3.4 Air Quality

The study area is located in Fresno, Madera, and Merced counties, which are part of the San Joaquin Valley Air Basin (SJVAB). The SJVAB also comprises all of Kings, San Joaquin, Stanislaus, and Tulare counties and the valley portion of Kern County. Potential air quality effects from the Proposed Action (related to indirect effects associated with recreation and invasive plant treatment) are primarily focused on the study area.

Ambient concentrations of air pollutants, contaminants, and odors are determined by the amount of emissions released by sources and the atmosphere's ability to transport and dilute such emissions. Natural factors that affect transport and dilution include terrain, wind, atmospheric stability, and the presence of sunlight. Therefore, existing air quality conditions in the area are determined by such natural factors as topography, meteorology, and climate, in addition to the amount of emissions released by existing sources. The San Joaquin Valley Air Pollution Control District (SJVAPCD) develops rules, regulations, policies, and/or goals to comply with applicable air quality legislation. In that role, SJVAPCD issued *Guide for Assessing and Mitigating Air Quality Impacts* in 2002 to assist lead agencies with evaluating air quality impacts of proposed projects for purposes of meeting CEQA requirements. Providing planning assistance is one of the SJVAPCD goals for achieving attainment of the Federal and State ambient air quality standards. The SJVAPCD relies, in part, on land use designations contained in general plan documents applicable to its jurisdiction to forecast, inventory, and allocate regional emissions budgets from indirect (i.e., land-use- and development-related) sources.

3.4.1 Topography, Climate, and Meteorology

The SJVAB, which occupies the southern half of the Central Valley, is approximately 250 miles long and, on average, 35 miles wide. The SJVAB is a well-defined climatic region with distinct topographic features on three sides. The Coast Range, which has an average elevation of 3,000 feet, is located on the western border of the SJVAB. The San Emigdio Mountains, which are in turn part of the Coast Range, and the Tehachapi Mountains, which are part of the Sierra Nevada, are both located on the south side of the SJVAB. The Sierra Nevada forms the eastern border of the SJVAB. The northernmost portion of the SJVAB is San Joaquin County. No topographic feature delineates the northern edge of the basin. The SJVAB can be considered a "bowl" open only to the north.

The SJVAB is basically flat with a downward gradient in terrain to the northwest. Air flows into the SJVAB through the Carquinez Strait, the only breach in the western mountain barrier, and moves across the Delta from the San Francisco Bay Area (Bay Area). The mountains surrounding the SJVAB create a barrier to airflow, which leads to entrapment of air pollutants when meteorological conditions are unfavorable for transport and dilution. As a result, the SJVAB is highly susceptible to pollutant accumulation over time.

The inland Mediterranean climate type of the SJVAB is characterized by hot, dry summers and cool, rainy winters. The climate is a result of the topography and the strength and location of a semipermanent, subtropical high-pressure cell. During summer, the Pacific high-pressure cell is centered over the northeastern Pacific Ocean, resulting in stable meteorological conditions and a steady northwesterly wind flow. Cold ocean water upwells from below to the surface because of the northwesterly flow, producing a band of cold water off the California coast.

Daily summer high temperatures often exceed 100 degrees Fahrenheit (ºF), averaging in the low 90s in the north and high 90s in the south. In the entire SJVAB, daily summer high temperatures average 95ºF. Over the last 30 years, temperatures in the SJVAB averaged 90ºF or higher for 106 days a year, and 100ºF or higher for 40 days a year. The daily summer temperature variation can be as high as 30ºF (SJVAPCD 2002). In winter, the Pacific high-pressure cell weakens and shifts southward, resulting in wind flow offshore, the absence of upwelling, and storms. Average high temperatures in the winter are in the 50s, but lows in the 30s and 40s can occur on days with persistent fog and low cloudiness. The average daily low temperature in the winter is 45ºF (SJVAPCD 2002).

A majority of the precipitation in the SJVAB occurs as rainfall during winter storms. The rare occurrence of precipitation during summer is in the form of convective rain showers. The amount of precipitation in the SJVAB decreases from north to south primarily because the Pacific storm track often passes through the northern portion of the SJVAB, while the southern portion remains protected by the Pacific high-pressure cell. Stockton in the north receives about 20 inches of precipitation per year, Fresno in the center receives about 10 inches per year, and Bakersfield at the southern end of the valley receives less than 6 inches per year. Average annual rainfall for the entire SJVAB is approximately 9.25 inches on the valley floor (SJVAPCD 2002).

The winds and unstable atmospheric conditions associated with the passage of winter storms result in periods of low air pollution and excellent visibility. Precipitation and fog tend to reduce or limit some pollutant concentrations. For instance, clouds and fog block sunlight, which is required to fuel photochemical reactions that form ozone. Because carbon monoxide (CO) is partially water-soluble, precipitation and fog also tend to reduce concentrations in the atmosphere. In addition, respirable particulate matter with an aerodynamic diameter of 10 micrometers or less (PM_{10}) can be washed from the atmosphere through wet deposition processes (e.g., rain). However, between winter storms, high pressure and light winds lead to the creation of low-level temperature inversions and stable atmospheric conditions resulting in the concentration of air pollutants (e.g., CO, PM_{10}).

Summer is considered the ozone season in the SJVAB. This season is characterized by poor air movement in the mornings and by longer daylight hours, which provide a plentiful amount of sunlight to fuel photochemical reactions between reactive organic gases (ROG) and oxides of nitrogen (NO_X), resulting in ozone formation. During the summer, wind speed and direction data indicate that summer wind usually originates at the north end of the San Joaquin Valley and flows in a south-southeasterly direction through Tehachapi Pass and into the Southeast Desert Air Basin (SJVAPCD 2002).

3.4.2 Criteria Air Pollutants

Concentrations of the air pollutants ozone, CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM_{10}, fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less ($PM_{2.5}$), and lead are used as indicators of ambient air quality conditions. Because these are the most prevalent air pollutants known to be deleterious to human health, and because extensive documentation is available on health-effects criteria for these pollutants, they are commonly referred to as "criteria air pollutants." SJVAPCD relies, in part, on land use designations contained in general plan documents applicable to its jurisdiction to forecast, inventory, and allocate regional emissions budgets from indirect sources.

Ozone

Ozone is a photochemical oxidant, a substance whose oxygen combines chemically with another substance in the presence of sunlight, and is the primary component of smog. Ozone is not directly emitted into the air, but is formed through complex chemical reactions between precursor emissions of ROGs and NO_X in the presence of sunlight. ROGs are volatile organic compounds that are photochemically reactive. ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that results from the combustion of fuels. A highly reactive molecule, ozone readily combines with many different components of the atmosphere. Consequently, high levels of ozone tend to exist only while high ROG and NO_X levels are present to sustain the ozone formation process. Ozone located in the lower atmosphere (troposphere) is a major health and environmental concern. The adverse health effects associated with exposure to ozone pertain primarily to the respiratory system.

Ozone precursor emissions of ROGs and NO_X have decreased over the past several years in California because of more stringent motor vehicle standards and cleaner burning fuels. The ozone problem in the SJVAB ranks among the most severe in the State.

Carbon Monoxide

CO is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels, primarily from mobile (transportation) sources. About 77 percent of nationwide CO emissions are from mobile sources. The other 23 percent consists of CO emissions from wood-burning stoves, incinerators, and industrial sources. Adverse health effects associated with exposure to CO concentrations include such symptoms as dizziness, headaches, and fatigue. CO exposure is especially harmful to individuals who suffer from cardiovascular and respiratory diseases (USEPA 2008).

The highest concentrations of CO are generally associated with cold, stagnant weather conditions that occur during the winter. In contrast to problems caused by ozone, which tends to be a regional pollutant, CO problems tend to be localized.

Nitrogen Dioxide

NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines. Combustion devices emit primarily nitric oxide (NO), which reacts through oxidation in the atmosphere to form NO_2 (USEPA 2008). The combined emissions of NO and NO_2 are referred to as NO_X and reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with ozone, the NO_2 concentration in a particular geographical area may not be representative of the local NO_X emission sources.

Because NO_2 has relatively low solubility in water, the principal site of toxicity is in the lower respiratory tract. The severity of adverse health effects depends primarily on the concentration inhaled rather than the duration of exposure. An individual may experience a variety of acute symptoms, including coughing, difficulty with breathing, vomiting, headache, and eye irritation during or shortly after exposure. After a period of approximately 4 to 12 hours, an exposed individual may experience chemical pneumonitis or pulmonary edema with breathing abnormalities, cough, cyanosis, chest pain, and rapid heartbeat. Severe, symptomatic NO_2 intoxication after acute exposure has been linked on occasion with prolonged respiratory impairment, with such symptoms as chronic bronchitis and decreased lung functions (USEPA 2008).

Sulfur Dioxide

SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills. The major adverse health effects associated with SO_2 exposure pertain to the upper respiratory tract. SO_2 is a respiratory irritant, with constriction of the bronchioles occurring from inhalation of SO_2 at 5 parts per million (ppm) or more. On contact with the moist, mucous membranes, SO_2 produces sulfurous acid, which is a direct irritant. Concentration rather than duration of the exposure is an important determinant of respiratory effects. Exposure to high SO_2 concentrations may result in edema of the lungs or glottis and respiratory paralysis.

Particulate Matter

Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction operations, fires and natural windblown dust, and particulate matter formed in the atmosphere by condensation and/or transformation of SO_2 and ROGs (USEPA 2008). Fine particulate matter ($PM_{2.5}$) is a subgroup of PM_{10}, consisting of smaller particles that have an aerodynamic diameter of 2.5 micrometers or less (ARB 2007).

Adverse health effects associated with PM_{10} depend on the specific composition of the particulate matter. Generally, adverse health effects associated with PM_{10} may result from both short-term and long-term exposure to elevated concentrations and may include breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, alterations to the immune system, carcinogenesis, and premature death (USEPA 2008). $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and may contain substances that are particularly harmful to human health.

PM_{10} emissions in the SJVAB are dominated by emissions from area-wide sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, waste burning, and residential fuel combustion. $PM_{2.5}$ emissions in the SJVAB are dominated by emissions from the same area-wide sources as PM_{10} (ARB 2007).

Lead

Lead is a metal found naturally in the environment and in manufactured products. Major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

All areas of the State are currently designated as attainment for the State lead standard (Cal/EPA does not designate areas for the national lead standard). Although ambient lead standards are no longer violated, lead emissions from stationary sources still pose “hot spot” problems in some areas. As a result, the California Air Resources Board (ARB) identified lead as a toxic air contaminant.

Monitoring Station Data and Attainment Area Designations

Criteria air pollutant concentrations are measured at several monitoring stations in the SJVAB. Three stations are near the Restoration Area. The closest is the North Villa Avenue station in the town of Clovis, approximately 5 miles south of the Restoration Area in Fresno County. The North Villa Avenue station measures ozone, CO, PM_{10}, $PM_{2.5}$, and NO_2. The next closest is the Pump Yard station, approximately 30 miles southeast of the Restoration Area in Madera County, which measures ozone and NO_X. The third closest is the South Coffee Avenue station, approximately 15 miles northeast in Merced County, which measures ozone and NO_X. All these monitoring stations are at elevations similar to the Restoration Area.

A pollutant is designated “nonattainment” if there was at least one violation of a State standard for that pollutant in the area, and a pollutant is designated “attainment” if the State standard for that pollutant was not violated at any site in the area during a 3-year period. The category of “unclassified” is used in an area that cannot be classified on the basis of available information as meeting or not meeting standards. The SJVAB is designated as being in nonattainment for the State 1-hour ozone standard and the national 8-hour ozone standard. In addition, the SJVAB is designated as being in nonattainment for the State 24-hour and annual PM_{10} standards, and the State annual $PM_{2.5}$ standard. The basin is also in nonattainment for the national 24-hour and annual PM_{10} standards and the 24-hour and annual $PM_{2.5}$ standards.

On July 6, 2006, U.S. Environmental Protection Agency (USEPA) proposed redesignation for the SJVAB as a PM_{10} attainment area, based on attainment of the national standard in the 2003 through 2005 period. USEPA finalized approval of the attainment designation on October 17, 2006 (SJVAPCD 2008a). Although USEPA has determined that the SJVAB has attained the national PM_{10} standards, its determination does not constitute a redesignation to attainment per section 107(d)(3) of the Clean Air Act. The SJVAB will continue to be designated nonattainment until all of the Section 107(d)(3) requirements are met (SJVAPCD 2008b).

Emission Sources

With respect to the emissions of criteria air pollutants within Fresno, Madera, and Merced counties, mobile sources are the largest contributor to the estimated annual average levels of CO and NO_X, accounting for approximately 70 percent, and 79 percent, respectively, of total emissions. Area-wide sources account for approximately 44 percent, 88 percent, and 73 percent of the total county ROG, PM_{10}, and $PM_{2.5}$ emissions, respectively (ARB 2008).

3.4.3 Toxic Air Contaminants

Concentrations of toxic air contaminants, or in Federal parlance, hazardous air pollutants (HAP), are also used as indicators of ambient air quality conditions. A toxic air contaminant is defined as an air pollutant that may cause or contribute to an increase in mortality or serious illness, or that may pose a hazard to human health. Toxic air contaminants are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

According to the *California Almanac of Emissions and Air Quality* (ARB 2007), the majority of the estimated health risk from toxic air contaminants can be attributed to relatively few compounds, the most important being PM from diesel-fueled engines (diesel PM). Diesel PM differs from other toxic air contaminants in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel PM is emitted by diesel-fueled internal combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present.

Unlike the other toxic air contaminants, no ambient monitoring data are available for diesel PM because no routine measurement method currently exists. However, ARB has made preliminary concentration estimates based on a PM exposure method. This method uses the ARB emissions inventory's PM_{10} database, ambient PM_{10} monitoring data, and results from several studies to estimate concentrations of diesel PM. In addition to diesel PM, toxic air contaminants for which data are available that pose the greatest existing ambient risk in California are benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene.

Diesel PM poses the greatest health risk among these 10 toxic air contaminants. Based on receptor modeling techniques, ARB estimated the diesel PM health risk in the SJVAB in 2000 to be 390 excess cancer cases per million people. Since 1990, the health risk of diesel PM in the SJVAB has been reduced by 50 percent. Overall, levels of most toxic air contaminants have gone down since 1990 except *para*-dichlorobenzene and formaldehyde (ARB 2007).

According to the ARB Community Health Air Pollution Information System, five major existing stationary sources of toxic air contaminants are present within 3 miles of the Restoration Area (ARB 2008). Vehicles on State Routes (SR) 140, 165, 99, 41, and 152 are sources of diesel PM and other mobile source air toxics.

3.4.4 Odors

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, headache).

The ability to detect odors varies considerably among the population and overall is quite subjective. Some individuals have the ability to smell very minute quantities of specific substances; others may not have the same sensitivity but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; an odor that is offensive to one person may be perfectly acceptable to another. It is important to also note that an unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity. Quality and intensity are two properties present in any odor.

Potential existing sources of odor include various agricultural activities in the vicinity of the Restoration Area (e.g., dairy operations, livestock operations, fertilizer use).

3.4.5 Greenhouse Gases

Certain gases in the earth's atmosphere, classified as greenhouse gases (GHG), play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. A portion of the radiation is absorbed by the earth's surface, and a smaller portion of this radiation is reflected back toward space. Infrared radiation is selectively absorbed by GHGs. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere.

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane (CH_4), ozone, nitrous oxide (N_2O), and fluorinated compounds. Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth's climate, known as global climate change or global warming (Ahrens 2003). It is extremely unlikely that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007).

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern, respectively. California is the 12th to 16th largest emitter of CO_2 in the world (CEC 2006). California produced 484 million gross metric tons of CO_2 equivalent in 2004. Combustion of fossil fuel in the transportation sector was the single largest source of

California's GHG emissions in 2004, accounting for 41 percent of total GHG emissions in the State (CEC 2006). This sector was followed by the electric power sector (including both in-State and out-of-State sources) (22 percent) and the industrial sector (21 percent) (CEC 2006). Facilities (i.e., stationary, continuous sources of GHG emissions) that generate greater than 25,000 metric tons of CO_2 per year (MT CO_2/yr) are mandated to report their GHG emissions to ARB pursuant to Assembly Bill (AB) 32. In addition, the AB 32-proposed cap and trade level is 10,000 MT CO_2/yr, and the ARB preliminary draft staff proposal on GHG CEQA threshold level is 7,000 MT CO_2/yr.

3.4.6 Existing Sensitive Receptors

Sensitive receptors are considered those with increased exposure to or risk from air pollutants. Sensitive receptors in and around the Restoration Area, as well as the entire study area, include residences, churches, schools, hospitals, parks, and golf courses.

3.5 Biological Resources – Terrestrial Resources

Biological resources are discussed by the following three geographic subareas: San Joaquin River upstream from Friant Dam near Millerton Lake, San Joaquin River from Friant Dam to the Merced River, and San Joaquin River from Merced River to the Delta. Plant communities and wildlife habitat, invasive wildlife, vegetation types, common wildlife, and sensitive biological resources are discussed as they apply. Text in this section was developed through a review of scientific literature and existing data sources. Existing documents reviewed for preparation of this section include the following:

- *San Joaquin River Restoration Study Background Report*, edited by McBain and Trush, December 2002
- *Riparian Vegetation of the San Joaquin River*, prepared for Reclamation by DWR, May 2002
- *Historical Riparian Habitat Conditions of the San Joaquin River—Friant Dam to the Merced River*, prepared by Jones and Stokes Associates, Inc., for Reclamation, Fresno, California, April 1998
- *Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River—Friant Dam to the Merced River,* prepared by Jones and Stokes Associates, Inc., for Reclamation, Fresno, California, October 1998
- *Temperance Flat Reservoir Botanical Resources Baseline Report*, prepared by EDAW, Inc., for Reclamation and DWR, September 2007

Information was also gathered and reviewed to identify and describe special-status plant and wildlife species that are known to exist, could potentially exist, or historically existed in the study area for this EA/IS. Information on special-status plant and wildlife species was compiled through a review of the following sources:

- California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California, 2009
- California Natural Diversity Database (CNDDB), 2008, 2009
- DFG State and Federally Listed Endangered, Threatened, and Rare Plants of California, 2008a, and Special Vascular Plants, Bryophytes, and Lichens List, 2008b
- DFG State and Federally Listed Endangered and Threatened Animals of California, 2008c, and Special Animals List, 2008d
- USFWS Federal Endangered and Threatened Species List for the region, 2009

Appendix H, Biological Resources:

- Attachment 1, Special-Status Species Reported by California Natural Diversity Database, contains a list of special-status species reported to the CNDDB for quadrangles within 1 mile of the Restoration Area

- Attachment 2, U.S. Fish and Wildlife Service List of Special-Status Species, presents a list provided by USFWS of special-status species that could be affected by activities in the area covered by the quadrangles encompassing the Restoration Area. These quadrangles include Arena, Biola, Bliss Ranch, Delta Ranch, Firebaugh, Firebaugh Northeast, Fresno North, Friant, Gravelly Ford, Greg, Gustine, Herndon, Ingomar, Jamesan, Lanes Bridge, Little Table Mountain, Madera, Mendota Dam, Millerton Lake East, Millerton Lake West, Newman, Oxalis, Poso Farm, San Luis Ranch, Sandy Mush, Santa Rita Bridge, Stevinson, Tranquility, and Turner Ranch.

- Attachment 3, Special-Status Plant and Wildlife Species with Potential to Occur in the Study Area, contains tables of special-status plants and animals known or with potential to occur in the study area.

For the purpose of this document, special-status species are plant and wildlife species that are as follows:

- Species listed, species proposed for listing, or candidates for possible future listing as threatened or endangered under the Federal ESA

- Species listed or proposed for listing by the State of California as threatened or endangered under California Endangered Species Act (CESA)

- Plant species designated as rare under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 et seq.)

- Plant species considered by CNPS to be "rare, threatened, or endangered in California" (Lists 1B and 2 in CNPS 2009)

- Wildlife species considered species of special concern by DFG

- Wildlife species designated as fully protected by the California Fish and Game Code

3.5.1 San Joaquin River Upstream from Friant Dam

This section describes the plant communities and wildlife habitat, common wildlife, and sensitive biological resources known upstream from Friant Dam in the vicinity of Millerton Lake and its watershed.

Plant Communities and Wildlife Habitat

The topography of the San Joaquin River basin rises above elevation 12,000 in the upper watershed portion of the Sierra Nevada. Topography in the Millerton Lake area ranges from approximately elevation 310 at Friant Dam to above elevation 2,100 at the ridges surrounding the upper end of the reservoir. Plant communities around Millerton Lake are mostly foothill woodlands and grassland, with riparian vegetation along the shoreline. Adjacent hillsides support foothill pine-blue oak woodland with abundant grass/forb and shrub understory. Open grassland and savannah-type habitat conditions also exist in some areas. Several large basalt tables known to have vernal pools surround the canyon, well above elevation 1,600.

Upland vegetation above Millerton Lake is dominated by foothill woodland with areas of open grassland and rock outcroppings. The predominant vegetation includes foothill pine, blue oak, and interior live oak. Montane coniferous forest is found at the higher elevations upstream from Mammoth Pool. Habitat types in this area are meadow, riparian deciduous, lodgepole pine, mixed conifer, ponderosa pine, rock outcrop, and brush (USJRWPA 1982).

Common Wildlife

The Millerton Lake area hosts a diverse wildlife community, both resident and seasonal. The upper San Joaquin River area is a relatively rich wildlife region of the Sierra Nevada foothills (Reclamation and DWR 2005). Forest canopy varies considerably by slope and aspect, whereas the shrub and ground cover layer is greatly affected by cattle grazing. Wildlife in the higher elevation portions of the watershed is typical of the midelevation Sierra Nevada. Important deer winter ranges and bear habitat exist in the Temperance Flat area, in the U.S. Department of the Interior, Bureau of Land Management, San Joaquin River Gorge Management Area.

Sensitive Biological Resources

Seven special-status plant species are known to occur in the Millerton Lake/Big Bend region. Hartweg's pseudobahia, Federally listed as endangered and found in grasslands, is reported present. Species that are Federally listed as threatened include San Joaquin Valley Orcutt grass and fleshy owl's-clover, which are species associated with vernal pools. Tree anemone is an extremely localized species endemic to chaparral and woodland in the region, and is State-listed as threatened. Bogg's Lake hedge-hyssop, State-listed as an endangered species, is found in vernal pools and lake margins. Several populations of Madera leptosiphon, on CNPS List 1B, are recorded along the shores of Millerton Lake, with one known population near Big Bend. Suitable conditions for this species probably exist in other parts of the study area, also. Blue elderberry, a shrub often associated with riparian habitat, occurs in the watershed from Big Bend upstream to Horseshoe Bend. Elderberry shrubs, including blue elderberry, are host plants for the valley elderberry longhorn beetle, Federally listed as threatened.

Several special-status wildlife species are known to occur in the Millerton Lake/Big Bend region (Reclamation and DWR 2005). These species include California red-legged frog, western pond turtle, western spadefoot toad, northern harrier, prairie falcon, bald eagle, valley elderberry longhorn beetle, and western (California) mastiff bat.

3.5.2 San Joaquin River from Friant Dam to Merced River

This section describes the plant communities and wildlife habitat, invasive wildlife, vegetation types, and sensitive biological resources known to occur in or adjacent to the Restoration Area.

Plant Communities and Wildlife Habitat

Plant communities and common wildlife species found in the Restoration Area are described in this section. Table 3-5 lists, in acres, plant communities and land cover in the various reaches of the Restoration Area mapped in 2002 by DWR. Other data sources were used to characterize and evaluate environmental consequences for areas not mapped by DWR. The following discussion summarizes these plant communities and land cover, including riparian forest, scrub, emergent wetlands, grassland and pasture, alkali sink, agriculture, open water, riverwash, disturbed areas, invasive plants, and urban.

Riparian Forest. Riparian forest has been classified (Table 3-5) into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest. In areas where canopy cover was less than 30 percent, the community was mapped as “low density” (DWR 2002). Large, mature riparian forest stands support the most dense and diverse breeding bird communities in California (Gaines 1974). Tall riparian trees provide high-quality nesting habitat for raptors, such as red-tailed hawk, red-shouldered hawk, Swainson’s hawk, and white-tailed kite. These trees also provide nesting habitat for cavity-nesting species, such as downy woodpecker, wood duck, northern flicker, ash-throated flycatcher, oak titmouse, tree swallow, and white-breasted nuthatch. Riparian forests and associated wetlands produce populations of insects that feed on foliage and stems during the growing season. These insects, in turn, are prey for migratory and resident birds, including Pacific-slope flycatcher, western wood-pewee, olive-sided flycatcher, warbling vireo, orange-crowned warbler, yellow warbler, Bullock’s oriole, and spotted towhee. Mammal species using riparian forests include coyote, raccoon, desert cottontail, and striped skunk.

Scrub. Several types of scrub habitat were mapped in the Restoration Area, including willow scrub, riparian scrub, and elderberry savannah (DWR 2002). Typical bird species found in riparian scrub habitat include western wood-pewee, black phoebe, yellow-billed magpie, bushtit, Bewick’s wren, lazuli bunting, blue grosbeak, and American goldfinch. Mammal species using scrub habitats are similar to those described for riparian forest habitats above.

Table 3-5.
Plant Communities and Land Cover in the Restoration Area

Vegetation Type		Reaches and Bypasses (acres)									
		Reach									Bypasses
		1A	1B	2A	2B	3	4A	4B1	4B2	5	
Riparian Forest	Cottonwood Riparian Forest	166	79	30	48	429	16	18	14	29	0
	Cottonwood Riparian Forest LD[1]	27	114	41	1	23	4	2	2	0	0
	Willow Riparian Forest	198	119	43	110	116	68	177	330	506	2
	Willow Riparian Forest LD[1]	28	0	4	6	8	14	88	100	249	0
	Mixed Riparian Forest	439	260	0	0	0	6	0	0	0	0
	Mixed Riparian Forest LD[1]	65	19	2	0	0	0	0	0	1	0
	Valley Oak Riparian Forest	265	0	0	0	0	0	16	7	35	0
Scrub	Willow Scrub	214	113	76	38	188	38	101	18	70	0
	Willow Scrub LD[1]	73	32	124	15	41	10	0	13	10	0
	Riparian Scrub	53	48	209	67	56	61	55	3	71	20
	Elderberry Savannah	2	0	3	63	0	0	0	0	0	0
Emergent Wetlands		204	5	11	64	8	41	164	139	217	0
Grassland and Pasture		1,513	286	470	227	157	201	620	2,131	2,955	1
Alkali Sink		0	0	0	0	0	0	0	0	2	0
Agriculture		1,450	2,821	2,569	1,858	4,669	2,775	3,768	111	580	18
Open Water		1,307	220	327	279	341	113	140	123	440	5
Riverwash[2]		34	47	170	3	22	68	3	0	6	0
Disturbed Areas		1,998	335	181	243	654	401	452	183	110	1
Invasive Plants	Nonnative Tree	54	22	9	0	0	0	0	0	12	0
	Giant Reed (Arundo)	3	4	6	0	0	0	0	0	0	0
Urban		158	0	0	0	332	0	0	0	0	0
No Data[3]		2,412	642	255	1,622	1011	780	909	157	41	19,576
Total		**10,655**	**5,166**	**4,530**	**4,644**	**8,058**	**4,595**	**6,513**	**331**	**5,333**	**19,622**
Ratio of Natural Habitat Per River Mile		**194.2 acres/ mile**	**48.0 acres/ mile**	**79 acres/mile**		**47.5 acres/ mile**	**14.8 acres/ mile**	**512.8 acres/mile**		**508.0 acres/ mile**	**Unknown**

Source: DWR 2002
Notes:
[1] Canopy covers less than 30 percent.
[2] Riverwash partially depends on flow at the time of the survey/photograph, and values should not be presumed to be precise.
Key:
LD = low density

Emergent Wetlands. Emergent wetlands typically occur in the river bottom immediately adjacent to the low-flow channel. Sites such as backwaters and sloughs, where water is present through much of the year, support emergent marsh vegetation such as tules and cattails. More ephemeral wetlands, especially along the margins of the river and in swales adjacent to the river, support an array of native and nonnative herbaceous species, including western goldenrod, arrowgrass, smartweed, Mexican rush, horseweed, willow herb, saltgrass, sunflower, and curly dock. Many bird species are known to use emergent wetlands, including song sparrow, common yellowthroat, marsh wren, and red-winged blackbird. Mammal species that use this habitat include California vole, common muskrat, and Norway rat. Pacific chorus frog and western terrestrial garter snake are commonly present in this habitat.

Grassland and Pasture. Grassland and pasture is an herb- and grass-dominated plant community. Generally, sites with grassland or pasture are well drained and flood only occasionally under present-day hydrologic conditions. Most areas of grassland or pasture are above the frequently flooded zone of the San Joaquin River. The grassland and pasture vegetation type is composed of an assemblage of nonnative annual and perennial grasses and occasional nonnative and native forbs. The most abundant species are nonnative grasses (ripgut brome, foxtail fescue, and Mediterranean barley) and herbs (red-stemmed filaree and horseweed). Typical bird species associated with grasslands include northern harrier, ring-necked pheasant, mourning dove, burrowing owl, horned lark, loggerhead shrike, and savannah sparrow. Mammal species that use grasslands include deer mouse, California vole, California ground squirrel, Botta’s pocket gopher, American badger, and coyote. Common reptile species associated with grasslands in the San Joaquin Valley include California toad, western fence lizard, western racer, and gopher snake.

Alkali Sink. Alkali sinks are shallow seasonally flooded areas or playas that are dominated by salt-tolerant wetland plants. Soils typically are fine textured with an impermeable caliche layer or clay pan. Salt encrustations are often deposited on the surface as the playa dries. Alkali sinks support valley sink scrub, which is a low-growing open to dense succulent shrubland community dominated by alkali-tolerant members of the goosefoot family, especially iodine bush and seablites. An herbaceous understory usually is lacking, but sparse cover of annual grasses, such as Mediterranean barley and red brome, may be present. Alkali sinks flood seasonally, but do not flood every year and respond to local thunderstorms. Wildlife species typically associated with alkali sink habitat include species of common and listed kangaroo rats, Nelson’s antelope squirrel, kit fox, coyote, side-blotched lizard, and BNLL.

Agriculture. Agricultural lands in the Restoration Area can provide food and cover for wildlife species, but the value of the habitat varies greatly among crop types and agricultural practices. Grain crops provide forage for songbirds, small rodents, and waterfowl at certain times of year. Pastures, alfalfa, and row crops, such as beets and tomatoes, provide foraging opportunities for raptors because of the frequent flooding, mowing, or harvesting of fields, which make prey readily available. Orchards and vineyards have relatively low value for wildlife because understory vegetation growth that would provide food and cover typically is removed. Species that use orchards and vineyards, such as ground squirrel, American crow, Brewer's blackbird, and European starling, often are considered agricultural pests.

Open Water. Open water is characterized by permanent or semipermanent ponded or flowing water. Open water may be the result of constructed impoundments or naturally occurring water bodies. Open water areas provide habitat for pond turtle, Pacific chorus frog, and bullfrog. Both submerged and floating aquatic vegetation are used as basking or foraging habitat and provide cover for aquatic wildlife species. Deeper open water areas without vegetation provide habitat for species that forage for fish, crayfish, or other aquatic organisms, such as river otter.

Riverwash. Riverwash consists of alluvial sands and gravel associated with the active channel of the San Joaquin River. Generally, riverwash areas exist as sand and gravel point bars within the floodplain of the river. Woody and herbaceous plant cover is low. Numerous herbaceous species occur in riverwash areas; however, most are relatively uncommon. The most abundant species are foxtail fescue, Bermuda grass, red-stemmed filaree, willow herb, and lupine species. Riverwash provides nesting habitat for shorebirds, such as killdeer, black-necked stilt, and American avocet. Other species, such as mallard or western pond turtle, may use riverwash habitats for roosting or resting.

Disturbed Areas. Disturbed areas include roads, canals, levees, and aggregate pits. Also included are areas used by off-highway vehicles and sites where rubble or fill has been deposited. Active and former aggregate mines are included if they are dry or unvegetated. As with agricultural habitats, low vegetation cover and species diversity in disturbed habitats limit their value to wildlife. However, these habitats may provide habitat for birds such as white-crowned sparrow, western meadowlark, and American goldfinch. These habitats also are expected to support some common mammals, such as California ground squirrel, deer mouse, and desert cottontail.

Invasive Plants. Invasive plants are species that are not native to the region, persist without human assistance, and have serious impacts on their nonnative environment (Simberloff et al. 1997, Davis and Thompson 2000). The term "invasive plant" differs from the classification terms "nonnative," "exotic," or "introduced plant" because it is (when applied correctly) used only to describe those nonnative plant species that displace native species on a large enough scale to alter habitat functions and values. The California Invasive Plant Council (CalIPC) maintains a list of species that have been designated as invasive in California. Prevalent species and their associated CalIPC category and California Department of Food and Agriculture (CDFA) rating are identified in Table 3-6. The term "noxious weed" is used by government agencies for nonnative plants that have been defined as pests by law or regulation (CDFA 2007). Many invasive noxious trees and shrubs that have the ability to occupy channel and floodplain surfaces are a constant threat to river floodway capacity, and substantial cost and resources are required to remove and control large stands. Unlike the native riparian flora, many invasive riparian species do not attract populations of invertebrate life or produce edible seed and fruit that provide food webs for aquatic and terrestrial riparian fish and wildlife.

Table 3-6.
Prevalent Invasive Species Identified by
Federal and State Agencies in the Restoration Area

Species	California Invasive Plant Council Inventory Category[1]	California Department of Food and Agriculture Rating[2]	U.S. Department of Agriculture Noxious Weed Status
Terrestrial Riparian Species			
Red sesbania (*Sesbania punicea*)	High, Red Alert	Q	–
Salt cedar (*Tamarix spp.*)	High	B	–
Giant reed (*Arundo donax*)	High	B	–
Chinese tallow (*Sapium sebiferum*)	Moderate	–	–
Tree-of-heaven (*Ailanthus altissima*)	Moderate	C	–
Blue gum (*Eucalyptus globulus*)	High	–	–
Aquatic Species			
Water hyacinth (*Eichornia crassipes*)	High	C	–
Water milfoil (*Myriophyllum aquaticum*)	High	C	–
Parrot's feather (*Myriophyllum aquaticum*)	High, Red Alert	–	–
Curly-leaf pondweed (*Potamogeton crispus*)	Moderate	–	–
Sponge plant (*Limnobium spongia*)	–	Q	–

Sources: DWR in preparation, California Invasive Plant Council 2006, CDFA 2007, USDA 2006

Notes:

[1] California Invasive Plant Council Inventory Categories:

- High – Have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- Moderate – Have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Reproductive biology and other attributes are conducive to moderate to high rates of dispersal, but establishment generally depends on ecological disturbance. Ecological amplitude and distribution range from limited to widespread.
- Limited – Invasive, but ecological impacts are minor on a statewide level, or not enough information was available to justify higher rating. Reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are limited, but these species may be locally persistent and problematic.
- Red Alert – Plants with the potential to spread explosively; infestations currently small and localized.

[2] California Department of Food and Agriculture Ratings:

- B – Eradication, containment, control, or other holding action at the discretion of the Commissioner.
- C – State-endorsed holding action and eradication only when found in a nursery; action to retard spread outside nurseries at the discretion of the Commissioner.
- Q – Temporary rating for eradication, containment, rejection, or other holding action at the State-county level, outside nurseries pending determination of a permanent rating.
- -- Not applicable

A comprehensive survey of riparian vegetation on the San Joaquin River identified several invasive species in the Restoration Area (DWR 2002). The invasive species were mapped separately from the riparian vegetation and land cover, with the exception of large stands of invasive trees (blue gum, salt cedar, and tree-of heaven) and giant reed (nonwoody) that could be identified on aerial photos. The invasive species included in the "invasives" geographic information system (GIS) layer are red sesbania, giant reed, blue gum, tree-of-heaven, pampas grass, and edible fig. A number of other invasive nonnative species are present, but their occurrence was not systematically mapped. These species include Himalayan blackberry, white mulberry, castor bean, Lombardy poplar, and tamarisk (DWR 2002).

Additional invasive plants have been identified through meetings with local stakeholders and SJRRP agency personnel. These species include nonnative trees (Chinese tallow, Catalpa, Russian olive, Chinaberry, and tree tobacco), emergent and submergent aquatic plants (sponge plant, water hyacinth, curly leaf pond weed, parrot feather, milfoil, and water primrose), and herbaceous weeds (thistles (bull, star, and milk), watergrass, bermuda grass, and other common nonnative grasses and forbs that compete with native riparian species for shoreline and low floodplain establishment and growth sites).
Blue gum is the most widespread and abundant invasive species in the Restoration Area, mapped by DWR (2002) in all reaches except Reaches 3 and 4 and the bypasses (see reach descriptions below), and encompasses more than 100 acres (Table 3-7). Giant reed is also widespread, mapped in all reaches except Reach 4 and the bypasses, and encompasses about 35 acres. Himalayan blackberry is also frequently encountered, especially in riparian scrub communities, where it is observed over long channelized portions of the river. Red sesbania is a relatively recent introduction to the San Joaquin River, but it is spreading aggressively and was already abundant in Reach 1 in 2000. In 2008, red sesbania was also widespread in Reach 2A and was observed at two locations along the Eastside Bypass (Stefani, pers. comm., 2008). The recent and rapid spread of red sesbania is a particular concern to the SJRRP because it has successfully colonized both disturbed bar soil and substrate (banks of aggregate mining pits, sand and gravel bars, and other exposed surfaces), as well as encroached into the occupied understory of existing dense riparian vegetation, and formed monocultures along the low-flow shoreline.

Table 3-7.
Acreage of Invasive Species Mapped in the Restoration Area in 1998 and 2000

Species	Reach 1		Reach 2		Reach 3		Reach 4		Reach 5		Total	
	Number of Locations	Acres	Number of Locations	Acres	Number of Locations	Acres	Number of Locations	Acres	Number of Locations	Acres	Number of Locations	Acres
Blue gum	68	117.75	4	7.05	–	–	–	–	3	12.29	75	105.09
Giant reed	59	23.37	47	17.46	3	0.22	–	–	1	0.26	110	34.35
Red sesbania	32	17.24	–	–	–	–	–	–	–	–	32	17.24
Tree-of-heaven	5	3.44	1	0.49	–	–	–	–	–	–	6	3.43
Edible fig	5	1.04	2	0.14	–	–	–	–	–	–	7	1.18
Lombardy poplar	–	–	–	–	–	–	–	–	1	1.62	1	1.62
Salt cedar	–	–	1	0.16	1	0.07	1	0.05	–	–	3	0.28
White mulberry	–	–	–	–	1	0.09	–	–		–	1	0.09
Castor bean	–	–	–	–	–	–	1	0.07	–	–	1	0.07
Pampas grass	1	0.03	–	–	–	–	–	–	–	–	1	0.03
Total invasives	171	162.87	55	25.30	5	0.38	2	0.12	5	14.17	238	163.54
Total Survey Area		15,821		9,174		8,058		11,439		5,333		49,825

Source: DWR 2002
Note:
Bypasses not included in area surveyed.
Key:
— Not Applicable

Also, based on recent information from stakeholders, water hyacinth is present in Reaches 2, 3, and 4, and a small population of Chinese tallow is present in Reach 1. In 2008, Chinese tallow was also observed in Reach 3 (Stefani, pers. comm., 2008). Low-flow channels choked with a mix of floating and submergent aquatic weeds severely decrease flow capacity, lower dissolved oxygen (higher biochemical oxygen demand), and benefit habitat for nonnative fish species (e.g., centrarchids) that prey on native juvenile fish. Dense surface mats of aquatic weeds also cause greater adult mosquito production and diminish the effectiveness of biological mosquito control measures (e.g., bacterial toxin dispersal, mosquitofish).

Overall, as mapped in 2000 by DWR (2002), Reach 1 contained the greatest acreage of invasive woody species, with more than 162 acres of invasive plants documented, and also the greatest diversity of invasive species, with seven documented invasive woody species. Reach 2 had the second largest acreage of invasive species, with over 25 acres mapped, while Reaches 3 and 4 contained few invasive plants. Reach 5 had 14 acres of invasive plants, mostly consisting of three large blue gum stands (DWR 2002).

Before 2008, the Chowchilla, Eastside, and Mariposa bypasses were not surveyed or mapped, and no other references with comparable data were found for these portions of the Restoration Area. In 2008, observations of red sesbania were recorded in the Eastside Bypass during that year's survey effort (Stefani, pers. comm., 2008).

Invasive Wildlife

The introduction of nonnative wildlife species can be detrimental to native species assemblages. Nonnative wildlife species distribution and abundance in the Restoration Area is unknown but likely includes American bullfrog, crayfish, and red-eared sliders, which are common in most of California's waterways. Several invasive invertebrate species, such as Asian clam and Chinese mitten crab, are known to occur within the study area. Each of these is discussed briefly below.

The Asian clam is present in rivers and streams throughout California. The species is most abundant in well-oxygenated, clear waters but is found both in stream and lake habitats. Clay and fine- to coarse-grained sand are preferred substrates, although Asian clams may be found in lower numbers on almost any substrate (USGS 2001). Asian clams have been documented in tributary rivers to the San Joaquin River, including the Merced River. The clam is thought to affect ecosystem processes by limiting suspended algal biomass within tributaries, thereby reducing export of suspended algae into mainstem rivers (Stillwater Sciences 2007).

The mitten crab is catadromous – adults reproduce in saltwater and the offspring migrate to freshwater to rear. The ecological impact of a large mitten crab population is not well understood. Although juveniles primarily consume vegetation, they do prey on animals, especially invertebrates, as they grow. Chinese mitten crabs have been found in the Delta and eastern San Joaquin County (Escalon-Bellota Weir on the Calaveras River and Little Johns Creek near Farmington), and south to the San Luis NWR near Gustine (DFG 1998). In the last decade, there have been several unconfirmed reports of the Chinese mitten crab from the lower Stanislaus and Merced rivers, but no official collections have been documented from this area; in addition, no crabs were reported from these areas during 2007 (Stillwater Sciences 2007).

Vegetation Types

Vegetation types in the Restoration Area are described here by reach based on a combination of on-the-ground vegetation sampling and interpretation of recent aerial photographs (DWR 2002). The area and distribution of vegetation by type are based on studies by DWR during 2000 (DWR 2002) and GIS data (DWR 2002) (Table 3-7).

Reach 1A. Reach 1A presently supports continuous riparian vegetation, except where the channel has been disrupted by instream aggregate removal or off-channel aggregate pits that have been captured by the river. This reach has the greatest diversity of vegetation types and has the highest overall diversity of plant species. Based on the 2000 vegetation surveys by DWR (2002), all eight classifications of riparian communities (cottonwood, willow, mixed, and oak riparian forest; willow and riparian scrub and elderberry savannah; and emergent wetlands) are present in this reach. Approximately half of the total number of plant taxa recorded were native. However, the largest areas occupied by invasive tree species (blue gum and tree-of-heaven) were recorded in Reach 1A. Giant reed and red sesbania were also recorded primarily in Reach 1A (DWR 2002).

Reach 1B. Reach 1B has one of the lowest ratios of natural vegetation per river mile – in 14 miles of channel, little over 1 square mile of natural habitat is present (Table 3-7). Woody riparian vegetation is prevalent and occurs mainly in narrow strips immediately adjacent to the river channel. Willow scrub is more abundant (13 percent) than in Reach 1A (7 percent) (DWR 2002). Mature vegetation on the back side of many point bars and on low floodplains is scarce. Remnant valley oaks are present on some of the higher terraces. Previously cleared terraces and the understory of the cottonwood and oak stands are dominated by nonnative annual grasses (McBain and Trush 2002). Blue gum, giant reed, red sesbania, and tree-of-heaven were prevalent in Reach 1B. Red sesbania was mapped downstream to Highway 99 in 2000, but likely is currently more abundant downstream given its potential to spread rapidly (DWR 2002).

Reach 2A. Riparian vegetation in the upper 10 miles of this reach (Reach 2A) is sparse or absent because the river is usually dry and the shallow groundwater is overdrafted (McBain and Trush 2002). Grassland/pasture is relatively abundant in Reach 2A, contributing almost 50 percent to the total natural land cover (excluding urban and agricultural land cover types). The most abundant riparian communities present are riparian and willow scrub habitats. The only significant stand of elderberry savannah mapped in the Restoration Area occurs on the left bank near the Chowchilla Bypass Bifurcation Structure, at the junction of Reaches 2A and 2B (DWR 2002). Invasive species recorded in Reach 2A in 2000 included large stands of blue gum and tree-of-heaven (9 acres) and giant reed (6 acres) (DWR 2002).

Reach 2B. The lower few miles of Reach 2B support narrow, patchy, but nearly continuous vegetation, because this area is continuously watered by the backwater of the Mendota Pool. The riparian zone is very narrowly confined to a thin strip 10 to 30 feet wide bordering the channel. The herbaceous understory, however, is very rich in native species and a high portion of the total vegetative cover is native plants. Invasive species were not mapped in Reach 2B by DWR (2002). The margins of the Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the waterline.

Reach 3. Nearly continuous riparian vegetation of various widths and cover types occurs on at least one side of the channel in this reach (McBain and Trush 2002); however, the narrow width of the riparian corridor results in a very low ratio of native vegetation per river mile (DWR 2002). In Reach 3, cottonwood riparian forest is the most abundant native vegetation type, followed by willow scrub, willow riparian forest, and riparian scrub. Small amounts (less than 0.5 acre each) of giant reed and nonnative trees were mapped in Reach 3 (DWR 2002).

Reach 4A. Reach 4A is sparsely vegetated, with a very thin band of vegetation along the channel margin (or none at all). Willow scrub and willow riparian forest occur in small to large stands, and ponds rimmed by small areas of marsh vegetation are present in the channel; however, this reach has the fewest habitat types and lowest ratio of natural vegetation per river mile in the Restoration Area.

Reach 4B. Reach 4B upstream from the Mariposa Bypass (Reach 4B1) supports a nearly unbroken, dense, but narrow corridor of willow scrub or young mixed riparian vegetation on most of the reach, with occasional large gaps in the canopy. As described in Section 2, Reach 4B1 no longer conveys flows. The channel in Reach 4B1 is poorly defined and filled with dense vegetation and, in some cases, is plugged with fill material. Because of the wider floodplain and available groundwater, and management of the land as part of the San Luis NWR, Reach 4B2 contains vast areas of natural vegetation, compared to the upstream reaches. Grasslands and pasture are the most common vegetation type, but willow riparian forest and emergent wetlands are also relatively abundant (DWR 2002). No significant stands of nonnative trees or giant reed were found in Reach 4 (DWR 2002).

Reach 5. In Reach 5, the San Joaquin River is surrounded by large expanses of upland grassland with numerous inclusions of woody riparian vegetation in the floodplain. Remnant riparian tree groves are concentrated on the margins of mostly dry secondary channels and depressions, or in old oxbows. Along the mainstem San Joaquin River, a relatively uniform pattern of patchy riparian canopy hugs the channel banks as large individual trees or clumps (primarily valley oaks or black willow), with a mostly grassland or brush understory (McBain and Trush 2002). The most abundant plant community is grassland and pasture, followed by willow riparian forest, emergent wetland, willow and riparian scrub, and willow, oak, and cottonwood riparian forests. Alkali scrub is also present in this reach (DWR 2002). Less than 0.5 acres of giant reed were mapped in Reach 5, but larger stands of nonnative trees were recorded (DWR 2002).

Chowchilla Bypass. The Chowchilla Bypass is grazed by livestock and mostly covered with nonnative annual grassland, although scattered cottonwoods and elderberry shrubs are present. A narrow band of emergent marsh dominated by tules and cattails may grow along the banks of the Chowchilla Bypass.

Mariposa Bypass. Vegetation in the Mariposa Bypass is similar to that along the Chowchilla Bypass. Upland vegetation is grassland and ruderal vegetation (i.e., the nonnative herbaceous vegetation of disturbed lands). Isolated trees and small patches of tree-dominated riparian vegetation are present, as are narrow bands of riparian scrub along some channel banks.

Eastside Bypass. Vegetation in the lower 10 miles of the Eastside Bypass is similar to that along the Chowchilla Bypass. Upland vegetation is grassland and ruderal vegetation. The reach between the Sand Slough Control Structure and Merced NWR (approximately 4.5 miles) supports a number of duck ponds. The next 2.2 miles of the bypass are located in the Merced NWR, which encompasses over 10,000 acres of wetlands, native grasslands, vernal pools, and riparian habitat, and hosts the largest wintering populations of lesser sandhill cranes and Ross' geese along the Pacific Flyway. Farther downstream, the Eastside Bypass passes through the Grasslands WMA, an area of private lands with conservation easements held by USFWS, and through the East Bear Creek Unit of the San Luis NWR Complex. Patchy riparian trees and shrubs occur along the banks of the

Eastside Bypass in these areas. Side channels and sloughs (e.g., Duck, Deep, and Bravel sloughs) are present along the lower Eastside Bypass, some of which support remnant patches of riparian vegetation.

Sensitive Biological Resources

Sensitive biological resources are discussed below for each reach of the Restoration Area. Special-status species, recovery areas, designated critical habitat, and sensitive natural communities are discussed as they apply for each reach of the Restoration Area.

Reach 1A. The riparian vegetation and elderberry savannah along Reach 1A support documented occurrences of the valley elderberry longhorn beetle. Vernal pools and grasslands on the bluffs adjacent to Reach 1A are known to support several special-status animals and plants, but these areas are not in the Restoration Area. Known great egret, great blue heron, and cormorant rookery sites are present in Reach 1A at the following locations: the base of Friant Dam, in the DFG Rank Island Ecological Reserve, and in the DFG Milburn Ecological Reserve. Rookeries at the base of Friant Dam and in Rank Island Ecological Reserve support great blue heron and great egret nests. The rookery in the Milburn Ecological Reserve supports nests of all three species. A spotted bat was collected from the San Joaquin Fish Hatchery in the 1970s, and there is a 1990s observation record of San Joaquin kit fox just west of Friant Dam (CNDDB 2009). High above the alluvial plain of the river corridor in Reach 1A, just outside the Restoration Area, are terraces that support vernal pool grasslands and emergent wetlands. Numerous occurrences of special-status animal and plant species are documented in these habitats, including California tiger salamander, vernal pool fairy shrimp, western spadefoot toad, hairy Orcutt grass, Sanford’s arrowhead, San Joaquin Valley Orcutt grass, spiny-sepaled button-celery, and succulent owl’s clover.

Reach 1B. No special-status plants or animals have been identified in Reach 1B (CNDDB 2008), largely because of the minimal amount of remnant native habitats along this stretch of the river. Nonetheless, it is likely that raptors and grassland-affiliated species use the remnant habitats in this reach.

Reach 2A. The only special-status species mapped by CNDDB (2007) as occurring in Reach 2A is Swainson’s hawk. An occurrence of heartscale is documented in the grasslands on the terraces above the alluvial plain, and outside the identified Restoration Area in this reach. These species are both associated with grassland habitats and, in the case of Swainson’s hawk, agricultural areas. It is likely that other grassland- and scrub-affiliated species use the limited remnant habitats in this reach, and valley elderberry longhorn beetle could potentially occur in the elderberry savannah. Elderberry shrubs have been documented along the river within this reach. Open water habitat may attract migratory ducks, such as mallards, gadwalls, and ruddy ducks. Emergent vegetation provides limited habitat for marsh-dwelling species, such as rails, herons, and various songbirds.

Reach 2B. Occurrences of Swainson’s hawk are recorded throughout Reach 2B; the CNDDB (2007) indicates that numerous nesting sites are present in the riparian forest, and foraging opportunities exist in the agricultural fields and grasslands along this reach.

Silvery legless lizard has been documented in the riparian scrub located at the Chowchilla Bypass Bifurcation Structure. In the marshy backwater area of the Mendota Pool that extends into Reach 2B, several special-status species are documented, including records from the mid-1970s of giant garter snake and western pond turtle and a 1948 record of Sanford's arrowhead (CNDDB 2007). Western yellow-billed cuckoo has been documented in the riparian and willow scrub habitats around the Mendota Pool in the 1950s (CNDDB 2007). Bank swallows, which use habitats along banks or bluffs usually adjacent to water, have been documented in the vicinity of the Mendota Pool. Several other species have been documented at Mendota Wildlife Area (WA), outside the Restoration Area, including Lost Hills crownscale, giant garter snake, BNLL, burrowing owl, western mastiff bat, Nelson's antelope squirrel, and San Joaquin Kit fox.

Reach 3. Giant garter snake, western pond turtle, western yellow-billed cuckoo, and San Joaquin pocket mouse are documented as occurring in suitable habitats in Reach 3. Occurrences of Swainson's hawk are recorded throughout this reach, where this hawk forages in the grassland and agricultural areas, and nests in the riparian forest along the river. Several occurrences of San Joaquin kit fox from the 1990s have been documented in the grasslands immediately east and west but outside the Restoration Area along this reach of the river. Lesser saltscale and Munz' tidy-tips, both associated with alkaline scrub and grassland habitats, are documented in the higher terraces above the alluvial plain and just outside the Restoration Area along this reach.

Reach 4. Occurrences of Swainson's hawk are recorded throughout Reach 4, where this hawk forages in the grassland and agricultural areas, and nests in the riparian forest along the river. The San Luis NWR and Grasslands WMA in Reach 4B support marsh and emergent wetlands, native grasslands, alkali sink, riparian forests, and vernal pool habitats; the Grassland WMA supports the largest remaining block of contiguous wetlands in the Central Valley. Numerous documented occurrences of special-status species affiliated with these habitats have been documented throughout this subreach. Species include Delta button-celery, American badger, California tiger salamander, Conservancy fairy shrimp, giant garter snake, northern harrier, San Joaquin kit fox, vernal pool fairy shrimp, vernal pool tadpole shrimp, western pond turtle, and western spadefoot toad.

Reach 5. Occurrences of Swainson's hawk are recorded throughout Reach 5, where this hawk forages in the grassland and agricultural areas, and nests in the riparian forest along the river. Just north of the San Joaquin River and Bear Creek confluence, the river crosses through Great Valley Grasslands State Park and then again traverses through the San Luis NWR. The State Park and San Luis NWR support marsh and emergent wetlands, alkali sacaton grasslands, alkali sink, riparian forest, and vernal pool habitats. Numerous occurrences of special-status species affiliated with these habitats are documented in the State Park and San Luis NWR, including Delta button-celery American badger, California tiger salamander, Conservancy fairy shrimp, longhorn fairy shrimp, San Joaquin kit fox, tricolored blackbird, vernal pool tadpole shrimp, western pond turtle, and western spadefoot toad. The State Park and NWR also support occurrences of other rare and endangered species, although these are not documented in the Restoration Area itself; these species include alkali milk-vetch, brittlescale, heartscale, Hispid bird's-beak, lesser saltscale, prostrate navarretia, vernal pool smallscale, and Wright's trichocoronis. Farther along this reach, the river traverses the North Grasslands WA, which contains over 7,000 acres of wetlands, riparian habitat, and uplands, and provides habitat for Swainson's hawk and greater sandhill crane. The West Hilmar WA is located to the north and contains 340 acres of oaks, cottonwoods, and grasslands providing habitat for great blue heron and great egret.

Chowchilla Bypass. Heartscale and subtle orache, both grassland-associated species, are documented in the Chowchilla Bypass. BNLL, which prefers open habitats and washes, is also known to occur in the Chowchilla Bypass. Large elderberry shrubs at the bifurcation structure, particularly where Lone Willow Slough comes onto the levee right-of-way, have potential to support valley elderberry longhorn beetle. Burrowing owls have been observed occupying burrows near the bifurcation structure, and the scattered cottonwoods along the Chowchilla Bypass provide nest sites for Swainson's hawk. Bald eagles are also known to nest along the Chowchilla Bypass. The *Recovery Plan for Upland Species of the San Joaquin Valley, California*, has identified the Chowchilla and Eastside bypasses and natural lands along them as a movement corridor for San Joaquin kit fox. The plan includes as one of its recovery actions for San Joaquin kit fox "maintenance and enhancement of the Chowchilla or Eastside Bypasses and natural lands along the corridor through acquisition, easement, or safe harbor initiatives" (USFWS 1998).

Eastside Bypass. Where the Eastside Bypass traverses through the Grassland WMA, San Luis NWR, and Merced NWR, which support marsh and perched wetlands, sand dunes, riparian forests, native grasslands, and vernal pool habitats, there are several documented occurrences of special-status species affiliated with these habitats. These species include Delta button-celery, Wright's trichocoronis, California tiger salamander, Conservancy fairy shrimp, San Joaquin kit fox, Swainson's hawk, tricolored blackbird, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The Merced NWR also supports habitat for Colusa grass. Other special-status species, including brittlescale, heartscale, Sanford's arrowhead, vernal pool smallscale, and American badger, are documented in the vicinity but outside the Restoration Area. Critical habitat for Hoover's spurge, Colusa grass, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Conservancy fairy shrimp has been designated within and adjacent to the Restoration Area along the Eastside Bypass.

Mariposa Bypass. The Mariposa Bypass supports several occurrences of Delta button-celery. Critical habitat for Hoover's spurge, Colusa grass, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Conservancy fairy shrimp has been designated within and adjacent to the Restoration Area along the Mariposa Bypass.

3.5.3 San Joaquin River from Merced River to the Delta

The San Joaquin River downstream from the Merced River confluence is similar to the river upstream from the confluence. The upstream portion of the reach below the Merced River is more incised than the downstream area, with generally drier conditions in the riparian zone and a less developed understory.

Agricultural land use has encroached on the riparian habitat along most of the river. Along much of the river, only a narrow ribbon of riparian habitat is supported. However, riparian habitat is more extensive locally, especially near the confluence with tributary rivers, within cutoff oxbows, and in the 6,500-acre San Joaquin River NWR between the confluences with the Tuolumne and Stanislaus rivers. Remnant common tule- and cattail-dominated marshes may occur in these areas.

Special-status species in this reach include plant species that occur in the river floodplain, such as Delta button-celery, and marsh plants, such as Sanford's arrowhead, a CNPS List 1B species. Special-status animals include valley elderberry longhorn beetle, Swainson's hawk, and a number of riparian-dependent songbirds, such as least Bell's vireo and yellow warbler. The riparian brush rabbit, Federally listed and State-listed as endangered, and riparian woodrat, Federally listed as endangered, are found along the lower San Joaquin River (CNDDB 2008).

3.6 Biological Resources – Fish

Fish in the San Joaquin River upstream from Friant Dam, San Joaquin River downstream from the Merced confluence (Restoration Area), and in the Delta have the potential to be affected by implementation of WY 2010 Interim Flows. Fisheries resources in each geographic subarea are briefly described below.

3.6.1 San Joaquin River Upstream from Friant Dam

Most of the commonly occurring species in Millerton Lake are introduced game or forage species. Principal game species include spotted bass, largemouth bass, smallmouth bass (collectively referred to as black bass), bluegill, black crappie, and striped bass. The principal forage species for most of the game fishes is threadfin shad. Several native nongame species have been collected from the reservoir, including Sacramento sucker, Sacramento pikeminnow, Sacramento blackfish, hitch, hardhead, and white sturgeon. Currently, Kern brook lamprey are not considered to occur within Millerton Lake.

Millerton Lake is dominated by black bass species, which spawn in shallow edge waters in depths anywhere from 3 to 9 feet deep. Spotted bass begin spawning in Millerton Lake as early as late March, peaking in late May and early June (Wang 1986). Largemouth bass begin spawning in Millerton Lake in March and may spawn through June (Mitchell 1982). If reservoir elevations fluctuate during the spawning and incubation period in spring, the young are at risk of increased mortality. Under current reservoir operations, Millerton Lake water levels change by a foot or more per day almost 50 percent of days, and change by 2 feet or more about 10 percent of days.

American shad, introduced into Millerton Lake in the 1950s, have marginal value as a sport fish in Millerton Lake, but are highly sought after as a sport fish by anglers in some regions of California and other states. American shad are also an important prey item for adult striped bass (California Striped Bass Association 2006). The Millerton Lake population of American shad is the only known successfully spawning, landlocked population.

3.6.2 San Joaquin River from Friant Dam to Merced River

Of the native fish species historically present in the San Joaquin River, at least eight are now uncommon, rare, or extinct, and nonnative warm-water fish species have become dominant. Nonnative species appear better adapted to current, disturbed habitat conditions than native assemblages. However, habitat conditions in Reach 1 (slightly higher gradient, cooler water temperatures, and higher water velocities) seem to have restricted many introduced species from colonizing this reach. Fish species currently known to occur in the Restoration Area are shown in Table 3-8.

Table 3-8.
Fish Species Identified or Presumed to Occur in the San Joaquin River

Common Name	Native or Introduced	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Downstream
Pacific lamprey	Native	X	X	X	X	X	X
Kern brook lamprey	Native	X					
Smallmouth bass	Introduced					X	
Sacramento pikeminnow	Native					X	X
Carp	Introduced	X	X			X	X
Goldfish	Introduced	X	X			X	X
Golden shiner	Introduced	X	X			X	X
Red shiner	Introduced		X			X	X
Hitch	Native					X	X
Fathead minnow	Introduced					X	X
Blackfish	Native					X	X
Sacramento splittail	Native					X	X
Sacramento sucker	Native	X	X			X	X
Black bullhead	Introduced					X	X
Brown bullhead	Introduced	X				X	X
Channel catfish	Introduced	X				X	X
White catfish	Introduced					X	X
Rainbow trout	Native	X					
Central Valley steelhead	Native						X
Threespine stickleback	Native	X					
Sculpin spp.	Native	X				X	X
Mosquitofish	Introduced	X	X			X	X
Black crappie	Introduced	X				X	X
White crappie	Introduced					X	X
Bluegill	Introduced	X	X			X	X
Green sunfish	Introduced	X	X			X	X
Redear sunfish	Introduced	X	X			X	X
Largemouth bass	Introduced	X	X			X	X
Spotted bass	Introduced	X	X			X	X
Bigscale logperch	Introduced					X	X
Tule perch	Native					X	X
Threadfin shad	Introduced		X			X	X
Striped bass	Introduced					X	X
Inland silverside	Introduced					X	X
Fall-run Chinook salmon	Native						X
Hardhead	Native	X	X				X
California roach	Native					X	X
White sturgeon	Native						X

Sources: DFG 1991, 2007, Saiki 1984, Brown and Moyle 1993, Yoshiyama et al. 1998.

In general, species diversity increases downstream, while species composition shifts from native species to nonnative species (DFG 2007). Much of Reach 2 is typically dry; thus, fish populations are confined to the upper part of Reach 2 upstream from Gravelly Ford, and to the Mendota Pool in the lower part of Reach 2, with restricted fish migration between these habitats. Because Reach 4 is dry much of the time, only a single fish species – inland silverside – has been documented in Reach 4 in the past 25 years (Saiki 1984, DFG 2007). Reach 5 has perennial flow. The occurrence of fish in the Restoration Area bypasses depends on the routing of flood flows through the bypass system. When water is present, fish of all life stages may enter the bypasses from upstream diversion points such as the Chowchilla Bypass Bifurcation Structure and Sand Slough Control Structure. Information on fish species that may use temporary aquatic habitat in the bypasses is not available. However, it is assumed that any species present near the diversion points would be routed into the bypasses along with flood flows.

3.6.3 San Joaquin River from Merced River to the Delta

The lower San Joaquin River downstream from Reach 5 provides physical habitat similar to Reach 5. Flows are substantially increased by input from the Merced, Tuolumne, Stanislaus, and Calaveras rivers. Water management in the San Joaquin River focuses on diversion of water out of streams and rivers into canals for agricultural use, with some of the applied water returned as agricultural drainage (Brown and May 2006). Fish species presently inhabiting the San Joaquin River from the confluence with the Merced River to the Delta are listed in Table 3-8.

Fall-run Chinook salmon inhabit the Merced, Tuolumne, and Stanislaus rivers, supported in part by hatchery stock in the Merced River. The average annual spawning escapement (1952 through 2005) for the three major San Joaquin River tributaries was an estimated 19,100 adults. Since 1952, fall-run Chinook salmon populations in the San Joaquin basin have fluctuated widely, with a distinct periodicity that generally corresponds to periods of drought and wet conditions. Recent escapement estimates in 2006 and 2007 indicate another period of severe declines, presumably unrelated to drought, with a near-record low escapement in 2007 (DFG 2008d). Steelhead are still present in low numbers in the Stanislaus, Tuolumne, and possibly the Merced river systems below the major dams (McEwan 2001, Zimmerman et al. 2008), but escapement estimates are not available.

Brown and May (2006) summarized presence/absence of fish species in the San Joaquin River downstream from the Merced River confluence. Native species include Sacramento sucker, Sacramento pikeminnow, Sacramento splittail, tule perch, prickly sculpin, Sacramento blackfish, and hardhead (Brown and May 2006) (Table 3-8). In addition, California roach, threespine stickleback, lamprey, and hitch likely occur, although they were not detected during the springtime monitoring efforts summarized by Brown and May (2006).

3.6.4 Sacramento-San Joaquin Delta

The historical Delta consisted of low-lying islands and marshes that flooded during high spring flows. More than 95 percent of the original tidal marshes have been leveed and filled, resulting in substantial losses of high-quality aquatic habitat (USGS 2007). The current Delta consists of islands, generally below sea level, surrounded by levees to keep out water. Freshwater inflow into the Delta has been substantially reduced by water diversions, mostly to support agriculture but with an increasing shift to M&I uses. Dredging and other physical changes have altered water flow patterns and salinity (USGS 2007). Nonnative species are changing the Delta's ecology by altering its food webs. All of these changes have had substantial effects on the Delta's biological resources, including marked declines in the abundance of many native fish and invertebrate species (Greiner et al. 2007).

The Delta supports freshwater fishes, anadromous fishes, estuarine fish, nursery grounds for marine fish, and freshwater species that can tolerate high salinities (Moyle 2002). Key native species that occur in the Delta include delta smelt, longfin smelt, Chinook salmon, steelhead, green and white sturgeon, splittail, and starry flounder. Species identified in Table 3-9 will be evaluated for effects from the WY 2010 Interim Flows.

Table 3-9.
Delta Fish Species Evaluated for WY 2010 Interim Flows

Species	Status
Delta smelt	Federally listed as threatened, State-listed as threatened
Longfin smelt	Proposed Federally listed as threatened, proposed State-listed as threatened
Green sturgeon	Federally listed as threatened
Central Valley late fall-run/ fall-run Chinook salmon	Federal species of concern, State species of special concern
Sacramento River winter-run Chinook salmon	Federally listed as endangered, State-listed as endangered
Central Valley spring-run Chinook salmon	Federally listed as threatened, State-listed as threatened
Central Valley steelhead	Federally listed as threatened
Sacramento splittail	State species of special concern

Key:
WY = Water Year

3.7 Cultural Resources

Cultural resources are defined as prehistoric and historic-era archaeological sites, Traditional Cultural Properties, Sites of Religious and Cultural Significance, and architectural properties (e.g., buildings, bridges, and structures). This definition includes historic properties as defined by the National Historic Preservation Act (NHPA).

Historic resources for this analysis were identified solely through archival documentation. No fieldwork was used to confirm the presence or absence of sites, nor has any new survey evaluation work been done to assess significance of existing historic-period resources within the Restoration Area. Historic-era resources identified through formal recordation on site records, California Department of Parks and Recreation (DPR) 523 property inventory forms, or through other State or local landmark inventory programs, are referred to in this analysis as “known” or “previously recorded” resources. To develop the sensitivity assessments, archival research and historic mapping were undertaken. The actual presence or integrity of historic-era architectural resources identified only through archival research and historic mapping is unknown, and these are referred to in this study as “identified resources.”

3.7.1 San Joaquin River Upstream from Friant Dam

Surveys of the Millerton Lake SRA have identified 19 sites that lie below the maximum water level and above the low water level of Millerton Lake (Byrd and Wee 2008, Theodoratus and Crain 1962). All 19 prehistoric sites, including 13 bedrock milling sites, 4 residential sites, and 1 lithic scatter. The most notable of these is MAD-98, which was excavated by Hines (1988).

These sites are currently seasonally inundated by Millerton Lake. If the existing pattern of lake fluctuations changes, it may be appropriate to assess potential changes to site impacts. Significantly lower lake levels may increase exposure of existing sites or expose unrecorded sites that are currently fully inundated by Millerton Lake. At present, only two known sites (MAD-8 and FRE-71) are fully inundated by the lake. Both are large prehistoric residential sites recorded by Hewes in the 1930s (1941). Unrecorded sites may also exist.

3.7.2 San Joaquin River from Friant Dam to Merced River

Known cultural resources within the Restoration Area include several places of importance to the various Yokuts Tribes in particular. Some of the sites are close to the river. Major areas of resource concentrations appear to be in Firebaugh, Friant, the lower river from Fremont Ford to the Stanislaus County border, Herndon, Lanes Bridge, various current and former river alignments in the Sanjon de Santa Rita, and a number of sloughs and river locales north of San Luis Island. Cultural resource archival records are relatively limited within the Restoration Area. Based largely on the Central California and San Joaquin Valley information centers records search results, 213 cultural resources studies have been documented. Archaeological surveys have inventoried 12 percent of the Restoration Area, as shown in Table 3-10.

Table 3-10.
Summary of Cultural Resources Results by Reach

Reach	1	2	3	4	5	Bypasses	Total
Acreage	47,883	23,667	23,600	43,821	17,678	12,750	169,399
Archaeological Survey (%)	24.6	5.1	1.6	9.7	8.3	11.7	12.2
Recorded Archaeological Sites (resources with trinomials)							
Historic-Era	15	1	0	2	0	0	18
Prehistoric	42	7	0	12	18	5	84
Prehistoric/Historic-Era	5	0	0	2	0	0	7
Total	62	8	0	16	18	5	109
Recorded Historic-Era Architecture							
Primary Number Only	20	0	1	1	3	0	25
Caltrans Bridge Inventory	4	0	0	0	1	0	5
Partially Documented	10	0	0	0	0	0	10
Archaeological Sites with Architecture [1]	3	1	0	2	0	0	6
From Fresno County Historic Places List[4]	–	–	–	–	0	0	10
Total	37	1	1	3	4	0	56
Potential Prehistoric Surface Site Distribution[3]							
Using Survey Results by Reach	171	59	522	82	156	17	536
Buried Prehistoric Site Potential							
Very Low-Low (%)	31	41	14	41	38	73	35
Moderate (%)	0	0	6	20	4	22	8
Very High-High (%)	57	54	78	37	55	3	51
Potentially Sensitive Historic-Era Archaeological Sites							
Number	139	20	23	26	6	0	214
%	65	9.3	10.7	12.1	2.8	0	99.9
Potential Historic-Era Architectural Resources							
Number	841	90	101	94	121	14	1,242
By Weighted Value	942	123	141	138	121	13	–

Notes:
[1] Also counted in archaeological site numbers.
[2] Average density for Reaches 2 and 4 (2.2) used to generate this value.
[3] Conservative estimate–higher densities indicated by landform age data.
[4] Locations uncertain.
Key:
– = Not available

A total of 109 archaeological sites have been recorded within the Restoration Area. This includes 84 prehistoric sites, 18 historic-era sites, and 7 sites with both prehistoric and historic-era components. Most are concentrated in Reach 1 (57 percent) where inventory efforts have been the most rigorous, while Reach 3 lacks documented sites (with only 2 percent surveyed).

The 91 prehistoric sites and components include 35 major residential sites, 11 residential sites, 28 bedrock milling localities, 11 artifact scatters, 3 artifact scatters with bedrock milling, 2 lithic scatters, and 1 site with a single house pit. Many of the major residential sites have mounds (n=7), house pit depressions on the surface (n=21), and human remains (n=17). Human remains have also been noted at six other sites.

The 25 historic-era archaeological sites include 8 refuse deposits, 7 structural remains, 4 structural remains with refuse deposits, 4 water-related resources (2 check dams, 1 ditch, and 1 canal with refuse), and 2 railroad grades. Those with structural remains include residential and commercial buildings, Dickerson's Ferry, and ranches.

A total of 56 historic-era architectural resources were variously documented within the Restoration Area. These include 32 residential and commercial buildings, 7 bridges, 6 canals, 3 ferries, 2 dams, and 6 miscellaneous (1 rookery, 2 forts, 1 point, 1 pueblo, and 1 railroad grade). Most are concentrated in Reach 1 where inventory efforts have been the most rigorous.

Sensitivity Assessments

Distinct approaches to assessing sensitivity were applied to prehistoric archaeological sites, historic-era archaeological sites, and historic-era architectural resources.

Prehistoric Sites. Prehistoric surface site densities are relatively low and highly patterned by landform, based on the results of archaeological surveys. Middle Holocene landforms have the highest site density (20 per 1,000 acres), followed by Early Holocene and Latest Holocene-Modern landforms (4 sites per 1,000 acres), while Late Holocene and Pleistocene-and-Earlier landforms have much lower densities (2 to 3 sites per 1,000 acres). Landform age distribution also varies greatly throughout the Restoration Area; for example, Middle Holocene landforms are concentrated in Reach 4. Based on survey results, site densities are highest in Reach 5, and lowest in the bypass system. It is anticipated that full inventory would document between 500 and 800 surface sites. Over half of the Restoration Area appears to have a high to very high potential for buried sites. This is because large portions are covered by Latest Holocene-Modern (36 percent) and Late Holocene (15 percent) landforms. These results suggest that the low surface site densities in the Restoration Area may be largely due to alluviation that has buried much of the archaeological record (notably sites dating from the Latest Pleistocene through the Middle Holocene). Hence, differential sensitivity for encountering surface and buried prehistoric sites is contextual within this large study area, but landform age appears to be the most appropriate tool for assessing localized sensitivity.

Historic-Era Sites. Owing to the minimal number of recorded sites, the historic-era sensitivity analysis included known sites and potential archaeological sites based on documentary research. Of 1,024 potential archaeological resources, 214 are assessed as potentially sensitive historical archaeological properties. These include 92 that predate 1915, 119 agricultural properties dating from 1915 to 1950, 2 1930s labor camps, and a Japanese Assembly Center. The remaining 810 potential site locations, all dating after 1915, were considered unlikely to contain significant information. Overall, agricultural properties (64 percent) dominate the potentially sensitive sites, followed by residences

(22 percent), and towns and settlements (10 percent). Most of these are concentrated in Reach 1 (65 percent). Reaches 2 through 4 contain from 9 percent to 12 percent of these potential resources, Reach 5 has less than 3 percent, and the Eastside Bypass has none.

Historic-Era Architecture. The number of "identified resources" outweighs the "known resources" by a factor of approximately 22:1, with identified resources numbering 1,242 and previously recorded resources totaling 56. In large part, this great discrepancy is explained by the limited number of historic-era property survey reports undertaken within the 169,398-acre Restoration Area. The 1,242 localities with potential historic-era architecture are dominated by buildings and structures, followed by transportation infrastructure and water-related engineering features (comprising 93 percent). Homestead patents comprise 5 percent, with the remaining 2 percent including mining, recreation, private land grants in the prestatehood era, and miscellaneous elements, such as cemeteries, land colonies, and historic settlements. The sensitivity assessment used a qualitative ranking by assigning a numerical value to each potential resource based on three main variables: (1) estimated construction, (2) assumed presence or absence at the end of the historic period, and (3) known historic association. Reach 1 has the highest sensitivity; Reaches 2, 3, 4, and 5 have appreciably less potential by a factor of about 7:1; and the Eastside Bypass has a ratio of 70:1.

Potential Resources Eligible for Inclusion in National Register

Five previously recorded resources have been determined eligible for the National Register of Historic Places. All are architectural resources: Mendota Dam (P-10-03200), Merced River Bridge (P-24-00724), Madera Canal (P-20-02308), Friant-Kern Canal, and Friant Dam. While the latter three resources contribute to the overall proposed CVP multiple property listing currently being undertaken by Reclamation, the Friant-Kern Canal and Friant Dam have also been found individually eligible for listing on the National Register. No individual archaeological sites are currently listed on the National Register, although one site, MER-415, has been determined eligible.

Salient research domains useful for assessing the significance and eligibility for nomination were identified separately for prehistoric and historic-era archaeological sites. For surface prehistoric sites, residential sites have the highest likelihood for being evaluated as eligible for inclusion on the National Register. Most of these sites are Late Holocene in age, and most of the archaeological record dating between 4,000 and 12,000 years ago lies buried by later alluvium. In contrast to surface sites, a more varied range of buried sites is more likely to be evaluated as eligible for the National Register because they would fill important data gaps in understanding the region's prehistory.

Agriculture sites (64 percent) and residences and towns (32 percent) dominate the potentially eligible historic-era archaeological sites. Most of the former date to between 1915 and 1950, while potentially eligible residences and towns all predate 1915. Although these property types were given greater weight, all potential types of archaeological properties were discussed with respect to their ability to address significant research questions and the appropriate data sets to do so.

3.8 Geology and Soils

Because of the regional-scale nature of earth resources, the geology and soils characteristics addressed in this section are described in a regional context, referring to geologic provinces, physiographic regions, or other large-scale areas, as appropriate.

3.8.1 Geology and Seismicity

The various geologic processes active in California over millions of years have created many geologically different areas, called provinces. The upper San Joaquin River lies in the Sierra Nevada Province, and the Restoration Area and lower San Joaquin River are in the Central Valley Province.

The Sierra Nevada Province encompasses the Sierra Nevada mountains, and comprises primarily intrusive rocks, including granite and granodiorite, with some metamorphosed granite and granite gneiss. The province is a tilted fault block nearly 400 miles long, with a high, steep multiple-scarp east face and a gently sloping west face that dips beneath the Central Valley Province (CGS 2002a).

The Central Valley Province encompasses the Central Valley, an alluvial plain about 50 miles wide and 400 miles long in the central part of California, stretching from just south of Bakersfield to Redding, California. The San Joaquin River and its tributaries flow out of the Sierra Nevada Province into the Central Valley, depositing sediments on the alluvial fans, riverbeds, floodplains, and historical wetlands of the Central Valley Province. The Central Valley Province is characterized by alluvial deposits and continental and marine sediments deposited almost continually since the Jurassic Period (CGS 2002b). The most recent surficial alluvial deposits are mined for aggregate, as discussed below (CGS 2002a).

Both the Sierra and Central Valley geologic provinces continue to be subject to minor tectonic activity (occurring within the past 1.6 million years). Active and inactive faults are recognized on both the north and south sides of the San Joaquin Valley. Earthquake groundshaking hazard potential is low in most of the San Joaquin Valley and Sierra Nevada foothills (CSSC 2003). The San Joaquin Valley is not a high-risk liquefaction area because of its generally low earthquake and groundshaking hazard risk; however, some liquefaction risk exists throughout the valley in areas where unconsolidated sediments and a high water table coincide, such as near rivers and in wetland areas (Mintier and Associates 2007).

3.8.2 Land Subsidence

Four types of land subsidence occur in the San Joaquin Valley: aquifer-system compaction due to groundwater level decline, near-surface hydrocompaction, subsidence due to fluid withdrawal from oil and gas fields, and subsidence caused by deep-seated tectonic movements (Ireland et al. 1982). Groundwater level decline has been one of the primary causes of land subsidence in the San Joaquin Valley because of compaction of aquifer sediments as a result of overdraft of the confined aquifer (Ireland 1986).

3.8.3 Salts

The accumulation of salts in the soils of the San Joaquin Valley is due to a combination of the regional geology, high water table, intensive irrigation practices, and importation of water from the Delta that is high in salinity and is applied to lands in the region. The Corcoran Clay and other clay layers contribute to a naturally high water table in the valley, concentrating salts in the root zone by evaporation through the soil. Farmers actively leach these salts from the soil into drainage water with irrigation and subsurface drainage practices. Drainage water with high concentrations of salts may be reused for irrigation (with or without treatment), accumulate in groundwater, or be discharged to evaporation ponds or tributaries to the San Joaquin River. The salinization caused by concentrations of naturally occurring soil salts is exacerbated by the use of more saline Delta water, imported via the DMC and the California Aqueduct, as a major source of irrigation water.

Additionally, naturally occurring trace elements in soils may be mobilized and concentrated along with salts. Soils throughout the San Joaquin Valley typically contain some selenium (see Figure 3-3), and soils on the west side of the valley are particularly selenium-rich. These soils have developed on alluvial deposits comprising eroded material from the Coast Range, where selenium is found in marine deposits. Selenium can pose a hazard to fish and wildlife when it becomes highly concentrated in surface waters.

To address the ongoing problem of salinization of soils and water in the Valley, the SWRCB, the Central Valley Regional Water Quality Control Board (RWQCB), and the multifaceted stakeholder group named the Central Valley Salinity Coalition, have teamed to lead efforts to identify and manage salt sources and processes causing salt loading in the San Joaquin Valley. Through the program CV-SALTS, this diverse group is devising a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management strategy. Reclamation has also agreed to participate in salinity control efforts in the lower San Joaquin River watershed, as described in its Management Agency Agreement with the Central Valley RWQCB.

Total maximum daily loads (TMDL), which define a maximum acceptable level of loading of a particular constituent in surface water, exist or are currently being developed for salts in the San Joaquin River and several tributaries. More information on salt-related TMDLs, as well as a more detailed description of the water quality conditions in the study area, are presented in Section 3.11, Hydrology and Water Quality.

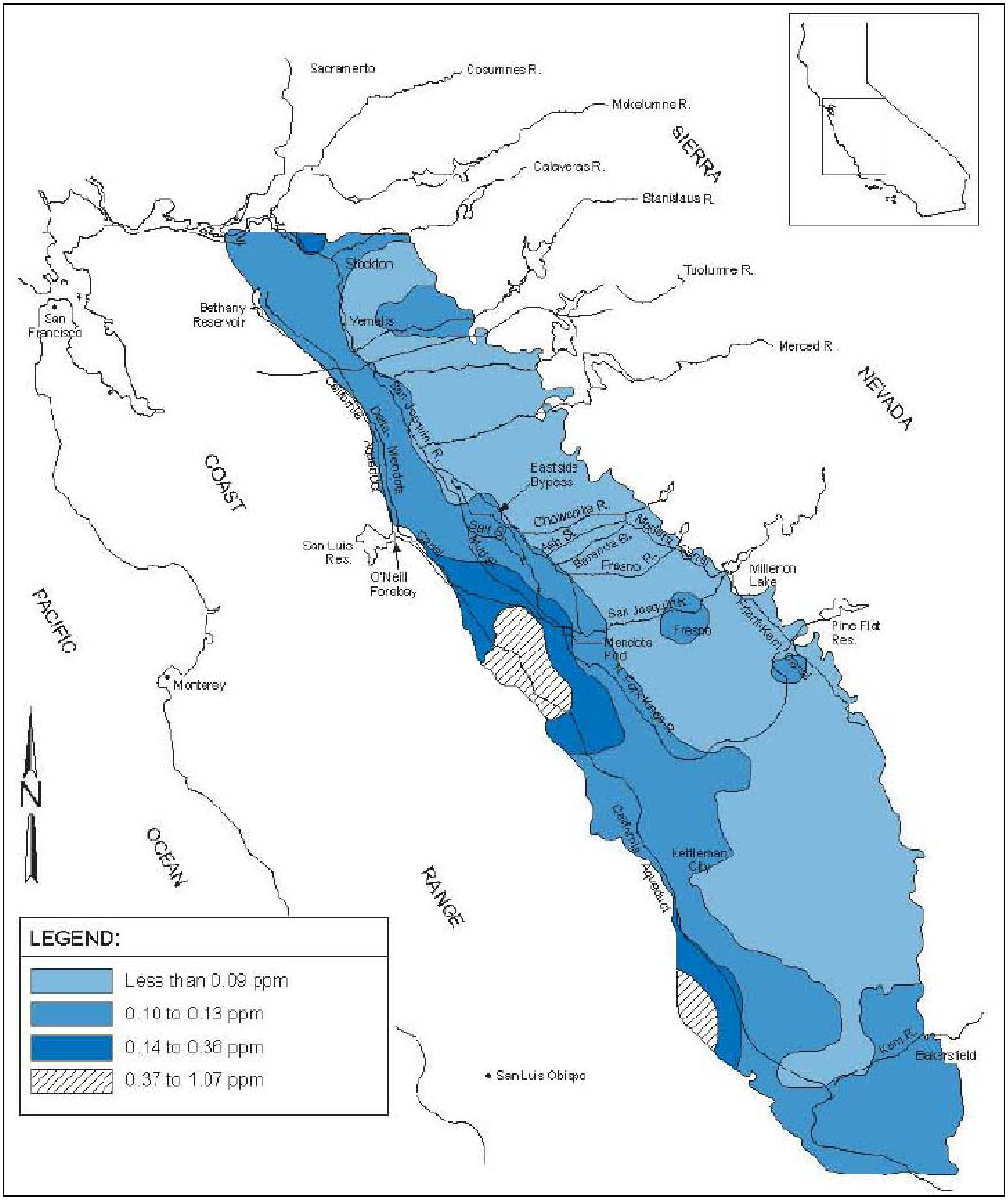


Figure 3-3.
Selenium Concentrations in Top 12 Inches of Soil in San Joaquin Valley

3.8.4 San Joaquin River from Friant Dam to Merced River

The following subsections describe geology and soils in the Restoration Area in more detail. Geology, seismicity and neotectonics, soils, erosion and sedimentation, and geomorphology are discussed as they apply to each reach of the Restoration Area and the bypasses.

Reach 1

At Friant Dam, the San Joaquin River leaves its narrow canyon in the Sierra Nevada mountains. After exiting the mountains, the river is confined by bluffs 50 to 100 feet high as a result of the river incising the Pleistocene alluvial fan. Within the bottomland between the bluffs, the river has also cut through more recently formed (Holocene) old alluvial fans, the remnants of which now make up terraces 15 to 30 feet high bounding the river. These confining features extend as far as Gravelly Ford.

Reach 1 has the steepest slopes in the Restoration Area. The reach has a coarse sediment substrate consisting of gravels and cobbles, which are prime salmonid spawning material. Since the construction of Friant Dam, the lower watershed has been cut off from the upper watershed, its major source of sediment. Remaining sediment sources to the lower watershed include (1) lateral erosion of terraces, (2) vertical incision of the riverbed itself, and (3) two small tributaries entering the reach directly, Cottonwood and Little Dry creeks. However, reduction in the original high-flow regime after emplacement of Friant Dam has reduced the ability of the river to recruit coarse terrace and bed sediment. Friant Dam (and other upstream dams) has not only severed the lower watershed from its source of coarse sediment, but also has cut off its main source of fine sediment. Fine sands and silts do not generally deposit in the active channel, but do deposit on the floodplain and are necessary for riparian vegetation regeneration. Without such fine sediment, riparian regeneration is impaired.

Soil in Reach 1 is dominated by sandy loam and sand, with minor amounts of loam, clay loam, and clay. Table 3-11 contains the calculated areas in acres for each generalized soil texture. Further National Resource Conservation Service (NRCS) data (Soil Survey Staff 2008) indicate that Reach 1 soils have moderate erosion potential. The exception is the bluffs of the San Joaquin River, which have steep slopes and are subject to high erosion potential.

Table 3-11.
Acreages of Soil Textures in Reaches and Bypasses

Reach	Subreach	Acreage of Soil Texture					Total Acreage
		Clay/Clay Loam	Loam	Sand	Sandy Loam	Variable[1]	
1	1A	103	96	1,541	6,193	2,732	10,663
	1B		24	902	3,629	610	5,165
	Reach 1 Total	103	119	2,443	9,822	3,341	15,828
2	2A		525	540	2,684	780	4,530
	2B	517	1,274	129	2,065	658	4,644
	Reach 2 Total	517	1,799	669	4,750	1,438	9,173
3	3	885	1,279	209	5,096	588	8,056
4	4A	624	713	254	2,602	402	4,595
	4B1	3,211	1,192	539	870	701	6,513
	4B2	1,338	509	82	418	983	3,331
	Reach 4 Total	5,173	2,415	875	3,890	2,086	14,439
5	5	2,583	317	341	756	1,464	5,460
Bypasses	(all subreaches)	4,896	7,937	672	3,980	2,137	19,623
Total All Reaches		19,950	18,198	9,198	46,755	17,920	112,020

Source: Soil Survey Staff 2008
Note:
[1] The category "variable" includes soils of undifferentiated texture and areas that were not mapped by the National Resource Conservation Service (i.e., covered by water during the mapping period).

Reach 2

Along the downstream end of Reach 1B, river terraces gradually merge with the floodplain, and by Gravelly Ford, bluffs and terraces no longer confine the river. The lack of confining features and the reduced gradient in Reach 2 both cause the channel to change to sand-bedded, meandering morphology. Meanders are moderate in Reach 2A and become more sinuous in Reach 2B as the river runs up against the prograding alluvial fans of the Coast Range drainages. The presence of the large-scale sloughs that typify the lower river reaches begins at the boundary of Reaches 2A and 2B.

Because of lack of through flows, most sediment is routed through the Chowchilla Bypass and very little sediment currently moves through Reach 2B. Instead, most sediment is routed with flows into the bypass, or accumulates at the entrance to the bypass. Historically, when flows through Reach 2 were more consistent, sediment supply decreased gradually from Reach 1B through Reach 2 the sediment was deposited on the floodplains.

Lack of vegetation and the sandy substrate cause the riverbed to be easily eroded when flows do pass through the reach. Bed mobility probably occurs at most baseflows, and bed scour is likely at flows of a few thousands cfs. As a result of this erosion, channel avulsion and migration can still occur between the project levees. Local landowners perform some sand mining in the levees, leaving pits 10 to 15 feet deep. However, the pits appear to fill after a single flood control release from Friant Dam. Reclamation and DWR are unaware of any Conditional Use Permits for mining activities in Reach 2A or in Eastside Bypass Reach 2.

Soil in Reaches 2A and 2B is dominated by sandy loam and sand, with sand becoming less common and loam more common with distance downstream. Additionally, loam, clay loam, and clay dominate the area of Fresno Slough and the Mendota Pool. Table 3-11 contains the calculated areas in acres for each generalized soil texture in Reaches 2A and 2B. NRCS data (Soil Survey Staff 2008) indicate that most Reach 2 soils have a moderate erosion potential.

Reach 3

Reach 3 is characterized by a meandering, sand-bedded channel, with a meander pattern that is less consistent than the meanders of Reach 2B. The river gradient decreases in Reach 3 relative to Reach 2 (Mussetter 2000a). Man-made structures, including canal embankments and project and nonproject levees, confine the river on both banks and prevent most overbank flows, channel migration, and avulsion. Confining canals are slightly set back from the channel between Mendota and Firebaugh, but downstream from Firebaugh, the channel is tightly bounded by canals that follow the meander of the river. These canals not only restrict the river channel but they also cut off the river from its historic floodplain.

Historic high-flow cut-off channels and meanders have also been separated from the main river channel by canals and levees. Many of these presently convey agricultural return flows and, during rain events, runoff. Examples of these in Reach 3 include Lone Willow Slough, which originates near the Chowchilla Bypass Bifurcation Structure and terminates just over a mile upstream from the Arroyo Canal diversion, and Button Willow Slough, a tributary to Lone Willow Slough.

Construction and operation of the Chowchilla Bypass system has effectively separated Reach 3 from most upstream sediment supply. Much of the sediment that is transported through Reach 2 is then temporarily caught behind Mendota Dam at the head of Reach 3. However, periodic pulling of boards on the dam and occasional draining of the Mendota Pool for inspection allow high flows to eventually carry this sediment into Reach 3. The Chowchilla Bypass Bifurcation Structure itself causes significant backwater effects, resulting in sediment build-up in the river channel just downstream from the structure.

Soil in Reach 3 is dominated by sandy loam, with minor amounts of loam, clay loam, clay, and sand. Table 3-11 contains the calculated areas in acres for each generalized soil texture in Reach 3.

Reach 4

Similar to Reach 3, Reach 4 begins as a meandering, sand-bedded channel with a gradient also similar to that of Reach 3 (Mussetter 2000a). However, in the upstream part of Reach 4, river morphology changes from the moderately confined configuration of Reaches 2 and 3 to the extensive flood basin geometry that characterizes Reaches 4 and 5. Beginning in Reach 4, the channel becomes confined by smaller riparian levees rather than by the bankfull channel and floodplains. Many large anabranching sloughs originate in Reach 4; these sloughs probably conveyed summer and winter baseflows in the past.

The river sediment load is typically low by the time flows arrive at Reach 4. The lack of extensive floodplains and a lower frequency of exposed sand bars within the channel indicate that Reach 4 was historically subject to sediment deprivation relative to upstream reaches. Since the construction of, and diversion of the majority of river flows into, the Chowchilla Bypass in Reach 2, sediment starvation of Reach 4 has increased.

At the boundary between Reaches 4A and 4B1, current operations of the Sand Slough Control Structure divert all flows into the Eastside Bypass. With flows, the entire sediment load of the river is conveyed into the bypass, entirely cutting off the sediment supply from the main river channel to Reach 4B1.

Downstream from the Sand Slough Control Structure, the Mariposa Bypass directs flow and sediment from Reach 4A and the bypass system into Reach 4B. Downstream from the Mariposa Bypass, Reach 4B receives further sediment influx from flow in the Chowchilla and Eastside bypasses and agricultural return flows.

Soil in the upstream half of Reach 4A is dominated by sandy loam, but further downstream, the river channel is characterized by more loam, clay loam, and clay. Soil in Reach 4B comprises mainly clay loam, clay, and some loam, with minor amounts of sandier soils. Lack of flows through this reach has likely prevented channel scour from removing these fine sediments. Table 3-11 contains the calculated areas in acres for each generalized soil texture in Reaches 4A and 4B. NRCS data (Soil Survey Staff 2008) indicate that overall, Reach 4 soils have moderate erosion potential.

Reach 5

The extensive flood basin morphology of Reach 4 continues into Reach 5, with little change in stream gradient. Historically, natural riparian levees provided moderate control of flows, although project and nonproject levees confine the river today. Anabranching channels that historically conveyed summer and winter baseflows continue to be common in this reach. Salt Slough and Mud Slough, tributaries that originate in the farmlands south of Reach 4, join the river in Reach 5. At the downstream end of Reach 5, the alluvial fan of the Merced River provides base level control of the river channel. Downstream from Reach 5, river geometry returns to a floodplain rather than flood basin morphology because of sediment supply from the Merced River.

Soil in Reach 5 is dominated by clay loam and clay, with minor amounts of coarser soils. Table 3-11 contains the calculated areas in acres for each generalized soil texture in Reach 5. NRCS data (Soil Survey Staff 2008) indicate that overall, Reach 5 soils have moderate erosion potential.

Chowchilla Bypass, Eastside Bypass, and Mariposa Bypass

The bypass system has been constructed in the San Joaquin River floodplain and is composed of man-made channels and converted sloughs. A low-flow channel exists in much of the bypass system; however, it is best defined in the Mariposa Bypass, where the high groundwater table maintains more frequent base flows. This aggradation has affected the conveyance capacity of the bypass system (USACE 1993).

Soil in the bypass system is dominated by loam, clay loam, and clay, with some sandy loam and minor amounts of sand. Table 3-11 contains the calculated area in acres for each generalized soil texture in the bypass system. NRCS data (Soil Survey Staff 2008) indicate that overall, soils in the bypass system have moderate erosion potential.

3.9 Mineral Resources

Because of the regional-scale nature of earth resources, the mineral characteristics addressed in this section are described in a regional context.

3.9.1 Mineral Production

In 2006, California ranked third in the Nation in nonfuel mineral production. In that year, California yielded $4.6 billion in nonfuel minerals, totaling 7 percent of the Nation’s entire production (Kohler 2006). The value and quantity produced of the most economically important products in the State are summarized in Table 3-12. Of these products, construction sand and gravel are the most widely mined resources in the vicinity of the San Joaquin River. Historically, gold was also extracted from the riverbed, as described below.

Table 3-12.
California Nonfuel Mineral Production in 2006

Product	Quantity (short tons)	Value ($ millions)
Construction sand and gravel	178,605,000	1,500
Portland cement	12,899,200	1,250
Boron minerals	674,700	731.8
Crushed stone	58,728,000	481.7
Other[1]	NA	395.6
Masonry cement	771,700	87.8
Industrial sand and gravel	2,260,100	62.2
Clays	1,334,000	46.1
Gold	1.11	19.6
Dimension stone	47,400	11.2
Gemstones	NA	1.1
Total	NA	**4,587**

Source: Kohler 2006
Note:
[1] Other includes diatomite, feldspar, gypsum, iron ore, lime, magnesium compounds, perlite, pumice and pumicite, salt, soda ash, silver, talc, sodium sulfate, and zeolites.
Key:
NA = Not available

Sand, Gravel and other Rock Products

In 2006, California was the Nation's largest producer of construction sand and gravel ($1.5 billion) and Portland cement ($1.25 billion) (Kohler 2006). California also produced significant quantities of crushed stone ($481 million), industrial sand and gravel ($62.2 million), masonry cement ($87.8 million), and dimension stone ($11.2 million) (Table 3-12). Together, the market value of these products totals $3.4 billion, almost 75 percent of the total value of State nonfuel mineral production. The San Joaquin River below Friant Dam is a significant source of sand and gravel in the State, and mining occurs at multiple locations on the floodplain and river terraces (Reclamation 1997, Mussetter 2000b).

Gold

Historically, gold was mined from quartz veins in the Mother Lode of the northern Sierra Nevada as well as from placer deposits in loosely consolidated alluvial sediments throughout the Sierra Nevada foothills. The San Joaquin River above Friant Dam was subject to some degree of placer mining from 1848 to 1880, followed by dredge mining from 1880 to the 1960s (Mussetter 2000b). These activities significantly reworked the riverine environments, redistributing sediments and altering channel forms. However, the San Joaquin River was not as affected by dredge mining as the more northerly Sierra Nevada drainages where gold was more plentiful (McBain and Trush 2002). Gold extraction does not currently occur on any part of the San Joaquin River.

3.9.2 San Joaquin River from Friant Dam to Merced River

The following subsections describe the minerals of the Restoration Area in more detail. Mining is discussed for Reach 1 and Reach 2 of the Restoration Area and the bypasses.

Reach 1

Reach 1A is the most substantially aggregate mining part of Reach 1. From Friant Dam to Skaggs Bridge (Highway 145), at least nine large pits ranging in size from 2.8 to 67.3 acres have been captured by the river (McBain and Trush 2002). More than 60 separate pits have been identified within this reach. Table 3-13 shows the total area of mining pits and percentage capture by the river between Friant Dam and Skaggs Bridge. Local channel degradation throughout Reach 1 can most likely be attributed to this mining in combination with the cutoff of sediment supply from the upper watershed (McBain and Trush 2002).

Table 3-13.
Aggregate Mining Areas in Reach 1 Between Friant Dam and Skaggs Bridge

Reach	Total Area of Mining Pits (acres)	Area of Pits Captured by River (acres)	Percentage of Pits Captured
Reach 1A from Friant Dam to State Route 41	494.5	7.5	1.5
Reach 1A from State Route 41 to State Route 99	784.4	155.4	19.8
Reach 1B from State Route 99 to Skaggs Bridge (Highway 145)	76.2	26.8	35.1
Totals	1,355.1	189.7	56.4

Source: McBain and Trush 2002

Substantial aggregate mining in the San Joaquin River and its tributaries has significantly decreased coarse sediment replenishment. In Reach 1A, an estimated 1,562,000 cubic yards of aggregate were removed from the active channel of the San Joaquin River between 1939 and 1989, and another 3,103,000 cubic yards were removed from the floodplain and terraces. In Reach 1B during the same time period, an estimated 107,000 cubic yards of aggregate were removed from the active river channel and 72,000 cubic yards were extracted from the floodplain and terraces (McBain and Trush 2002).

This total quantity of aggregate is in fact much greater than the amount of coarse sediment thought to have been delivered from the upper watershed under unimpaired (pre-Friant Dam) conditions (between 26,000 and 48,600 cubic yards/year). Given this sediment transport rate, in the absence of Friant Dam, the river would have transported approximately 1,865,000 cubic yards of material into Reach 1 in the 50-year period from 1939 through 1989. The aggregate removed from the active river channel in Reach 1A alone during this same time period (1,562,000 cubic yards) nearly equals this amount. Local channel degradation throughout Reach 1 can mostly likely be attributed to this mining in combination with the cutoff of sediment supply from the upper watershed (McBain and Trush 2002).

Reach 2

Local landowners perform some sand mining in the levees, leaving pits 10 to 15 feet deep. However, the pits appear to fill after a single flood control release from Friant Dam. Reclamation and DWR are unaware of any Conditional Use Permits for mining activities in Reach 2.

Chowchilla Bypass, Eastside Bypass, and Mariposa Bypass

A sediment detention basin is located in the Chowchilla Bypass downstream from the bifurcation structure. The 250,000-cubic yard basin captures incoming sediment, particularly sand, to prevent it from filling the bypass channels further downstream. As part of their operations and maintenance, the Lower San Joaquin Levee District (LSJLD) contracts with private companies to excavate this sand to maintain basin capacity. LSJLD generates revenue from sand removal activities. Sand scoured from Eastside Bypass Reach 1 is deposited in Eastside Bypass Reach 3.

3.10 Hazards and Hazardous Materials

Hazards and hazardous materials are described in terms of anthropogenic hazards, West Nile virus (WNV), Valley Fever, school safety, oil and gas wells, wildland fire, and aircraft safety.

3.10.1 Anthropogenic Hazards

The following subsections describe anthropogenic hazards in the study area, which are primarily limited to the Restoration Area and downstream.

San Joaquin River from Friant Dam to Merced River

Anthropogenic sources of hazardous materials and waste may exist in both the agricultural and urbanized portions of the Restoration Area. Contaminated sites generally are the result of unregulated spills of hazardous materials, such as gasoline or industrial chemicals, which result in unacceptable levels of toxic substances in soil or water that pose risks to human health and safety. Contamination also may result from ongoing land uses that generate substantial amounts of hazardous wastes, such as mines and landfills.

Hazardous waste sites listed below were compiled from the Department of Toxic Substances Control's Cortese List, SWRCB's Geotracker (2008), and USEPA's Enviromapper databases.

Areas currently or historically used for agricultural purposes, such as a large portion of the study area, are likely to have received pesticide, herbicide, and fertilizer applications. Therefore, it should be assumed that all geographic areas discussed below are potentially contaminated with residual agricultural chemicals.

Reach 1. In addition to two sites for which remediation has been completed, two additional sites in Reach 1 are known to contain hazardous materials and are considered to have "open" SWRCB cleanup status. Palm Bluffs Corporate, located at 7690 Palm Avenue, Fresno, is listed as a land disposal site. Southern Pacific Transportation Company, located at 17390 Friant Road, Friant, is listed for potential chromium and other metals contamination.

Reach 2. One site in Reach 2 is listed in the above-mentioned databases. Mendota Landfill is considered by SWRCB to have open cleanup status, and potential volatile organic compound contamination.

Reach 3. The SWRCB lists eight sites for which remediation has been completed. Four leaking underground storage tank (LUST) sites are known in Firebaugh, in the vicinity of Reach 3.

Reaches 4 and 5. No sites listed in the above-mentioned databases are located in Reaches 4 and 5.

Chowchilla Bypass and Tributaries. No sites listed in the above-mentioned databases are located in the Chowchilla Bypass or tributary of the Restoration Area.

Eastside Bypass, Mariposa Bypass, and Tributaries. No sites listed in the above-mentioned databases are located in the Eastside and Mariposa bypasses or tributaries of the Restoration Area.

San Joaquin River from Merced River to the Delta

Anthropogenic hazards may occur on the west side of the San Joaquin River below the Merced River confluence but are not known to contaminate the river.

3.10.2 West Nile Virus

All mosquito species are potential vectors of organisms that can cause disease to pets, domestic animals, wildlife, and humans. Public concern regarding WNV, a disease transmitted to humans, has increased since the virus was first detected in the United States in 1999. A mosquito acquires WNV by feeding on a bird with the virus in its blood. Although most people infected with WNV experience no symptoms, approximately 20 percent will develop West Nile Fever. West Nile Fever symptoms, which may last from a few days to several weeks, include fever, fatigue, body aches, headache, skin rash on the trunk of the body, and swollen lymph glands. Approximately 1 in 150 persons who are exposed to WNV, usually those over the age of 50 or considered to be immunocompromised, will develop severe West Nile Disease. Severe West Nile Disease symptoms include West Nile encephalitis (inflammation of the brain), West Nile meningitis (inflammation of the membrane around the brain and spinal cord), and West Nile poliomyelitis (inflammation of the brain and surrounding membrane).

All counties in the Restoration Area or downstream to the Delta have reported cases of WNV (CDPH et al. 2009). Mosquito habitat for all of the life cycles of the species is located in this geographic region within several miles of wetted portions of the San Joaquin River, bypasses, and tributaries.

3.10.3 Valley Fever

Valley Fever is an infection, usually targeting the lungs, which results from inhalation of the fungus *Coccidioidomycosis*. *Coccidioidomycosis* spores live in soil and generally are limited to areas of the southwestern United States, Mexico, and parts of Central and South America. It can be contracted only from inhaling spores; it cannot be passed from an infected person to an uninfected person. In California, it is most commonly found in the Central Valley. Spores can enter the air when earthmoving activities, including natural disasters such as earthquakes or excavation activities, disturb spore-bearing soil. Approximately 60 percent of exposed people experience symptoms. Infection can cause flu-like symptoms, and if it is disseminated to organs other than the lungs, Valley Fever can lead to severe pneumonia, meningitis, and death (CDC 2008).

The Centers for Disease Control and Prevention(CDC) considers Valley Fever to be endemic in California. Because this disease is considered to be particularly prevalent in California's Central Valley, it is likely that *Coccidioidomycosis* is present in the Restoration Area and other portions of the study area, and could be disturbed and become airborne during any earthmoving activities.

3.10.4 School Safety

School-aged children are considered to be particularly sensitive to adverse effects resulting from exposure to hazardous materials, substances, or waste. Public Resources Code Section 21151.4 requires that lead agencies evaluate projects proposed within a quarter-mile of a school to determine whether release of hazardous air emissions or hazardous substances, resulting from implementing the Proposed Action, would pose a human health or safety hazard. Fourteen schools are located within a quarter-mile of Reaches 1 and 3 of the Restoration Area. No schools are located within a quarter-mile of Reaches 2, 4, or 5; the bypasses; or the San Joaquin River below the Merced River confluence to the Delta. Schools located within the Restoration Area are listed in Table 3-14.

Table 3-14.
Schools Located Within the Restoration Area

Reach 1	Schools Within a Quarter-Mile of Reach
Reach 1	Alview Elementary School
	Friant Elementary School
	Liddell Elementary School
	River Bluff Elementary School
	Valley Oak Elementary School
Reach 3	El Puente High School
	Firebaugh Head Start
	Firebaugh High School
	Firebaugh Middle School
	Firebaugh Migrant Head Start
	Hazel M. Bailey Primary School
	Mills Intermediate School
	St. Joseph High School
	St. Joseph School

Note:
[1] No schools are located within a quarter-mile of Reaches 2, 4, 5, or the bypasses

3.10.5 Oil and Gas Wells

Oil or gas wells are abandoned when production ends at a well or when it is determined to be a dryhole (e.g., no existing oil or gas). Proper abandonment procedures involve plugging the well by placing cement in the well bore or casing at certain intervals, as specified in California laws and regulations. The plug is intended to seal the well bore or casing and prevent fluid from migrating between underground rock layers. Health and safety hazards may occur if earthmoving activities disrupt active, idle, or abandoned wells. Disruption could potentially result in soil and groundwater contamination, oil and methane seeps, fire hazards, and air quality degradation (DOGGR 2007, 2008).

The California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) has inventoried abandoned wells located in the Restoration Area (DOGGR 2008). In addition to wells identified by DOGGR, confidential wells (e.g., exploratory wells) may be located along the reaches in the Restoration Area. Wells are granted confidentiality for up to 2 years. Confidential wells and other wells not listed may be found during site surveying for earthmoving activities. Table 3-15 shows the number of known abandoned oil and gas wells within the Restoration Area.

Table 3-15.
Known Abandoned Oil and Gas Wells Within Restoration Area

River and Bypass Reaches	Number of Known Abandoned Oil and Gas Wells
San Joaquin River – Reach 1	1
San Joaquin River – Reach 2	9
San Joaquin River – Reach 3	4
San Joaquin River – Reach 4	6
San Joaquin River – Reach 5	0
Fresno Slough/James Bypass	9
Chowchilla Bypass and Tributaries	8
Eastside Bypass, Mariposa Bypass, and Tributaries	1

Source: CDC 2008

3.10.6 Wildland Fire

Wildland fires pose a hazard to both persons and property in many areas of California. The severity of wildland fires is influenced primarily by vegetation, topography, and weather (temperature, humidity, and wind). The California Department of Forestry and Fire Protection (CALFIRE) developed a fire hazard severity scale that considers vegetation, climate, and slope to evaluate the level of wildfire hazard in all State Responsibility Areas. The designation of State Responsibility Areas and Local Responsibility Areas is used to identify responsibility for providing basic wildland fire protection assistance, and to identify three levels of fire hazard severity zones (moderate, high, and very high) to indicate the severity of fire hazard in a particular geographic area (CALFIRE 2009).

Reaches 2 through 5, all bypasses and tributaries, and the lower San Joaquin River are located in a Local Responsibility Area and a moderate or an unzoned Fire Hazard Severity Zone.

3.10.7 Aircraft Safety

Collisions between aircraft and wildlife can compromise the safety of passengers and flight crews. Damage to an aircraft resulting from a wildlife collision can range from a small dent in the wing to catastrophic engine failure, destruction of the aircraft, and potential loss of life. Airports within 2 nautical miles of a project area may be affected by land use changes that attract wildlife that can cause hazards. Natural or constructed areas found in the Restoration Area, such as poorly drained locations, wetlands, odor-causing rotting organic matter (putrescible waste), detention/retention ponds, disposal operations, wastewater treatment plants, and agricultural or aquaculture activities can provide wildlife habitat.

According to the Federal Aviation Administration (FAA) (FAA 2007), the following groups of species, found in the Restoration Area, are hazardous to airport operations: waterfowl, wading birds, and shorebirds; gulls; sparrows, larks, and finches; raptors; swallows; blackbirds and starlings; corvids; and columbids.

Airports within 2 miles of each river and bypass reaches are shown in Table 3-16.

Table 3-16.
Airports Within 2 Miles of River and Bypass Reaches

River and Bypass Reaches	Airports Located Within 2 Miles
Reach 1	Arnold Ranch Sierra Sky Park
Reach 2	Mendota Airport
Reach 3	Firebaugh Airport
Reach 4	Triangle T Ranch Willis Ranch
Reach 5	Gustline Stevinson Strip
Fresno Slough/James Bypass	Mendota Airport
Chowchilla Bypass and Tributaries	Emmett Field Red Top Triangle T Ranch
Eastside Bypass, Mariposa Bypass, and Tributaries	None
San Joaquin River from Merced River to the Delta	Ahlem Farms Westley Yandell Ranch

Source: FAA 2007

3.11 Hydrology and Water Quality

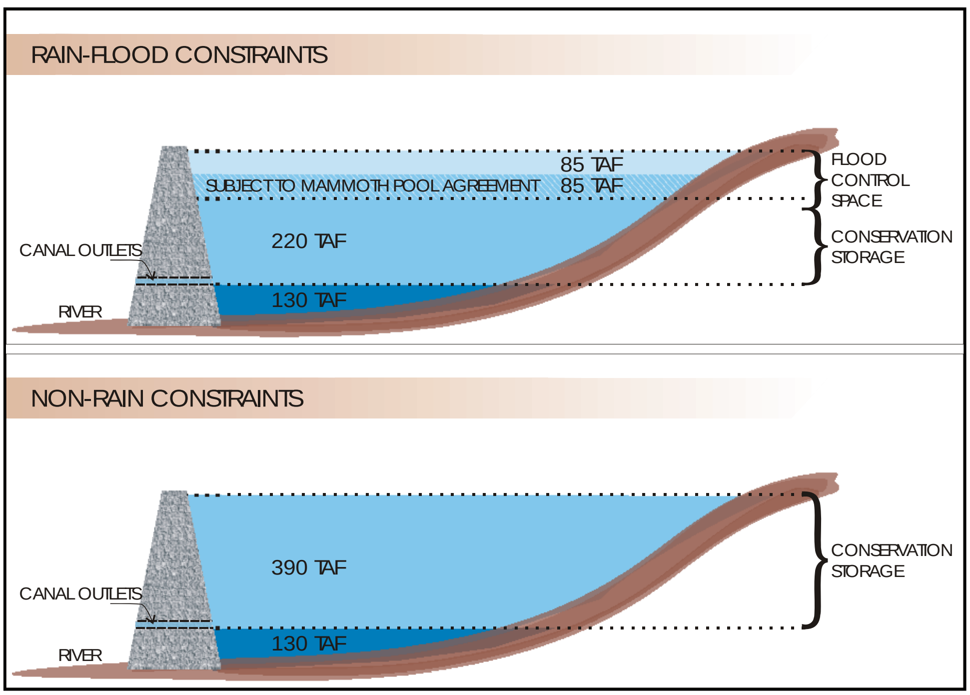
Hydrology and water quality conditions in the study area include surface water supplies and facilities operations, surface water quality, and groundwater. These conditions are described below for the geographic subareas, as appropriate.

3.11.1 Surface Water Supplies and Facilities Operations

All major rivers in the Central Valley have been developed by construction of dams and conveyance facilities for water supply, flood management, and hydropower generation. Flows in the San Joaquin River are affected by water projects on the river's tributaries, imports to the river from other regions, diversions from the river, return flows, and Millerton Lake. Surface water supplies and facilities operations are described in the following subsections for all five geographic subareas.

San Joaquin River Upstream from Friant Dam

Millerton Lake has a volume of 524 TAF and a surface area of 4,905 acres at the top of active storage. Figure 3-4 shows an active conservation space of 390 TAF, with up to 170 TAF for flood management space in Millerton Lake from October through March. The mean annual unimpaired runoff to Millerton Lake is 1,812 TAF, with a range of 362 to 4,642 TAF.



Source: Reclamation 2003
Key: TAF = thousand acre-feet

Figure 3-4.
Schematic of Millerton Lake Storage Requirements

Millerton Lake is operated as an annual reservoir – all water supplies available in a given year are allocated, with the expectation of delivery. Median reservoir water level ranges from elevation (North American Vertical Datum of 1988 (NAVD 1988)) 564 in late spring to elevation (NAVD 1988) 497 in late summer. Water deliveries, principally for irrigation, are made through outlet works to the Friant-Kern and Madera canals, completed in 1949 and 1944, respectively. A river outlet works is located within the lower portion of the dam. Additional physical data pertaining to Friant Dam and Millerton Lake are presented in Table 3-17.

Table 3-17.
Pertinent Physical Data – Friant Dam and Millerton Lake

Friant Dam and Millerton Lake Flows			
Average annual unimpaired runoff (1901–2008)	1,811,681 acre-feet	Average daily inflow	2,500 cfs
Minimum average daily inflow (Oct. 10, 1977)	0 cfs	Maximum average daily inflow (Dec. 23, 1955)	61,700 cfs
Maximum instantaneous inflow (Dec. 23, 1955)	97,000 cfs	*Spillway design flood*	
Minimum average daily outflow (Oct. 20, 1940)	5.5 cfs	Peak inflow	197,000 cfs
Maximum average daily outflow (June 6, 1969)	12,400 cfs	Peak outflow	158,500 cfs
Friant Dam and Millerton Lake Characteristics[1]			
Friant Dam (concrete gravity)		**Millerton Lake**	
Elevation, top of parapet	587.6 feet above msl	*Elevations*	
Freeboard above spillway flood pool	3.25 feet	Minimum operating level[2]	468.7 feet above msl
Elevation, crown of roadway	583.8 feet above msl	Top of active storage capacity	580.6 feet above msl
Maximum height, foundation to crown of roadway	319 feet	Spillway flood pool	587.6 feet above msl
Crest Length		*Area*	
Left abutment, nonoverflow section	1,478 feet	Minimum operating level	2,108 acres
Overflow river section	332 feet	Top of active storage capacity	4,905 acres
Right abutment, nonoverflow section	1,678 feet	Spillway flood pool	5,085 acres
Total length	3,488 feet	*Storage capacity*	
Width of crest at elevation 581.25	20.0 feet	Minimum operating level[2]	130,740 acre-feet
Total concrete in dam and appurtenances	2,135,000 cubic yards	Top of active storage capacity	524,250 acre-feet
		Spillway flood pool	559,300 acre-feet
		Drainage area	1,638 square miles
Spillway (gated ogee)		**Outlets**	
Crest length		*River outlets (110-inch-dia. w/ 96-inch hollow jet valves)*	
Gross	332 feet	Number and elevation	4 @ 382.6 feet above msl
Net	300 feet	Capacity at minimum pool	12,400 cfs
Crest elevation	562.6 feet above msl	Capacity at top of active storage	16,400 cfs
Discharge capacity (height = 18.0 feet)	83,160 cfs	*Diversion outlets, Madera Canal (91-inch-dia. w/ 86-inch needle valve)*	
Crest gates (1 drum and 2 Obermeyer)		Number and elevation	2 @ 448.6 feet above msl
Number and size	3 @ 100 feet by 18 feet	*Diversion outlets, Friant-Kern Canal (110-inch-dia. w/ 96-inch hollow jet valve)*	
Top elevation when lowered	562.6 feet above msl	Number and elevation	4 @ 466.6 feet above msl
Top elevation when raised	580.6 feet above msl		
Friant-Kern Canal		**Madera Canal**	
Length	152 miles	Length	36 miles
Operating capacity below Friant Dam	5,000 cfs	Capacity below Friant Dam	1,250 cfs
Operating capacity at terminus of canal	2,000 cfs	Capacity at Chowchilla River	625 cfs

Source: USACE 1955 (revised 1980), with elevations revised to NAVD 1988; CDEC gage records.
Notes:
[1] Elevations are given in North American Vertical Datum (NAVD) of 1988.
[2] Minimum operating level generally corresponds with elevation of Friant-Kern Canal outlets.
Key:
cfs = cubic feet per second
Dec. = December
dia. = diameter
msl = mean sea level
Oct. = October

San Joaquin River from Friant Dam to Merced River

This section describes water operations within the Restoration Area for nine distinct river reaches and subreaches, and several flood bypasses. Average historical flows in the San Joaquin River within the Restoration Area, are described below.

Reach 1. San Joaquin River releases are made at Friant Dam to comply with Holding Contract requirements along Reach 1. Streamflow of at least 5 cfs must be maintained past the last diversion before Gravelly Ford, with no requirements for streamflow into Reach 2. The design channel capacity of Reach 1 is 8,000 cfs. Sand and aggregate mining pits in the channel and floodplain in Reach 1 are hydrologically connected to Reach 1, and can attenuate flow and increase evaporation. Agricultural return flows in Reach 1 are minor. Reach 1 is divided into Reach 1A and Reach 1B.

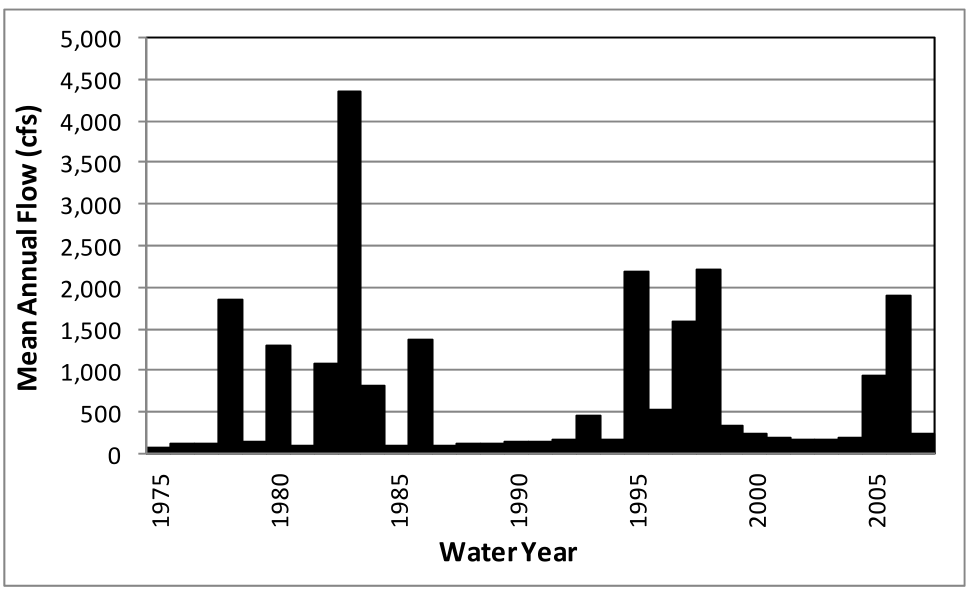
Flows within Reach 1A are predominantly influenced by releases from Friant Dam along with diversions and seepage losses. Mining pits in Reach 1 are primarily located in Reach 1A. Cottonwood Creek and Little Dry Creek, two intermittent streams, join the San Joaquin River in Reach 1A. Since 1949, Reclamation has made annual releases of about 117 TAF from Friant Dam to the San Joaquin River to comply with Holding Contract requirements upstream from Gravelly Ford. Additional river flows occur during years when releases are made to the San Joaquin River for flood management purposes. Nonflood releases made from Friant Dam for water diversions are typically below 150 cfs. Four streamflow gages are located within or near Reach 1A. Table 3-18 lists the gages located in or near this reach, along with the gages’ period of record, mean annual streamflow, and maximum daily average flow. Figures 3-5, 3-6, 3-7, and 3-8 show historical mean annual flows at the gages. Tables 3-19, 3-20, 3-21, and 3-22 show monthly mean flows at the gages. Ninety water diversions are located along this reach, not all of which are active on a regular basis.

Flows within Reach 1B are predominantly influenced by inflow from Reach 1A, diversions, and seepage losses. Table 3-23 lists the gages located in or near this reach segment, along with periods of record and mean and maximum daily mean streamflow. Figures 3-9, 3-10, and 3-11 show mean annual flows at the gages. Tables 3-24, 3-25, and 3-26 show historical mean monthly flows at the gages. Fifteen water diversions are located along this reach.

Table 3-18.
Streamflow Gages in Reach 1A

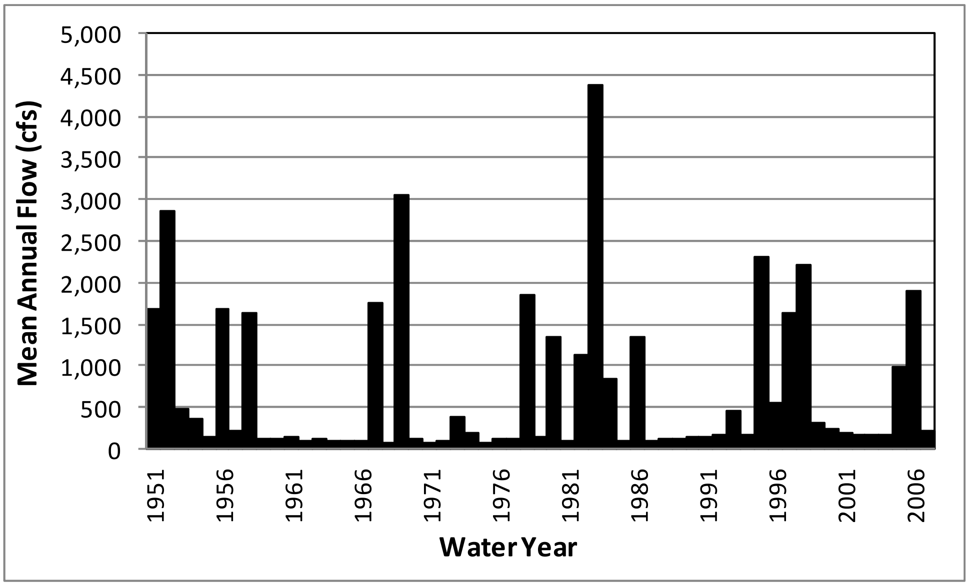
Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River release from Friant Dam	MIL	267.6	1,640	1974 – 2007	707	25,556 (January 4, 1997)
San Joaquin River below Friant Dam	11251000	266.0	1,676	1950 – present[2]	703	36,800 (January 3, 1997)
Cottonwood Creek near Friant Dam	CTK	NA	35.6	1974 – 2007	7	783 (January 27, 1983)
Little Dry Creek near Friant Dam	LDC	NA	57.9	1974 – 2007	22	2,457 (March 11, 1995)

Source: CDEC 2008; USGS 2008
Notes:
[1] Calendar years.
[2] Period of record coincides with start of diversions from Friant Dam (1950).
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



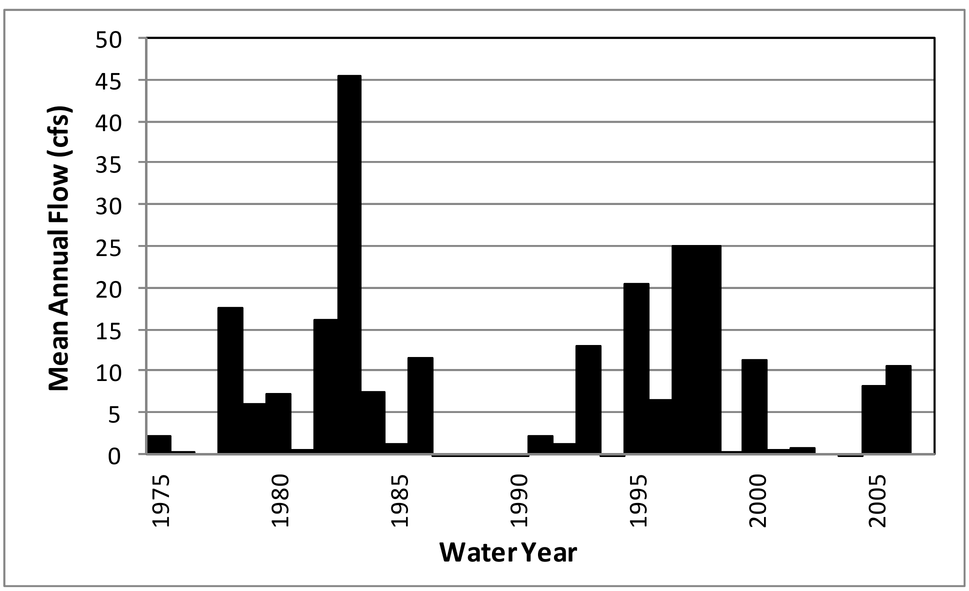
Source: CDEC 2008, Gage ID MIL

Figure 3-5.
Historical Mean Annual Flow for Friant Dam Releases



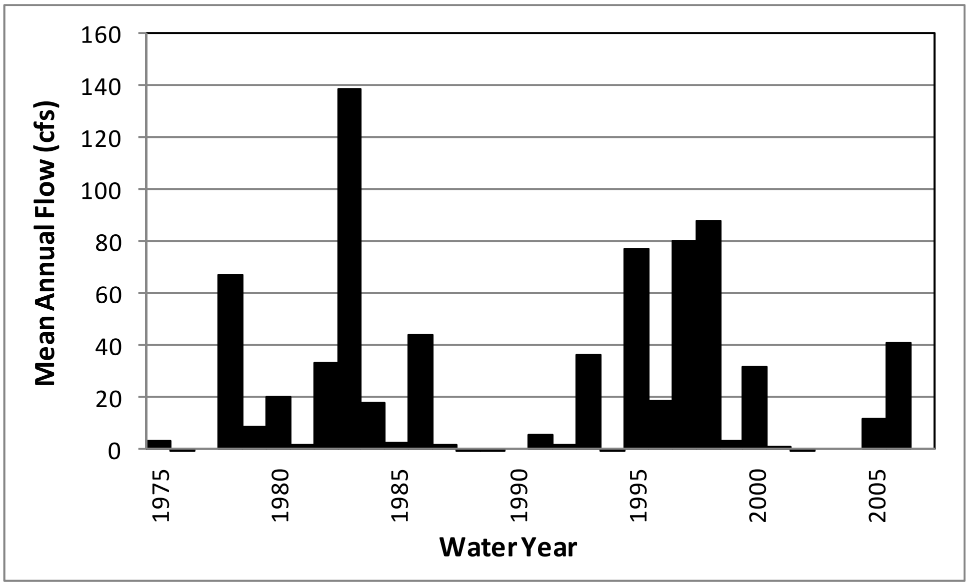
Source: USGS 2008, Gage ID 11251000

Figure 3-6.
Historical Mean Annual Flow for San Joaquin River Flow Below Friant Dam



Source: CDEC 2008, Gage ID CTK

Figure 3-7.
Historical Mean Annual Flow for Cottonwood Creek near Friant Dam



Source: CDEC 2008, Gage ID LDC

Figure 3-8.
Historical Mean Annual Flow for Little Dry Creek near Friant Dam

Table 3-19.
Historical Mean Monthly Flows for Friant Dam Releases

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	187	199	306	635	823	1,078	1,599	1,423	1,162	731	258	254
Wet	146	277	600	1,609	2648	3,379	4,453	3,402	2,720	1,971	371	402
Normal-Wet	321	301	444	682	281	410	269	349	281	239	195	173
Normal-Dry	152	116	92	81	86	89	132	156	191	207	202	196
Dry	128	101	83	67	77	105	145	167	200	225	222	195
Critical-High	86	68	51	62	52	107	109	171	172	171	160	132
Critical-Low	99	83	96	69	84	112	153	128	175	191	193	150

Source: CDEC 2008, Gage ID MIL
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-20.
Historical Mean Monthly Flows for San Joaquin River Below Friant Dam

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	198	167	284	590	883	965	1,478	1,495	1,240	588	260	223
Wet	157	228	533	1,618	2,882	3,266	4,601	4,532	3,641	1,602	399	369
Normal-Wet	283	209	448	613	507	394	509	370	442	340	264	152
Normal-Dry	224	140	107	102	148	132	170	216	178	178	179	192
Dry	107	86	66	54	69	92	123	138	173	199	197	165
Critical-High	108	69	118	107	61	112	131	159	167	175	161	120
Critical-Low	90	69	97	68	92	107	151	115	177	194	195	150

Source: USGS 2008, Gage ID 11251000
Note:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-21.
Historical Mean Monthly Flows for Cottonwood Creek near Friant Dam

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	0	4	17	26	28	11	2	0	0	0	0
Wet	0	0	11	54	73	74	26	5	1	0	0	0
Normal-Wet	0	0	4	5	22	21	5	0	0	0	0	0
Normal-Dry	0	0	0	1	1	5	1	0	0	0	0	0
Dry	0	0	0	0	2	1	0	0	0	0	0	0
Critical-High	0	0	0	0	1	2	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID CTK
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-22.
Historical Mean Monthly Flows for Little Dry Creek near Friant Dam

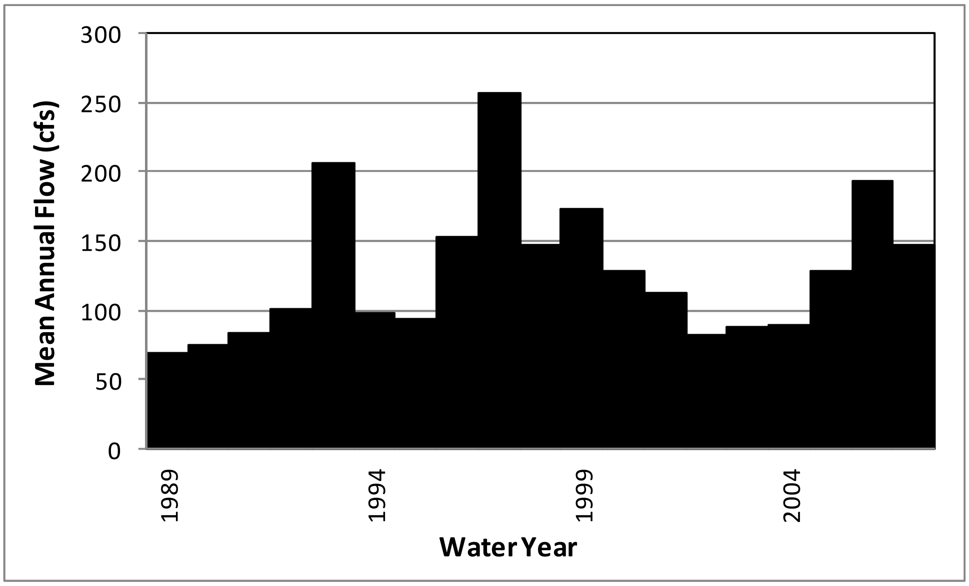
Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	1	12	43	84	84	39	7	2	0	0	0
Wet	0	2	31	143	249	252	87	20	6	0	0	0
Normal-Wet	0	2	17	7	65	44	10	1	0	0	0	0
Normal-Dry	0	0	1	1	3	13	2	0	0	0	0	0
Dry	0	0	0	0	6	3	1	0	0	0	0	0
Critical-High	0	0	0	0	2	1	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID LDC
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-23.
Streamflow Gages in Reach 1B

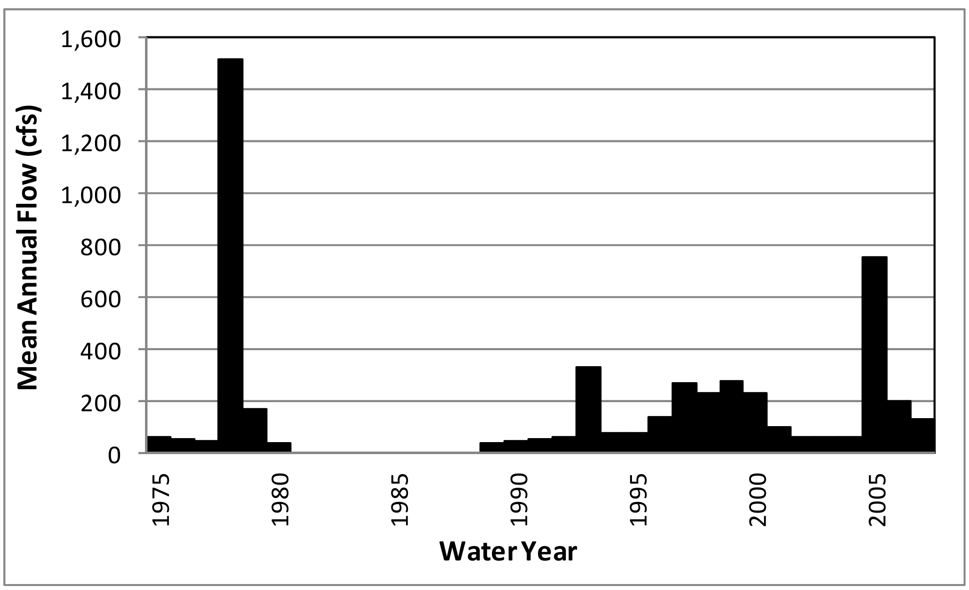
Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Mean Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River at Donny Bridge	DNB	240.7	NA	1988 – 2007	122	7,900 (December 30, 1996)
San Joaquin River at Skaggs Bridge	NA[2]	232.1	NA	1974 – 2007	215	7,900 (December 30, 1996)
San Joaquin River near Biola	11253000	NA	1,811	1952 – 1961	514	7,860 (April 7, 1958)

Source: CDEC 2008; USGS 2008; Reclamation 2007
Notes:
[1] Calendar year.
[2] Data obtained from Reclamation (Reclamation 2007)
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



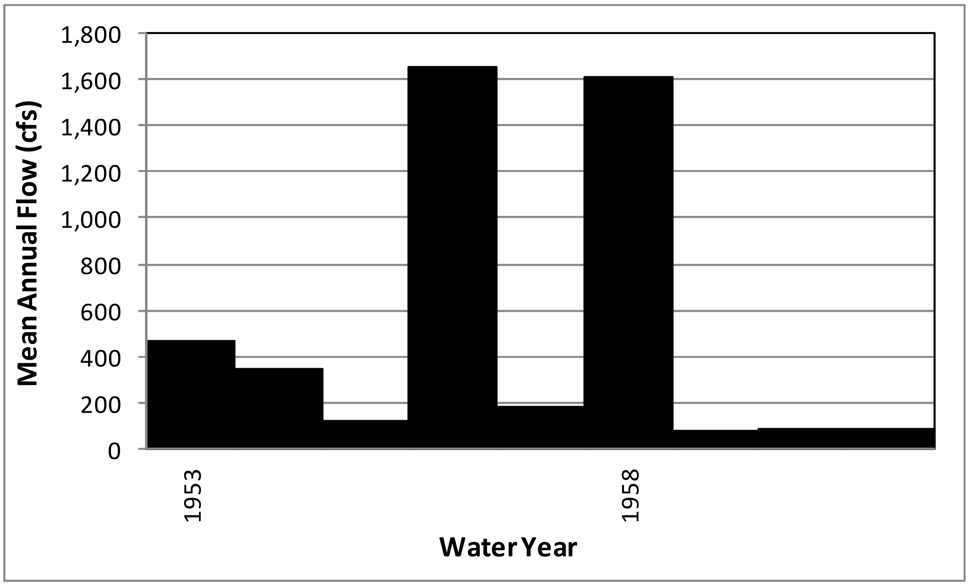
Source: CDEC 2008, Gage ID DNB

Figure 3-9.
Historical Mean Annual Flow for San Joaquin River at Donny Bridge



Source: Reclamation 2007, Gage ID not available

Figure 3-10.
Historical Mean Annual Flow for San Joaquin River at Skaggs Bridge



Source: USGS 2008, Gage ID 11253000

Figure 3-11.
Historical Mean Annual Flow for San Joaquin River near Biola

Table 3-24.
Historical Mean Monthly Flows for San Joaquin River at Donny Bridge

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	111	85	118	115	132	129	92	98	156	149	140	138
Wet	127	94	285	256	182	505	Data not available	187	202	173	199	158
Normal-Wet	90	70	57	53	308	72	98	75	269	192	129	115
Normal-Dry	100	84	75	72	70	91	80	81	96	95	99	119
Dry	81	67	63	51	64	77	86	97	115	131	133	125
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID DNB
Note:
[1] Period of record Water Years 1989 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-25.
Historical Mean Monthly Flows for San Joaquin River at Skaggs Bridge

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	97	73	106	110	228	379	460	479	379	143	132	123
Wet	87	67	225	242	1,100	2,278	2,158	2,177	1,357	189	252	201
Normal -Wet	130	99	128	104	322	359	127	106	192	150	125	100
Normal -Dry	85	69	54	45	42	72	59	58	70	64	71	92
Dry	60	38	36	33	44	51	58	72	81	87	92	89
Critical-High	49	48	39	33	51	46	52	70	67	52	55	49
Critical-Low	44	40	42	44	31	36	52	34	51	47	57	45

Source: Reclamation 2007
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-26.
Historical Mean Monthly Flows for San Joaquin River near Biola

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	289	176	333	711	601	495	1,099	1,198	813	148	128	194
Wet	80	68	903	2,687	2,056	1,547	4,205	4,331	3,152	280	139	187
Normal-Wet	Data not available											
Normal-Dry	455	262	193	175	232	238	261	386	167	118	139	241
Dry	72	74	49	23	54	89	97	92	108	123	119	108
Critical-High	89	59	175	132	54	81	84	97	70	64	58	52
Critical-Low	Data not available											

Source: USGS 2008, Gage ID 11253000
Note:
[1] Period of record Water Years 1953 – 1961; some years may be missing data.
Key:
cfs = cubic feet per second

Reach 2. Reach 2 is typically dry; flows reach the Mendota Pool from Reach 2B or from Fresno Slough only during periods of flood management flow releases. Flood flows in both the San Joaquin and Kings rivers were experienced at Mendota Pool in 1997, 2001, 2005, 2006, and 2007. At all other times, the DMC is the primary source of water to the Mendota Pool. The Mendota Pool delivers water to the San Joaquin River Exchange Contractors Water Authority, other CVP contractors, wildlife refuges and management areas, and State water authorities. The Mendota Pool provides no long-term storage for water supply operations or flood control. Reach 2 is divided into Reach 2A and Reach 2B.

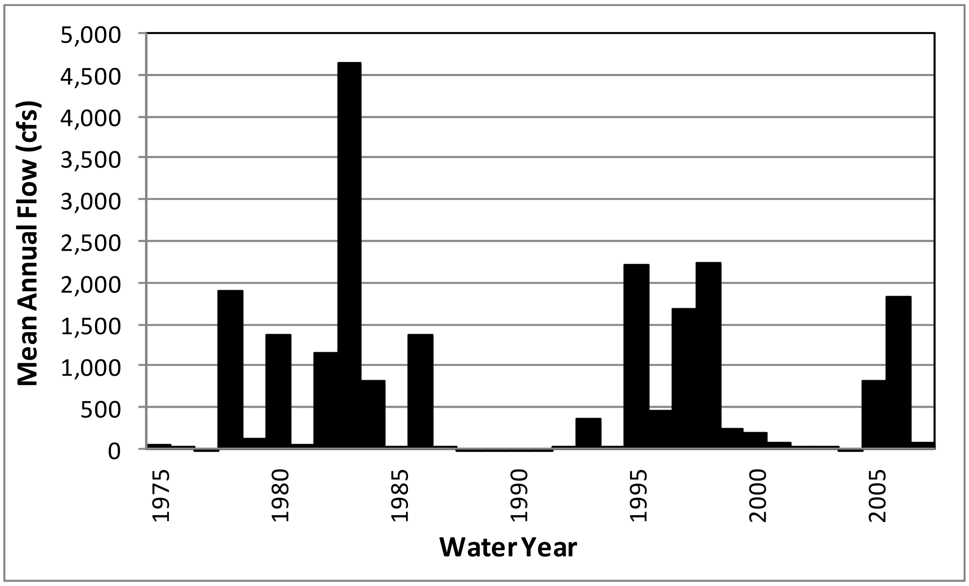
Reach 2A is typified by the accumulation of sand caused in part by backwater effects of the Chowchilla Bypass Bifurcation Structure and by a lower gradient relative to Reach 1. Gravelly Ford, as its name implies, and Reach 2A have high percolation losses, such that the reach is dry under normal conditions. Under steady-state conditions, flow does not reach the Chowchilla Bypass Bifurcation Structure when discharge at Gravelly Ford is less than 75 cfs (McBain and Trush 2002). Reach 2A has a design channel capacity of 8,000 cfs to accommodate controlled releases from Friant Dam. Agricultural return flows within this reach are minor. Table 3-27 lists the gage located in this reach segment, along with the period of record, mean annual and maximum daily mean streamflow. Figure 3-12 shows historical mean annual flow at the gage for the period of record shown in Table 3-27. Table 3-28 shows historical mean monthly flow at the gage. Nine water diversions are located along this reach. One major road crossing in this reach could affect flow stage.

Table 3-27.
Streamflow Gage in Reach 2A

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River at Gravelly Ford	GRF	236.9	NA	1974 – 2007	652	37,843 (January 4, 1997)

Source: CDEC 2008

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID GRF

Figure 3-12.
Historical Mean Annual Flow for San Joaquin River at Gravelly Ford

Table 3-28.
Historical Mean Monthly Flows for San Joaquin River at Gravelly Ford

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	100	109	236	672	880	1,153	1,560	1,340	1,028	633	138	139
Wet	40	174	532	1,887	2,945	3,726	4,568	3,417	2,601	2,053	376	380
Normal-Wet	295	215	370	630	314	512	251	305	151	92	82	62
Normal-Dry	55	33	24	21	23	35	21	21	30	20	20	32
Dry	29	13	12	9	15	16	18	18	19	9	17	20
Critical-High	29	23	20	16	30	23	28	39	36	21	22	17
Critical-Low	17	21	13	20	13	5	2	3	3	1	6	5

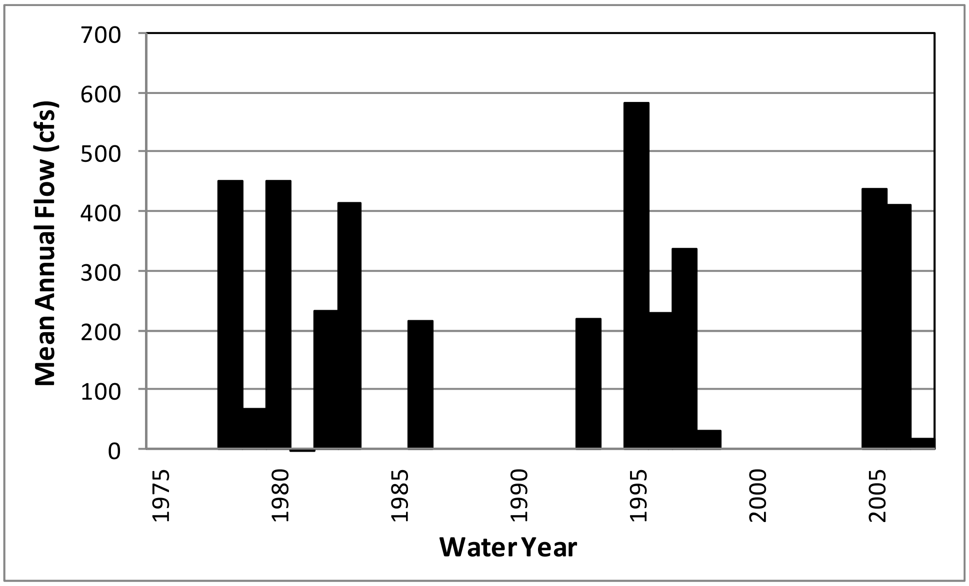
Source: CDEC 2008, Gage ID GRF
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Reach 2B is a sandy channel extending into for Mendota Pool. The design channel capacity of this reach is 2,500 cfs, but significant seepage has been observed at flows above 1,300 cfs (RMC 2007). Agricultural return flows within this reach are minor. Reach 2B ends at Mendota Dam, and Mendota Pool backwater extends up a portion of this reach. Table 3-29 shows the gage located in this reach segment, along with the period of record and historical mean annual and maximum daily mean streamflow. Figure 3-13 shows historical mean annual flow at the gage for the period of record shown in Table 3-29, and demonstrates the dry conditions within Reach 2B. Table 3-30 shows historical mean monthly flow at the gage. Thirty-one water diversions are located along this reach. One major road crossing in this reach could affect flow stage.

Table 3-29.
Streamflow Gages in Reach 2B

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River below Chowchilla Bypass Bifurcation Structure	SJB	217.8	NA	1974 – 1986, 1988 – 1997, 2005 – 2007	159	2,660 (May 23, 1978)

Source: CDEC 2008
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID SJB

Figure 3-13.
Historical Mean Annual Flow for San Joaquin River Below Chowchilla Bypass Bifurcation Structure

Table 3-30.
Historical Mean Monthly Flows for San Joaquin River Below Chowchilla Bypass Bifurcation Structure

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	11	4	6	81	164	285	328	348	327	230	60	54
Wet	9	2	17	205	439	675	638	690	686	589	174	153
Normal-Wet	15	5	0	18	140	396	257	157	55	0	0	0
Normal-Dry	5	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID SJB
Note:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

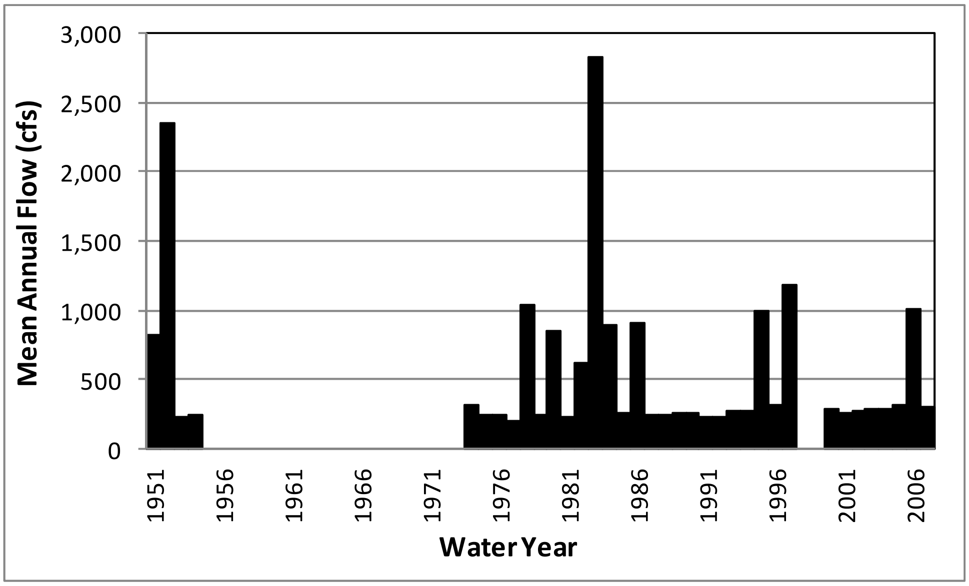
Reach 3. The design capacity of Reach 3 is 4,500 cfs (exterior levees). DWR has estimated the capacity of interior levees in this reach to be 1,300 cfs with 3 feet of freeboard. The RMC has reported that Reach 3 conveys up to 800 cfs of water for irrigation diversions at Sack Dam, and that higher flows (less than 4,500 cfs) can cause seepage and levee stability problems in this reach (2007). No operational storage for water supply exists within this reach. Flows within this reach predominantly consist of water conveyed by the DMC and released from the Mendota Pool for diversion. Under typical conditions, most water reaching Sack Dam is diverted to the Arroyo Canal. Flows greater than required for diversions (such as during upstream flood releases) spill over Sack Dam into the San Joaquin River downstream into Reach 4A. Table 3-31 lists the gage located in this reach, along with the period of record and annual mean and maximum daily mean streamflow. Figure 3-14 shows the historical mean annual flow at the gage for the period of record shown in Table 3-31. Table 3-32 shows the historical mean monthly flow at the gage. Seven water diversions are located along this reach. One major road crossing in this reach could affect flow stage.

Table 3-31.
Streamflow Gage in Reach 3

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River near Mendota	11254000	217.8	3,940	1950 – 1954, 1974 – present[1]	545	8,770 (May 29, 1952)

Source: USGS 2008
Note:
[1] Period of record coincides with start of diversions from Friant Dam (1950).

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: USGS 2008, Gage ID 11254000

Figure 3-14.
Historical Mean Annual Flow for San Joaquin River near Mendota

Table 3-32.
Historical Mean Monthly Flows for San Joaquin River near Mendota

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	203	221	306	444	661	732	920	979	839	613	439	275
Wet	160	234	488	1,019	1,770	2,274	2,646	2,534	1,820	939	483	311
Normal-Wet	292	530	746	654	495	278	223	364	463	497	433	274
Normal-Dry	175	101	67	86	208	190	240	328	491	522	406	247
Dry	218	115	61	56	175	230	209	245	445	526	445	275
Critical-High	133	67	1	87	146	157	231	345	479	486	459	312
Critical-Low	188	58	4	27	126	219	141	141	341	507	412	214

Source: USGS 2008, Gage ID 11254000
Note:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Reach 4. No operational storage for water supply exists within this reach. Reach 4 is divided into Reach 4A, Reach 4B1, and Reach 4B2.

Estimated flow capacity in Reach 4A is approximately 4,500 cfs, beginning at Sack Dam and extending to the Sand Slough Control Structure. Most water reaching Sack Dam is diverted to the Arroyo Canal; however, the channel below Sack Dam has flow during the agricultural season (agricultural return flows) and during upstream flood releases. Table 3-33 lists the gages located in Reach 4A, along with the period of record and annual mean and maximum daily mean streamflows. Figures 3-15 and 3-16 show the historical mean annual flows at the gages for the period of record shown in Table 3-33. Tables 3-34 and 3-35 show the historical mean monthly flows at the gages. Four water diversions are located along this reach. No road crossings would affect flow stage in Reach 4A.

Table 3-33.
Streamflow Gages in Reach 4A

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River near Dos Palos	11256000	NA	4,669	1950 – 1954, 1974 – 1987, 1995[1]	478	8,170 (June 5, 1952)
San Joaquin River near El Nido	11260000	NA	6,443	1939 – 1949[2]	705	3,700 (June 22, 1942)

Source: USGS 2008

Notes:

[1] Period of record coincides with start of diversions from Friant Dam (1950).

[2] Period of record occurs during Friant Dam construction and filling.

Key:

CDEC = California Data Exchange Center

cfs = cubic feet per second

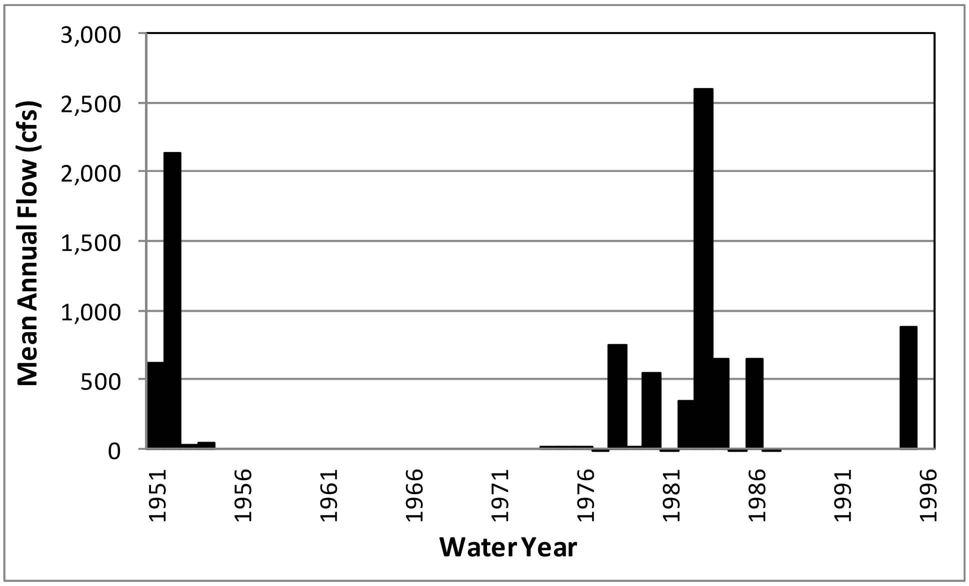
ID = identification

MP = milepost

NA = not applicable/not available

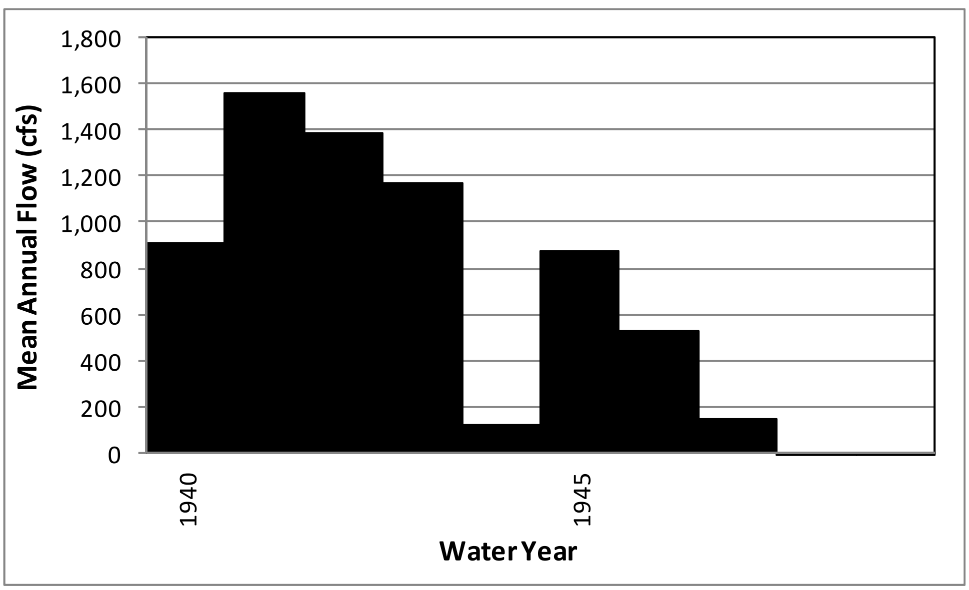
No. = number

USGS = U.S. Geological Survey



Source: USGS 2008, Gage ID 112560000

Figure 3-15.
Historical Mean Annual Flow for San Joaquin River near Dos Palos



Source: USGS 2008, Gage ID 11260000

Figure 3-16.
Historical Mean Annual Flow for San Joaquin River near El Nido

Table 3-34.
Historical Mean Monthly Flows for San Joaquin River near Dos Palos

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	49	202	458	556	794	943	1,064	1,007	562	187	22	29
Wet	6	182	610	751	1,642	2,515	2879	2,726	1,512	469	45	68
Normal-Wet	154	501	873	995	585	55	4	3	6	6	7	3
Normal-Dry	5	4	52	62	154	6	8	7	8	6	6	7
Dry	0	0	0	41	23	15	3	8	10	Data not available		
Critical-High	58	6	6	51	1	2	1	3	7	12	8	0
Critical-Low	0	13	0	0	2	3	2	1	9	9	9	6

Source: USGS 2008, Gage ID 112560000
Note:
[1] Period of record Water Years 1951 – 1996; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-35.
Historical Mean Monthly Flows for San Joaquin River near El Nido

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	27	106	399	934	1,248	1,112	1,201	1,538	1,489	473	17	13
Wet	0	0	630	1,842	2,521	2,805	2,600	3,096	3,429	1,779	26	8
Normal-Wet	54	199	594	1,303	1,840	1,540	1,629	2117	1,947	482	24	20
Normal-Dry	1	16	97	247	204	153	20	54	79	22	2	3
Dry	Data not available											
Critical-High	Data not available											
Critical-Low	Data not available											

Source: USGS 2008, Gage ID 11260000
Note:
[1] Period of record Water Years 1940 – 1949; some years may be missing data.
Key:
cfs = cubic feet per second

Reach 4B1 has a design capacity of 1,500 cfs, and the Sand Slough Control Structure is designed to maintain this design discharge; however, the current conveyance capacity of Reach 4B1 is unknown and could be as low as zero in some locations. Actual operations keep the gates of the San Joaquin River headgates closed, diverting all flow from Reach 4B1 to the Eastside Bypass via Sand Slough over the last few decades (McBain and Trush 2002). Reach 4B1, therefore, is dry until downstream agricultural return flows contribute to its baseflow. Four road crossings in Reach 4B1 have the potential to affect flow stage.

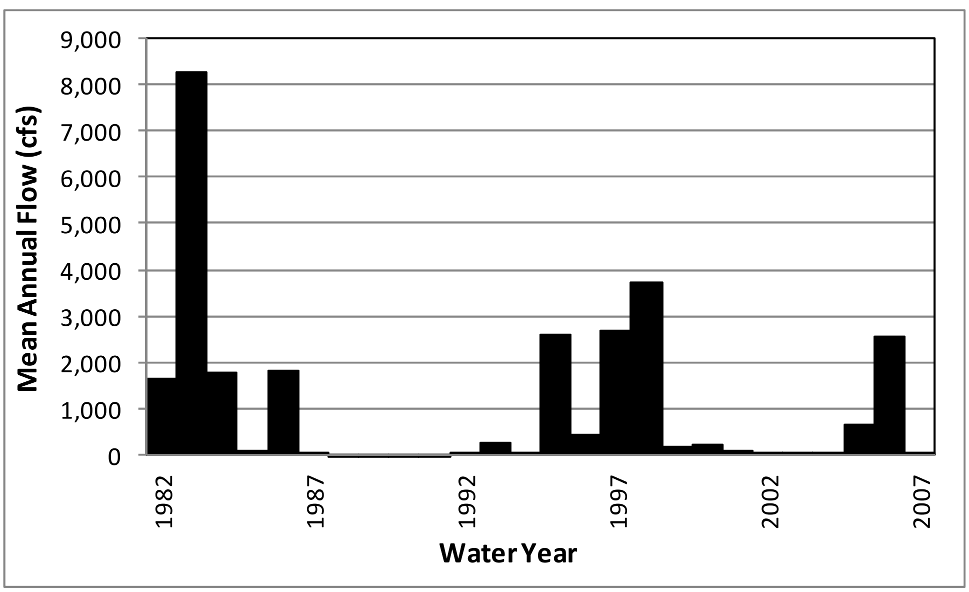
The design channel capacity of Reach 4B2 is 10,000 cfs. The channel carries tributary and flood flows from the Mariposa Bypass. No operational storage for water supply exists within this reach. Two water diversions are located along this reach. No road crossings affect flow stage in Reach 4B2.

Reach 5. The design capacity of Reach 5 is 26,000 cfs; no significant capacity constraints have been identified in this reach. Reach 5 receives flow from Reach 4B2 and the Eastside Bypass. Agricultural and WMA return flows also enter Reach 5 via Mud and Salt sloughs, which drain the west side of the San Joaquin Valley. Table 3-36 lists the gages located in or near this reach, along with the periods of record and annual mean and maximum daily mean streamflows. Figures 3-17, 3-18, 3-19, and 3-20 show the historical mean annual flows at the gages for the periods of record shown in Table 3-36. Tables 3-37, 3-38, 3-39, and 3-40 show the historical mean monthly flows at the gages. Four water diversions are located in this reach. Three major road crossing within this reach could affect flow stage.

Table 3-36.
Streamflow Gages in Reach 5

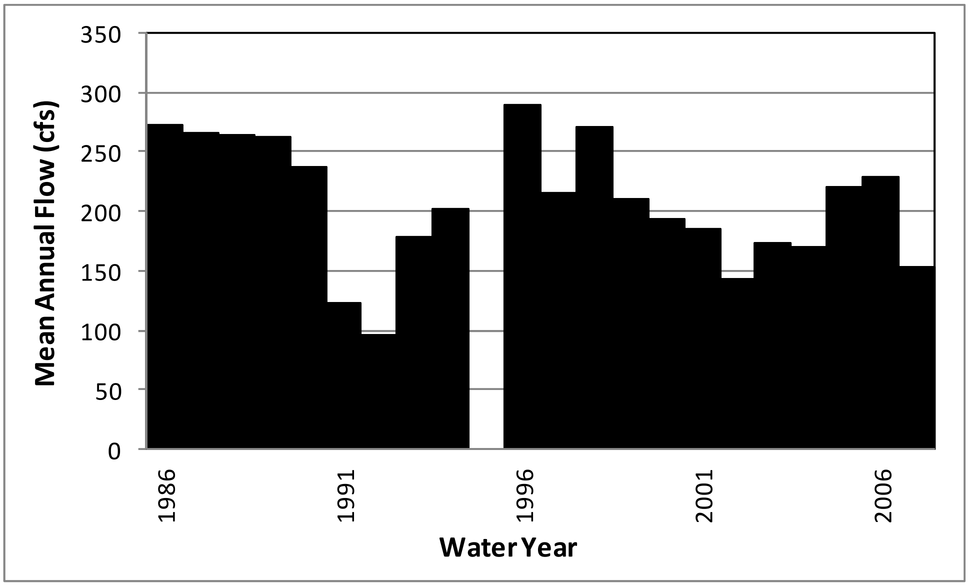
Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
San Joaquin River near Stevinson	SJS	118.2	NA	1981 – present	1,042	23,900 (January 28, 1997)
Salt Slough at Highway 165 near Stevinson	11261100	NA	NA	1985 – present	206	810 (February 20, 1986)
San Joaquin River at Fremont Ford Bridge	11261500	118.2	7,619	1950 – 1971, 1985 – 1989, 2001 – present[1]	640	22,500 (April 8, 2006)
Mud Slough near Gustine	11262900	NA	NA	1985 – present	101	1,060 (February 9, 1998)

Source: CDEC 2008; USGS 2008
Note:
[1] Period of record coincides with start of diversions from Friant Dam (1950).
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



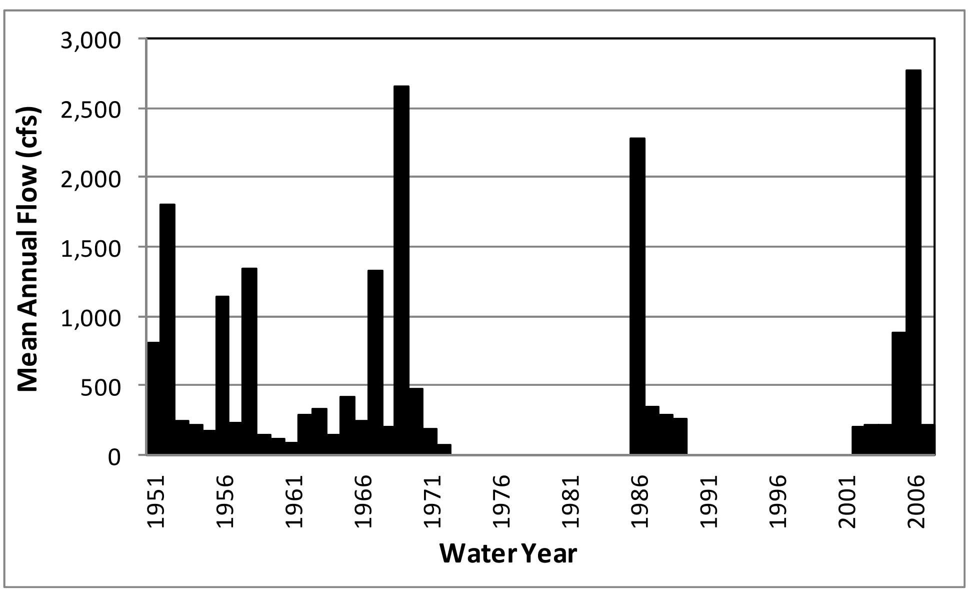
Source: CDEC 2008, Gage ID SJS

Figure 3-17.
Historical Mean Annual Flow for San Joaquin River near Stevinson



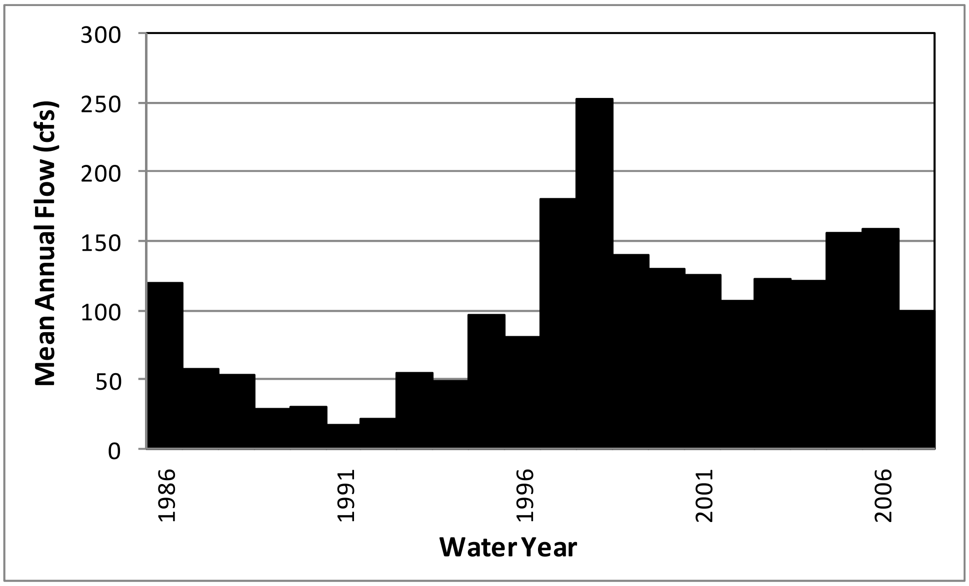
Source: USGS 2008, Gage ID 11261100

Figure 3-18.
Historical Mean Annual Flow for Salt Slough at Highway 165 near Stevinson



Source: USGS 2008, Gage ID 11261500

Figure 3-19.
Historical Mean Annual Flow for San Joaquin River at Fremont Ford Bridge



Source: USGS 2008, Gage ID 11262900

Figure 3-20.
Historical Mean Annual Flow for Mud Slough near Gustine

Table 3-37.
Historical Mean Monthly Flows for San Joaquin near Stevinson

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	188	229	705	1619	1,768	1,985	2,344	1,764	1,213	671	83	148
Wet	109	326	1,593	4,269	5,745	6,423	6,716	4,783	3,307	2,314	229	448
Normal-Wet	670	654	1,301	1,699	654	678	148	289	70	46	55	78
Normal-Dry	60	23	32	90	95	177	42	22	21	12	13	30
Dry	59	22	20	46	157	66	27	19	13	8	7	10
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID SJS
Note:
[1] Period of record Water Years 1982 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-38.
Historical Mean Monthly Flows for Salt Slough at Highway 165 near Stevinson

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	146	173	146	181	284	356	241	199	197	213	215	142
Wet	117	141	124	208	364	362	291	239	234	264	292	185
Normal-Wet	159	178	184	186	336	403	226	179	186	211	216	137
Normal-Dry	147	155	120	147	212	320	210	163	178	184	180	109
Dry	167	206	155	148	242	352	241	212	212	227	230	170
Critical-High	Data not available											
Critical-Low	Data not available											

Source: USGS 2008, Gage ID 11261100
Note:
[1] Period of record Water Years 1986 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-39.
Historical Mean Monthly Flows for San Joaquin River at Fremont Ford Bridge

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	132	161	306	769	1,098	1,152	1,483	1,171	979	292	193	195
Wet	99	99	375	1,586	3,309	4,029	4,188	3,245	2,879	706	313	388
Normal-Wet	55	211	696	832	1213	512	523	274	210	156	157	160
Normal-Dry	149	159	180	503	422	371	236	243	207	147	144	137
Dry	211	170	174	199	267	316	241	249	219	183	203	182
Critical-High	24	36	60	131	139	95	125	144	103	66	80	66
Critical-Low	Data not available											

Source: USGS 2008, Gage ID 11261500
Note:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-40.
Historical Mean Monthly Flows for Mud Slough near Gustine

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	88	107	120	166	205	187	85	58	56	53	46	36
Wet	61	90	140	288	358	308	146	81	73	69	54	37
Normal-Wet	122	141	161	158	256	204	81	75	71	54	53	50
Normal-Dry	96	110	101	107	124	138	55	46	43	56	48	39
Dry	35	51	49	62	91	82	38	19	28	25	26	7
Critical-High	Data not available											
Critical-Low	Data not available											

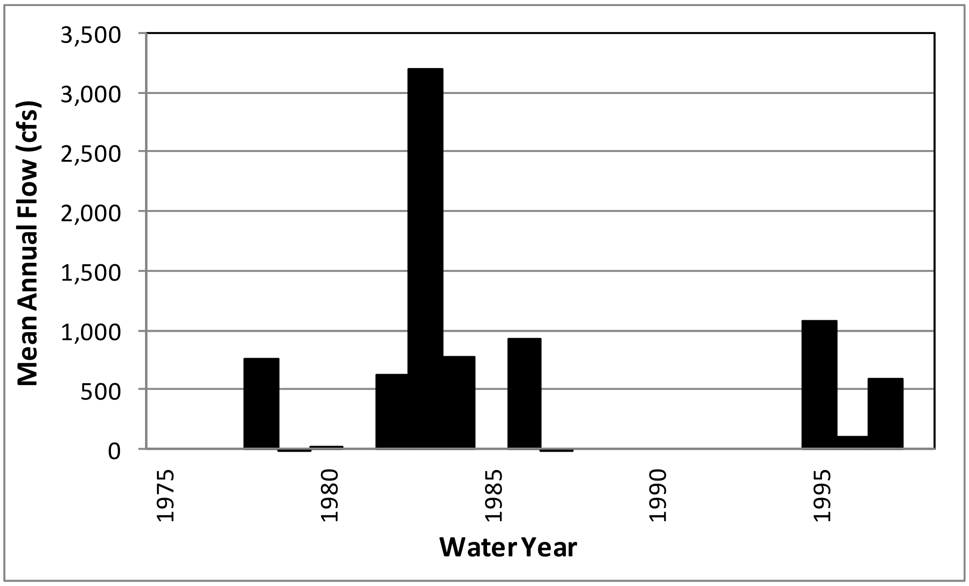
Source: USGS 2008, Gage ID 11262900
Note:
[1] Period of record Water Years 1986 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Fresno Slough/James Bypass. Under current operational requirements, Kings River flood flows can enter the Mendota Pool via the Fresno Slough/James Bypass. Flows from the Kings River are regulated by Pine Flat Dam. If combined Fresno Slough/James Bypass and San Joaquin River flows would exceed the 4,500 cfs channel capacity downstream from the Mendota Pool, then the San Joaquin River flows can be incrementally diverted to the Chowchilla Bypass to allow for Fresno Slough/James Bypass flows. (More details can be found in Section 3.11.4, Flood Management.) Reclamation supplements natural flow from the Fresno Slough/James Bypass and San Joaquin River into the Mendota Pool with deliveries from the DMC to satisfy water supply contracts. Flows from the Kings River are regulated by the Pine Flat Dam operator, Kings River Water Conservation District. Table 3-41 lists the gage located at the head of this bypass, along with the period of record and annual mean and maximum daily mean streamflow. Figure 3-21 shows mean annual flow at the gage for the period of record shown in Table 3-41. Table 3-42 shows the historical mean monthly flow at the gage.

Table 3-41.
Streamflow Gage at Fresno Slough/James Bypass

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
Fresno Slough/ James Bypass near San Joaquin	11253500	NA	NA	1974 – 1987, 1995 – 1997	495	5,355 (March 3, 1983)

Source: USGS 2008
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP= milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: USGS 2008, Gage ID 11253500

Figure 3-21.
Historical Mean Annual Flow for Fresno Slough/James Bypass near San Joaquin River

Table 3-42.
Historical Mean Monthly Flows for Fresno Slough/James Bypass near San Joaquin River

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	108	244	371	584	597	764	11,57	1261	653	330	74	54
Wet	0	220	533	901	1,283	1,620	2,478	2,524	1,396	707	159	117
Normal-Wet	431	591	550	752	6	31	4	313	5	1	0	0
Normal-Dry	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	11	22	Data not available							
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

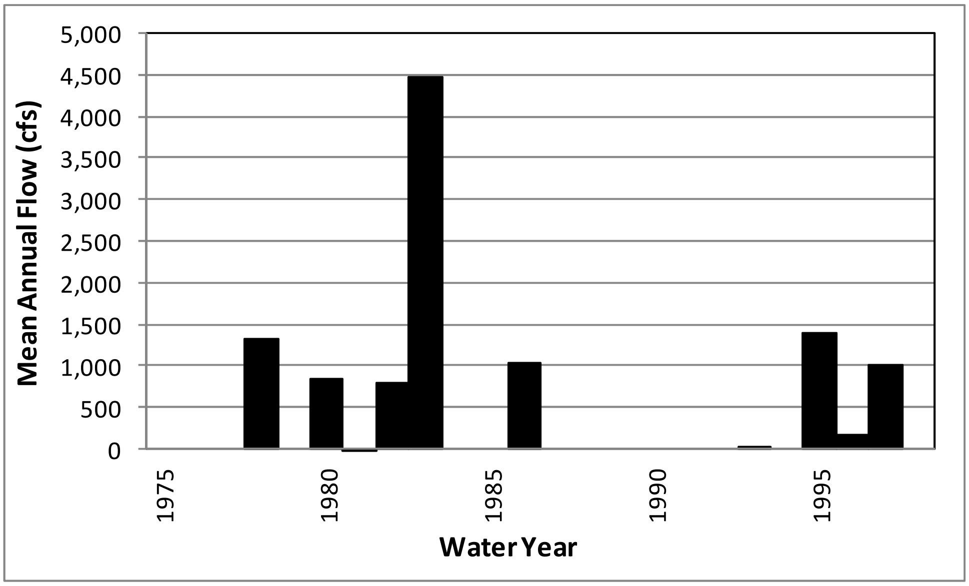
Source: USGS 2008, Gage ID 11253500
Note:
[1] Period of record Water Years 1975 – 1998; some years may be missing data.
Key:
cfs = cubic feet per second

Chowchilla Bypass and Tributaries. The Chowchilla Bypass Bifurcation Structure at the head of Reach 2B regulates the flow split between the San Joaquin River and Chowchilla Bypass. The structure is operated according to flows in the San Joaquin River, flows from the Kings River system via Fresno Slough, and water demands in the Mendota Pool. The design channel capacity of the bypass is 5,500 cfs from the bifurcation structure to its confluence with the Eastside Bypass and the Fresno River. Table 3-43 lists the gage located at the head of this bypass, along with the period of record and annual mean and maximum daily mean streamflow. Figure 3-22 shows the historical mean annual flow at the gage for the period of record shown in Table 3-43. Table 3-44 shows the historical mean monthly flow at the gage.

Table 3-43.
Streamflow Gage at Chowchilla Bypass at Head

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
Chowchilla Bypass at Head	CBP	216.0	NA	1974 – 1986, 1988 – 1997	462	9,430 (February 19, 1986)

Source: CDEC 2008
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID CBP

Figure 3-22.
Historical Mean Annual Flow for Chowchilla Bypass at Head

Table 3-44.
Historical Mean Monthly Flows for Chowchilla Bypass at Head

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	0	22	533	821	1,214	1,339	957	487	335	29	40
Wet	0	0	57	1,400	2,151	3,073	3,682	2,490	1,339	920	80	111
Normal-Wet	0	0	0	0	35	302	0	282	0	0	0	0
Normal-Dry	2	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

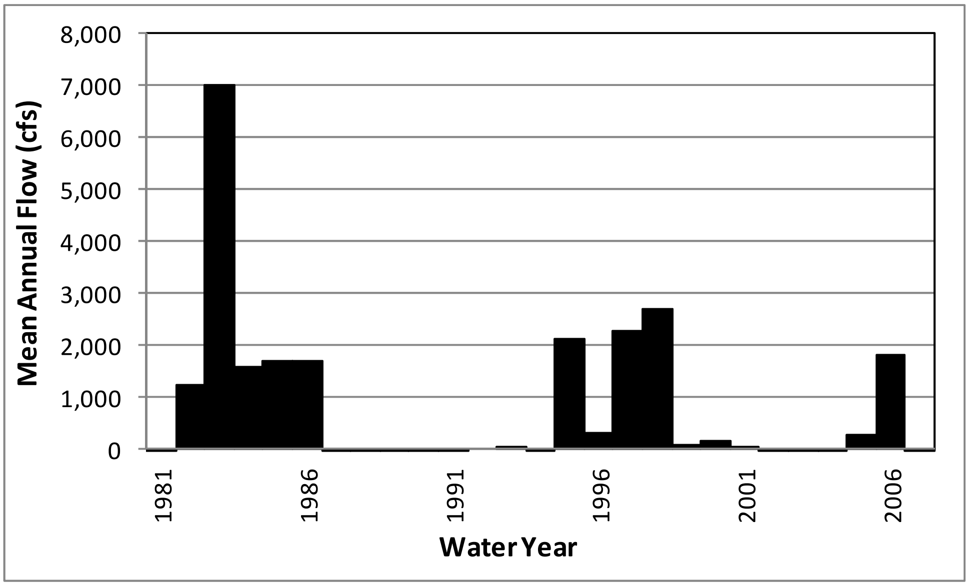
Source: CDEC 2008, Gage ID CBP
Note:
[1] Period of record Water Years 1975 – 1998; some years may be missing data.
Key:
cfs = cubic feet per second

Eastside Bypass, Mariposa Bypass, and Tributaries. The three Eastside Bypass reaches have a design channel capacity of 10,000 cfs, 16,500 cfs, and 13,500 cfs, respectively. The design channel capacity in Eastside Bypass Reach 1 increases to 12,000 cfs and 17,000 cfs as it intercepts Berenda and Ash Slough. The design channel capacity in Eastside Bypass Reach 3 increases to 18,500 cfs at the confluence of Bear Creek. Flow within Eastside Bypass Reach 3 is controlled by the Eastside Bypass Bifurcation Structure. Actual channel capacities may be less because of subsidence of the Eastside Bypass levees. Flow within the Mariposa Bypass is controlled by the Mariposa Bypass Bifurcation Structure, which diverts water from the Eastside Bypass back to Reach 4 of the San Joaquin River. Table 3-45 lists the gages located in or near the Eastside Bypass, along with the periods of record and annual mean and maximum daily mean streamflows. Figures 3-33, 3-34, and 3-35 show mean annual flows at the gages for the periods of record shown in Table 3-45. Tables 3-46, 3-47, and 3-48 show the historical mean monthly flows at the gages.

Table 3-45.
Streamflow Gages in Eastside Bypass

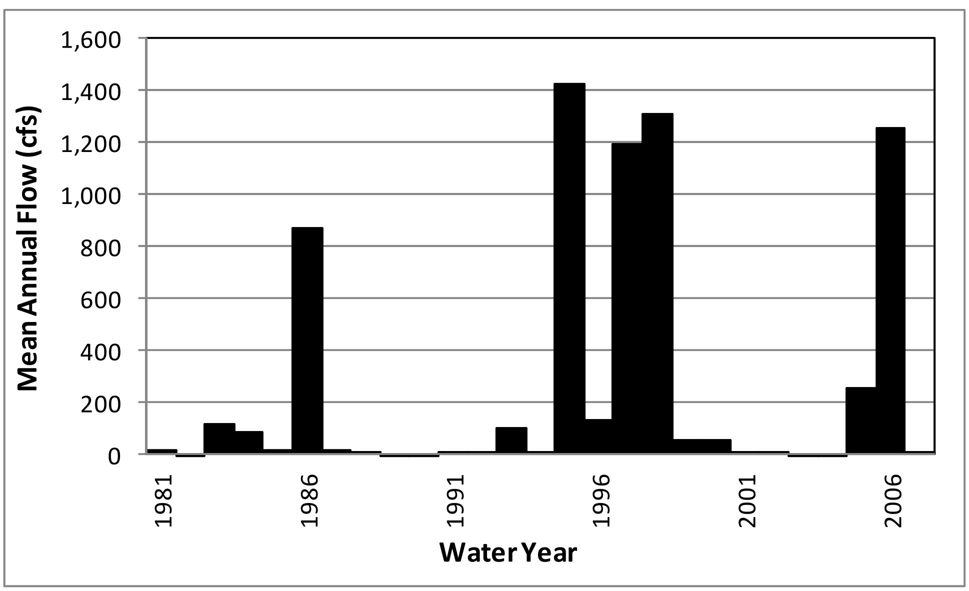
Gage Name	CDEC ID or DWR Station No.	Drainage Area (square miles)	Period of Record	Mean Annual Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
Eastside Bypass near El Nido	ELN	NA	1980 – 2007	840	20,400 (January 27, 1997)
Eastside Bypass below Mariposa Bypass	EBM	NA	1980 – 2007	257	11,400 (January 27, 1997)
Bear Creek below Eastside Bypass	B05516	NA	1980 – 2007	81	4,170 (April 6, 2006)

Key: *Source: CDEC 2008; Reclamation 2008*
CDEC = California Data Exchange Center
cfs = cubic feet per second
DWR = California Department of Water Resources
ID = identification
NA = not applicable/not available
No. = number



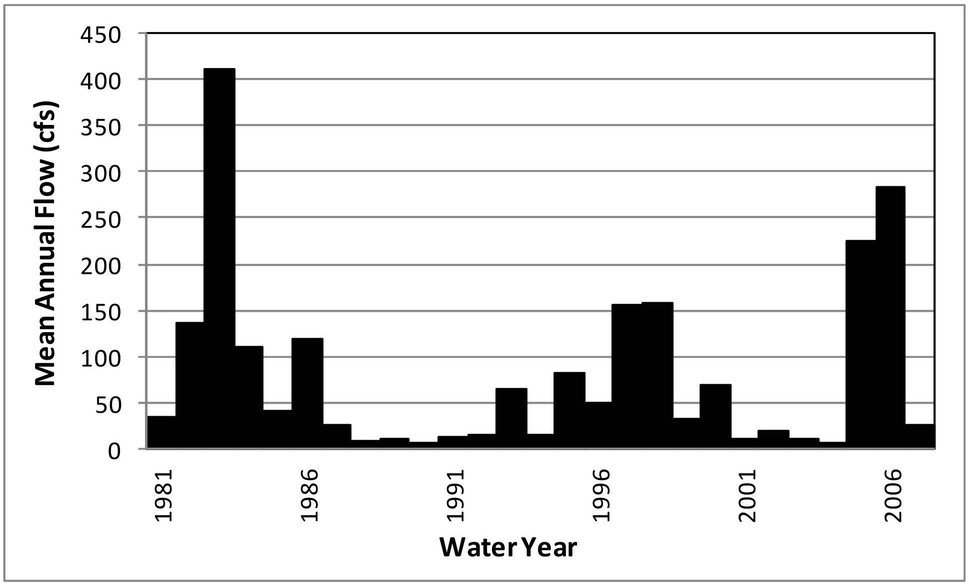
Source: CDEC 2008, Gage ID ELN

Figure 3-23.
Historical Mean Annual Flow for Eastside Bypass near El Nido



Source: CDEC 2008, Gage ID EBM

Figure 3-24.
Historical Mean Annual Flow for Eastside Bypass Below Mariposa Bypass



Source: Reclamation 2008, Gage ID B05516

Figure 3-25.
Historical Mean Annual Flow for Bear Creek Below Eastside Bypass

Table 3-46.
Historical Mean Monthly Flows for Eastside Bypass near El Nido

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	110	198	559	1,108	1,331	1,711	2,122	1,521	1,002	512	32	58
Wet	1	280	1,282	3,173	4,582	4,844	6,008	4,129	2,846	1,922	113	219
Normal-Wet	572	656	1191	1477	118	723	14	263	2	0	1	1
Normal-Dry	7	9	13	23	464	1,230	967	119	111	5	7	3
Dry	12	8	11	23	4	0	1	0	0	0	0	0
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID ELN
Note:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-47.
Historical Mean Monthly Flows for Eastside Bypass Below Mariposa Bypass

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	23	16	50	338	424	376	634	602	410	206	17	10
Wet	22	27	102	1,217	1,427	1,262	1,539	1,331	906	727	51	20
Normal-Wet	58	36	98	23	191	131	22	157	22	19	20	20
Normal-Dry	14	3	8	21	9	46	3	1	1	0	0	0
Dry	10	4	9	21	45	1	3	2	1	1	1	1
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID EBM
Note:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-48.
Historical Mean Monthly Flows for Bear Creek Below Eastside Bypass

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	50	23	57	186	172	184	121	43	29	22	25	47
Wet	59	39	108	434	416	390	159	75	56	40	52	122
Normal-Wet	51	27	86	48	167	88	50	33	40	28	21	27
Normal-Dry	44	7	12	29	22	70	10	8	4	1	2	20
Dry	49	6	3	9	58	21	7	5	3	1	2	13
Critical-High	Data not available											
Critical-Low	Data not available											

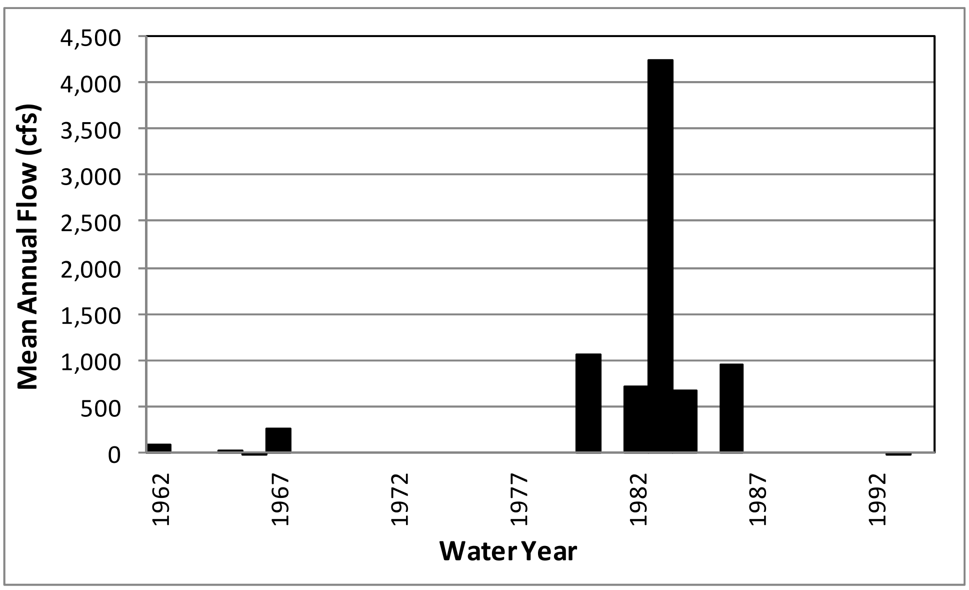
Source: Reclamation 2008, DWR Gage ID B05516
Note:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
Key:
cfs = cubic feet per second

Table 3-49 lists the gage located in the Mariposa Bypass, along with the period of record and annual mean and maximum daily mean streamflow. Figure 3-26 shows the historical mean annual flow at the gage for the period of record shown in Table 3-49. Table 3-50 shows the historical mean monthly flow at the gage.

Table 3-49.
Streamflow Gage in Mariposa Bypass near Crane Ranch

Gage Name	DWR Station No.	Drainage Area (square miles)	Period of Record	Mean Streamflow (cfs)	Maximum Daily Mean Streamflow (cfs) (date measured)
Mariposa Bypass near Crane Ranch	B00420	NA	1980 – 1994	456	9,960 (March 3, 1983)

Source: Reclamation 2008
Key:
cfs = cubic feet per second
DWR = Department of Water Resources
NA = not applicable/not available
No. = number



Source: Reclamation 2008, Gage ID B00420

Figure 3-26.
Historical Mean Annual Flow for Mariposa Bypass near Crane Ranch

Table 3-50.
Historical Mean Monthly Flows for Mariposa Bypass near Crane Ranch

Year Type	Mean Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	66	147	410	598	720	1,076	958	556	422	285	28	44
Wet	0	315	893	1,525	2,044	3,050	2,871	1,574	1,196	911	90	141
Normal-Wet	496	472	671	1,038	1	0	6	0	0	0	0	0
Normal-Dry	0	0	0	1	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	Data not available											
Critical-Low	Data not available											

Source: Reclamation 2008, Gage ID. B00420
Note:
[1] Period of record Water Years 1962 – 1994; some years may be missing data.
Key:
cfs = cubic feet per second

San Joaquin River from Merced River to the Delta

Flows in the San Joaquin River below the Merced River confluence to the Delta are controlled in large part by releases from reservoirs located on tributary systems, including the Merced, Tuolumne, and Stanislaus rivers, to satisfy contract deliveries and instream flow requirements. Average historical flows in the San Joaquin River near Newman, located just downstream from the Merced River confluence, are shown in Table 3-18. Flows are also controlled in part by operational agreements such as VAMP.

VAMP is an experimental-management program, under the jurisdiction of the SWRCB (per D-1641). VAMP was established as a 12-year program to protect juvenile Chinook salmon emigrating through the San Joaquin River and Delta, and to evaluate how Chinook salmon survival rates change in response to alterations in San Joaquin River flows and exports at CVP and SWP facilities in the south Delta when the Head of Old River Barrier is installed.

VAMP includes a 31-day pulse flow period in April and May of up to 110 TAF, depending on the flow conditions. Water needed to create the pulse flow is obtained by Reclamation through performance-based agreements that require the release of water or reduction of delivery from reservoirs on the Merced, Tuolumne, and Stanislaus rivers and from the Exchange Contractors at Mendota Pool, to meet the target flow requirements. Under the San Joaquin River Agreement, SJRGA coordinates operations to meet VAMP requirements. Reclamation and DWR compensate SJRGA to make water supplies available for instream flows, as needed, up to prescribed limits. Releases from major reservoirs on the tributaries are made in response to multiple operational objectives that would not be affected by WY 2010 Interim Flows, including flood management, downstream diversions, instream fisheries flows, and instream water quality flows. These operational objectives are in addition to VAMP.

The major reservoirs on the tributary rivers are all operated for local requirements, including flood control and water supply. The operation of these reservoirs to meet these demands includes rules that are based on reservoir storage at any given time. For example, flood control rules typically specify required releases during periods of high inflows as a reservoir fills. If the reservoir has a different storage at the start of the high inflow period, it will capture a different volume of the high inflow and will reach the flood control storage limit at a different time, changing the releases from the reservoir.

Sacramento-San Joaquin Delta

Both the CVP and the SWP use Delta channels to convey water released from the upstream Sacramento River basin reservoirs to their pumping stations in the south Delta for export south of the Delta. These pumping facilities are large enough to impact local flow patterns in the Delta channels and cause changes to stages and salinities. The Jones Pumping Plant has a nominal and permitted pumping capacity of 4,600 cfs. Harvey O. Banks Pumping Plant (Banks Pumping Plant) has a nominal installed pumping capacity of 10,300 cfs. However, flow diverted from the Delta into Clifton Court Forebay is limited by permit to 6,680 cfs during much of the year. A number of agreements exist between the CVP and SWP operators (Reclamation and DWR, respectively) regarding how they will jointly operate to meet both their own goals and needs, and to meet shared responsibilities for in-basin flow and water quality requirements in the Delta. Both entities export water from the Delta for project use in areas to the south. The rates of export are operationally conditioned by the 2008 USFWS and 2009 NMFS Biological Opinions (BO) for the long-term coordinated operations for the CVP and SWP.

Central Valley Project/State Water Project Water Service Areas

The following sections describe storage and diversion facilities for CVP and SWP water service areas.

Central Valley Project Friant Division Water Service Area and Facilities. Friant Division facilities include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south, respectively, to agricultural and urban water contractors. These facilities are described in the San Joaquin River Upstream from Friant Dam section, above. Historically, the Friant Division has delivered an average of about 1,300 TAF of water annually. Figure 3-2 shows the locations and acreage of the 28 Friant Division long-term contractors.

The area supplied by the Friant Division remains in a state of groundwater overdraft today. Reclamation employs a two-class system of water allocation to support conjunctive water management and take advantage of water during wetter years:

- Class 1 supplies, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to quality groundwater. During project operations, the first 800 TAF of annual water supply are delivered as Class 1 water.

- Class 2 water is a supplemental supply and is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft. Class 2 contractors typically have access to good quality groundwater supplies and can use groundwater during periods of surface water deficiency. Many Class 2 contractors are in areas with high groundwater recharge capability and operate dedicated groundwater recharge facilities. Total Class 2 contracts equal 1.4 million acre-feet (MAF).

In addition to Class 1 and Class 2 water deliveries, Reclamation delivers water (called Section 215 water) made possible as a result of a water supply not otherwise storable for project purposes or frequent and otherwise unmanaged flood flows of short duration under the authority of Section 215 of the Reclamation Reform Act of 1988.Delivery of Section 215 water has enabled San Joaquin Valley groundwater replenishment at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

Central Valley Project Water Service Areas and Facilities. Reclamation operates several other reservoirs with a combined storage capacity of about 12 MAF. The DMC, completed in 1951, carries water from the Jones Pumping Plant in the Delta along the west side of the San Joaquin Valley for irrigation supply, for use by Delta Division, San Luis Unit, and San Felipe Unit contractors, and to replace San Joaquin River water stored at Friant Dam and diverted into the Friant-Kern and Madera canals. The DMC is about 117 miles long and ends at the Mendota Pool. The initial diversion capacity is 4,600 cfs, which decreases to 3,211 cfs at the terminus.

The CVP provides water to Settlement Contractors in the Sacramento Valley, Exchange Contractors in the San Joaquin Valley, agricultural and M&I water service contractors in both the Sacramento and San Joaquin valleys, and wildlife refuges both north and south of the Delta. Through an Exchange Contract, Reclamation provides a substitute water supply to the Exchange Contractors, including CCID, Columbia Canal Company, SLCC, and the Firebaugh Canal Water District, in exchange for the use of waters of the San Joaquin River within the Friant Division. The four entities of the Exchange Contractors each have separate conveyance and delivery systems, operated independently. The Exchange Contractors, along with eight additional water right contractors, have conveyance and delivery systems that generally divert water from the DMC or Mendota Pool, convey water to customer delivery turnouts, and at times discharge to tributaries of the San Joaquin River.

State Water Project Water Service Areas and Facilities. San Luis Reservoir, with a total capacity of about 2.0 MAF, is shared at 0.97 MAF for the CVP and 1.1 MAF for the SWP. The O’Neill Forebay serves as a regulating reservoir for San Luis Reservoir; the William R. Gianelli Pumping-Generating Plant (Gianelli Pumping-Generating Plant), also a joint CVP/SWP facility, can pump flows from the O’Neill Forebay into San Luis

Reservoir, and also make releases from San Luis Reservoir to the O'Neill Forebay for diversion to either the DMC or the California Aqueduct. The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers, or deliver it directly to agricultural and M&I water users (DWR 1999).

3.11.2 Surface Water Quality

Surface water quality monitoring programs are currently being conducted by Reclamation, USGS, DFG, DWR, and the Central Valley RWQCB in the Restoration Area. In particular, the Central Valley RWQCB, in conjunction with the Westside San Joaquin River Watershed Coalition, monitors for pesticides and other agricultural contaminants within the affected reaches on a monthly basis. The USEPA maintains a database of existing surface water quality monitoring programs in the San Joaquin River watershed through the San Joaquin River Monitoring and Assessment Strategy Web site. surface water quality monitoring programs and data sources (USEPA 2008) are listed in Table 3-51. Table 3-52 lists existing surface water quality monitoring stations identified to support the SJRRP. Most of the surface water quality monitoring stations were chosen because they are established monitoring sites, funded by other projects, have sufficient historical data, and are likely to continue operation for at least 10 more years

Table 3-51.
Current Surface Water Quality Monitoring Programs in the Restoration Area

Water Quality Monitoring Program	Lead Agencies	Period of Record	Parameters	Frequency
IEP Environmental Monitoring Program	DWR	1971–present	Biological community, basic parameters, sediments, clarity (turbidity, Secchi depth), nutrients, organics, toxicity	Continuous, monthly, quarterly
Subsurface Agricultural Drainage Monitoring Program	Central Valley RWQCB	2000–present	Basic parameters, ions & minerals, trace elements & metals	Weekly
San Joaquin-Tulare Basins National Water Quality Assessment Program	USGS	1991–present	Basic parameters, nutrients, organics, pesticides, sediments	Biweekly
Central Valley Project Baseline Water Quality Monitoring Program	Reclamation	1998–present	Trace metals, ions & minerals, nutrients	Quarterly
DFG Water Quality Sampling	DFG	2003–present	Basic parameters	Hourly
Grasslands Bypass Project	Reclamation, Central Valley RWQCB	1996–present	Basic parameters, ions & minerals, nutrients, trace elements & metals	Weekly, monthly
San Joaquin District – Surface Water Monitoring Sites	DWR	1959–present	Basic parameters, nutrients, trace elements & metals	Monthly
San Joaquin River Real-Time Water Quality Management Program	Reclamation, DWR	1996–present	EC, DO, temperature	Hourly
Surface Water Ambient Monitoring Program	Central Valley RWQCB	1999–present	Basic parameters, organics, bacteria, pathogens	Weekly, bimonthly, semiannually
Reclamation Flow Data	Reclamation	1944–present	Basic parameters	Daily

Table 3-51.
Current Water Quality Monitoring Programs in the Restoration Area (contd.)

Water Quality Monitoring Program	Lead Agencies	Period of Record	Parameters	Frequency
Irrigated Lands Program	Westside San Joaquin River Watershed Coalition, Central Valley RWQCB	2004–present	Basic parameters, sediments, clarity (turbidity), pesticides, macroinvertebrates, ultraviolet absorbance, hardness, ions & minerals, organics, nutrients	Monthly, bimonthly
Municipal Water Quality Investigations	DWR	1982–present	DBPs, basic parameters, ions & minerals, nutrients, pathogens, arsenic	Monthly (May to October), weekly (November to April)

Key:
Basic parameters = dissolved oxygen (DO), pH, electrical conductivity (EC), water temperature
Biological community = benthic macroinvertebrates, phytoplankton, and zooplankton
Clarity = Secchi depth, turbidity
DBPs = disinfection by-products
DFG = California Department of Fish and Game
DWR = California Department of Water Resources
IEP = Interagency Ecological Program
Ions & minerals = calcium, magnesium, potassium, sodium, chloride, fluoride, silica, sulfate, iron, manganese, boron, and arsenic
Nutrients = nitrogen, phosphorus
Organics = total organic carbon (TOC), dissolved organic carbon (DOC)
Pathogens = fecal coliforms, total coliforms, *E. Coli*
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RWQCB = Regional Water Quality Control Board
Sediments = total suspended solids (TSS), total dissolved solids (TDS)
Trace elements & metals = molybdenum, selenium, mercury, thallium, copper, and zinc
USGS = U.S. Geological Survey

Table 3-52.
Surface Water Quality Monitoring Stations Identified to Support SJRRP

Location	Responsible Agency	Parameters	Frequency	Remarks
Friant Dam (Millerton Lake)	Reclamation (SCCAO)	Physical [1]	Continuous	Multiple parameter sonde*
San Joaquin River below Friant Dam	Reclamation (SCCAO)	Physical [1]	Continuous	Multiple parameter sonde
	Reclamation (MP157)	Short list* [2] Baseline [3]	Daily composite* Quarterly	Autosampler* Grab sample
San Joaquin River at Gravelly Ford	Reclamation (SCCAO)	Temperature	Continuous	Multiple parameter sonde*
San Joaquin River below bifurcation	Reclamation (SCCAO)	Temperature	Continuous	Multiple parameter sonde*
San Joaquin River near Mendota	Reclamation (SCCAO)	Physical [1]	Continuous	Multiple parameter sonde
	Reclamation (MP157)	Short list* [2] Baseline* [3]	Daily composite* Quarterly*	Autosampler* Grab sample*
San Joaquin River below Sack Dam	TBD	Physical* [1]	Continuous*	Multiple parameter sonde*
San Joaquin River at top of Reach 4B	TBD	Conductivity* Temperature* Dissolved oxygen* Turbidity*	Continuous*	Recommend using established site at Fremont Ford
San Joaquin River at Fremont Ford Bridge	USGS	Physical [1]	Continuous	Multiple parameter sonde
	Central Valley RWQCB	Selenium Boron Nutrients [4] Others [5]	Weekly	Grassland Bypass Project Station H
San Joaquin River at Hills Ferry	TBD	Physical* [1]	Continuous*	Multiple parameter sonde
	SLDMWA	Selenium Boron	Weekly	Grassland Bypass Project Station H
	Reclamation (MP157)	Short list* [2] Baseline* [3]	Daily composite* Quarterly	Autosampler* Grab sample*

Table 3-52.
Water Quality Monitoring Stations Identified to Support the SJRRP (contd.)

Location	Responsible Agency	Parameters	Frequency	Remarks
San Joaquin River near Crows Landing	USGS	Physical [1]	Continuous	Grassland Bypass Project Station N
	Central Valley RWQCB	Selenium Boron	Daily composite	Autosampler*
		Nutrients [4] Others [5]	Weekly	Grab sample

Notes:
* New equipment or sampling for the San Joaquin River Restoration Program water quality monitoring plan.
[1] Real-time measurements of electrical conductivity (salinity), temperature, pH, dissolved oxygen, turbidity, and chlorophyll; calibration, as needed.
[2] Short list of constituents for lab analysis – to be determined (e.g., selenium, boron).
[3] Central Valley Project Baseline Water Quality Monitoring Program; full Title 22 organic and inorganic compounds, plus bacterial.
[4] Parameters included in the Nutrient Series are nitrate, ammonia, total Kjeldahl nitrogen, total phosphate, and ortho phosphate, required by the Waste Discharge Permit for Grassland Bypass Project. Nutrient Series sampling period increases to every other week during irrigation season (March through August).
[5] Other constituents include bacteria, trace elements, total organic carbon, and other minerals.

Key:
Central Valley RWQCB = Central Valley Regional Water Quality Control Board
MP157 = Reclamation Mid-Pacific Region, Environmental Monitoring Branch
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SCCAO = Reclamation, South Central California Area Office
SJRRP = San Joaquin River Restoration Program
SLDMWA = San Luis & Delta-Mendota Water Authority
TBD = to be determined
USGS = U.S. Geological Survey

The following sections describe the affected environment for surface water quality within the five geographic subareas of the EA/IS study area.

The Central Valley RWQCB, through the Surface Water Quality Monitoring Program (SWAMP), monitors water quality at numerous sites in the San Joaquin River basin. Eight sites are located on the San Joaquin River, downstream from major inflows, and numerous sites are located on San Joaquin River tributaries. San Joaquin River SWAMP sites located near and downstream from the San Joaquin River confluence with Merced River include the following:

- San Joaquin River at Hills Ferry (Site Code STC 512), located 30 yards upstream from Merced River
- San Joaquin River at Crows Landing (Site Code STC504)
- San Joaquin River at Patterson (Site Code STC507)
- San Joaquin River at Maze Boulevard (Site Code STC510
- San Joaquin River at Airport Way (Site Code STC501)

The San Joaquin River SWAMP sites serve as long-term trend monitoring stations. Sites are monitored weekly, monthly, or quarterly (depending on the constituent and available funding), and monitoring data collected through the program include data obtained during high flow events. All of the sites have data covering at least several of the flood flows that occurred during 1997, 2001, 2005, 2006, and 2007. The suite of parameters monitored at each site varies, and includes a subset of the following: water temperature, electrical conductivity (EC), pH, dissolved oxygen, boron, selenium, total suspended solids (TSS), turbidity, bacteria, nutrients, biological oxygen demand, metals, and minerals.

San Joaquin River SWAMP water quality data collected by the Central Valley RWQCB suggest that EC, total organic carbon, turbidity, and TSS were influenced by storm events, especially EC during the first storm runoff (RWQCB 2009). Concentrations of these constituents spiked during storm events, likely because of increased runoff across agricultural lands, and then decreased, but remained at elevated levels, during the irrigation season.

San Joaquin River Upstream from Friant Dam

Water upstream from Friant Dam is generally “soft” with low mineral and nutrient concentrations due to the insolubility of granitic soils in the watershed and the river’s granite substrate. As the San Joaquin River and tributary streams flow from the Sierra Nevada foothills across the eastern valley floor, their mineral concentration increases. Sediment is captured behind the many impoundments in this geographic subarea.

Most of Millerton Lake becomes thermally stratified during spring and summer. Complete mixing of the water column likely occurs during winter. Dissolved oxygen concentrations in Millerton Lake are generally high during most of the year, with lowest concentrations typically exhibited during November at depths greater than 175 feet.

San Joaquin River from Friant Dam to Merced River

Water quality in various segments of the San Joaquin River below Friant Dam is degraded because of low flow, and discharges from agricultural areas, wildlife refuges, and wastewater treatment plants. The following subsections describe surface water quality conditions within San Joaquin River reaches in the Restoration Area. The *Water Quality Control Plan* for the Sacramento and San Joaquin river basins (Basin Plan), adopted by the Central Valley RWQCB in 1998, is the regulatory reference for meeting Federal and State water quality requirements, and lists existing and potential beneficial uses of the San Joaquin River. The current Basin Plan review is anticipated to provide regulatory guidance for TMDL standards at locations along the San Joaquin River.

Water quality in Reach 1 is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. Water quality data collected at San Joaquin River below Friant demonstrate the generally high quality of water released at Friant Dam from Millerton Lake to Reach 1. Temperatures of San Joaquin River water releases to Reach 1 depend on the cold-water volume available at Millerton Lake (Reclamation 2007).

During the irrigation season, water released at Mendota Dam to Reach 3 generally has higher concentrations of total dissolved solids (TDS) than water in the upper reaches of the San Joaquin River. Increased EC and TSS concentrations demonstrate the effect of Delta contributions to San Joaquin River flow. Water temperatures below Mendota Dam depend on water temperatures of inflow from the DMC and, occasionally, the Kings River system via James Bypass (Reclamation 2007).

Water quality criteria applicable to some beneficial uses are not currently met within Reaches 3 and 4. Proposed Clean Water Act Section 303(d) listings for these reaches include boron, EC, and some pesticides. TMDL and Basin Plan amendments are currently in place for diazinon and chloropyrifos runoff into the San Joaquin River. TMDLs and Basin Plan amendments are currently being developed for selenium, salt and boron, and pesticides. Water temperature conditions in Reach 4A depend on inflow water temperatures during flood flows from Reach 3 (Reclamation 2007).

Reach 5 typically has the poorest water quality of any reach of the river. Reach 5 and its tributaries (Bear Creek and Mud and Salt sloughs) do not meet water quality criteria applicable to some designated beneficial uses, as shown in Table 3-53. In addition to TMDLs and Basin Plan amendments currently in place or being developed for Reaches 3 and 4, TMDLs were developed to address selenium in Salt Slough and the Grasslands Drainage Area.

Water quality data collected at Salt Slough, Mud Slough, and San Joaquin River sites within Reach 5 demonstrate the effects of irrigation runoff contributions from eastside tributaries. San Joaquin River water temperatures within Reach 5 are influenced greatly by the water temperature of Salt Slough inflow, which contributes the majority of streamflow in the reach (Reclamation 2007).

Table 3-53.
Proposed 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments, San Joaquin River System, Reach 5, and Tributaries

Segment	Pollutant/Stressor	Potential Source
San Joaquin River, Bear Creek to Mud Slough (Reach 5)	Boron	Agriculture
	DDT	Agriculture
	Electrical conductivity	Agriculture
	Group A pesticides	Agriculture
	Mercury	Agriculture
	Unknown toxicity	Source unknown
San Joaquin River, Mud Slough to Merced River (Reach 5)	Boron	Agriculture
	DDT	Agriculture
	Electrical conductivity	Agriculture
	Group A pesticides	Agriculture
	Mercury	Agriculture
	Unknown toxicity	Source unknown
Bear Creek	Mercury	Resource extraction
Mud Slough	Boron	Agriculture
	Electrical conductivity	Agriculture
	Pesticides	Agriculture
	Unknown toxicity	Source unknown
Salt Slough	Boron	Agriculture
	Chlorpyrifos	Agriculture
	Diazinon	Agriculture
	Electrical conductivity	Agriculture
	Unknown toxicity	Agriculture

Key:
DDT = dichlorodiphenyl-trichloroethane

San Joaquin River from Merced River to the Delta

Below its confluence with the Merced River, San Joaquin River water quality generally improves at successive confluences with rivers draining the Sierra Nevada, particularly at confluences with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, mineral concentrations tend to increase because of inflows of agricultural drainage water, other wastewaters, and effluent groundwater (DWR 1965). TDS in the San Joaquin River near Vernalis has historically ranged from 52 milligrams per liter (mg/L) at high flows to 1,220 mg/L from 1951 to 1962 (DWR 1965).

Water quality impairments identified by the Central Valley RWQCB for the San Joaquin River from Merced River to the Delta, and recommended to SWRCB during 2006 for listing on the Federal Clean Water Act Section 303(d) list, are provided in Table 3-54. In addition to these water quality impairments, a TMDL and Basin Plan amendment for organic enrichment/low dissolved oxygen in the Stockton Deepwater Ship Channel portion of the San Joaquin River were also identified.

Table 3-54.
Proposed 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments, San Joaquin River System from Merced River to Delta

Segment	Pollutant/Stressor	Potential Source	Affected Area/Reach Length
San Joaquin River, Merced River to Tuolumne River	Boron	Agriculture	29 miles
	DDT	Agriculture	
	Electrical conductivity	Agriculture	
	Group A pesticides	Agriculture	
	Mercury	Resource Extraction	
	Unknown toxicity	Agriculture	
San Joaquin River, Tuolumne River to Stanislaus River	Boron	Agriculture	8.4 miles
	DDT	Agriculture	
	Electrical conductivity	Agriculture	
	Group A pesticides	Agriculture	
	Mercury	Resource Extraction	
	Unknown toxicity	Agriculture	
San Joaquin River, Stanislaus River to Delta	Boron	Agriculture	3 miles
	DDT	Agriculture	
	Electrical conductivity	Agriculture	
	Group A pesticides	Agriculture	
	Mercury	Resource Extraction	
	Toxaphene	Source unknown	
	Unknown toxicity	Agriculture	

Key: DDT = dichlorodiphenyl-trichloroethane

Sacramento-San Joaquin Delta

Water quality in the Delta is highly variable temporally and spatially and is a function of complex circulation patterns that are affected by Delta inflows, pumping for local Delta agricultural operations and regional exports, operation of flow control structures, and tidal action. The existing water quality problems of the Delta system may be categorized as the presence of toxic materials, eutrophication and associated fluctuations in dissolved oxygen, presence of suspended sediments and turbidity, salinity, and presence of bacteria.

Delta waterways within the area under Central Valley RWQCB jurisdiction are listed as impaired on the USEPA 303(d) list for dissolved oxygen, EC, dichlorodiphenyl-trichloroethane (DDT), mercury, Group A pesticides, diazinon and chlorpyrifos, and unknown toxicity (Central Valley RWQCB 2007). The Delta is also listed as impaired for mercury, chlordane, selenium, DDT, dioxin compounds, polychlorinated biphenyl (PCB) compounds, dieldrin, diazinon, exotic species, and furan compounds (San Francisco Bay RWQCB 2003).

The north Delta tends to have better water quality primarily because of inflow from the Sacramento River. The quality of water in the west Delta is strongly influenced by tidal exchange with San Francisco Bay; during low-flow periods, seawater intrusion increases salinity. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, and effects of diversions that can sometimes increase seawater intrusion from San Francisco Bay.

The Sacramento and San Joaquin rivers contribute approximately 61 percent and 33 percent, respectively, to tributary inflow TDS concentrations within the Delta. TDS concentrations are relatively low in the Sacramento River, but because of its large volumetric contribution, the river provides the majority of the TDS load supplied by tributary inflow to the Delta (DWR 2001). Although actual flow from the San Joaquin River is lower than from the Sacramento River, TDS concentrations in San Joaquin River water average approximately 7 times those in the Sacramento River. As mentioned, the influence of this relatively poor San Joaquin River water quality is greatest in the south Delta channels and in CVP and SWP exports. Water temperature in the Delta is only slightly influenced by water management activities (i.e., dam releases) (Reclamation and DWR 2005).

Delta exports contain elevated concentrations of disinfection byproduct precursors (e.g., dissolved organic carbon (DOC)), and the presence of bromide increases the potential for formation of brominated compounds in treated drinking water. Organic carbon in the Delta originates from runoff from agricultural and urban land, drainage water pumped from Delta islands that have soils with high organic matter, runoff and drainage from wetlands, wastewater discharges, and primary production in Delta waters. Delta agricultural drainage can also contain high levels of nutrients, suspended solids, organic carbon, minerals (salinity), and trace chemicals such as organophosphate, carbamate, and organochlorine pesticides.

Central Valley Project/State Water Project Water Service Areas

Water delivered to Friant Division contractors via the Friant-Kern and Madera canals from Millerton Lake is representative of water quality conditions in Millerton Lake and the upper San Joaquin River watershed, generally soft with low mineral and nutrient concentrations. Surface water quality in the other CVP water service areas is affected by fluctuations of water quality in the Delta, which in turn are influenced by climate, water quality in the San Joaquin River, local agricultural diversions and drainage water, and the Sacramento River. Water quality concerns of particular importance are those related to salinity and drinking water quality. Surface water quality conditions within SWP water service areas and at SWP facilities are similar to the conditions described above for other CVP water service areas and facilities. Constituents that affect drinking water quality are more of a concern within the SWP water service area because of high demand for municipal water supplies for SWP contractors.

3.11.3 Groundwater

This section discusses hydrogeology, groundwater storage and production, groundwater levels, land subsidence, and seepage and waterlogging within the San Joaquin Valley Groundwater Basin. The San Joaquin Valley Groundwater Basin (see Figure 3-27) comprises the San Joaquin River Hydrologic Region and the Tulare Lake Hydrologic Region. The San Joaquin River Hydrologic Region consists of basins draining into the San Joaquin River system, from the Cosumnes River basin on the north through the southern boundary of the San Joaquin River watershed (DWR 1999). The Tulare Lake Hydrologic Region is a closed drainage basin at the south end of the San Joaquin Valley, south of the San Joaquin River watershed, encompassing basins draining to the Kern Lakebed, Tulare Lakebed, and Buena Vista Lakebed (DWR 1999).

The San Joaquin Valley Groundwater Basin is composed of 16 subbasins: 9 in the San Joaquin Hydrologic Region and 7 in the Tulare Lake Hydrologic Region. The San Joaquin Hydrologic Region is heavily groundwater-reliant, with groundwater making up approximately 30 percent of the annual supply for agricultural and urban uses (DWR 2003). Groundwater in this region accounts for 5 percent of the State’s total agricultural and urban water use (DWR 1998). The Tulare Lake Hydrologic Region has also been historically heavily reliant on groundwater supplies. Groundwater use in this region has historically accounted for 41 percent of the total annual water supply and for 35 percent of all groundwater use in the State. Groundwater use in this region represents approximately 10 percent of the State’s total agricultural and urban water use (DWR 1998).

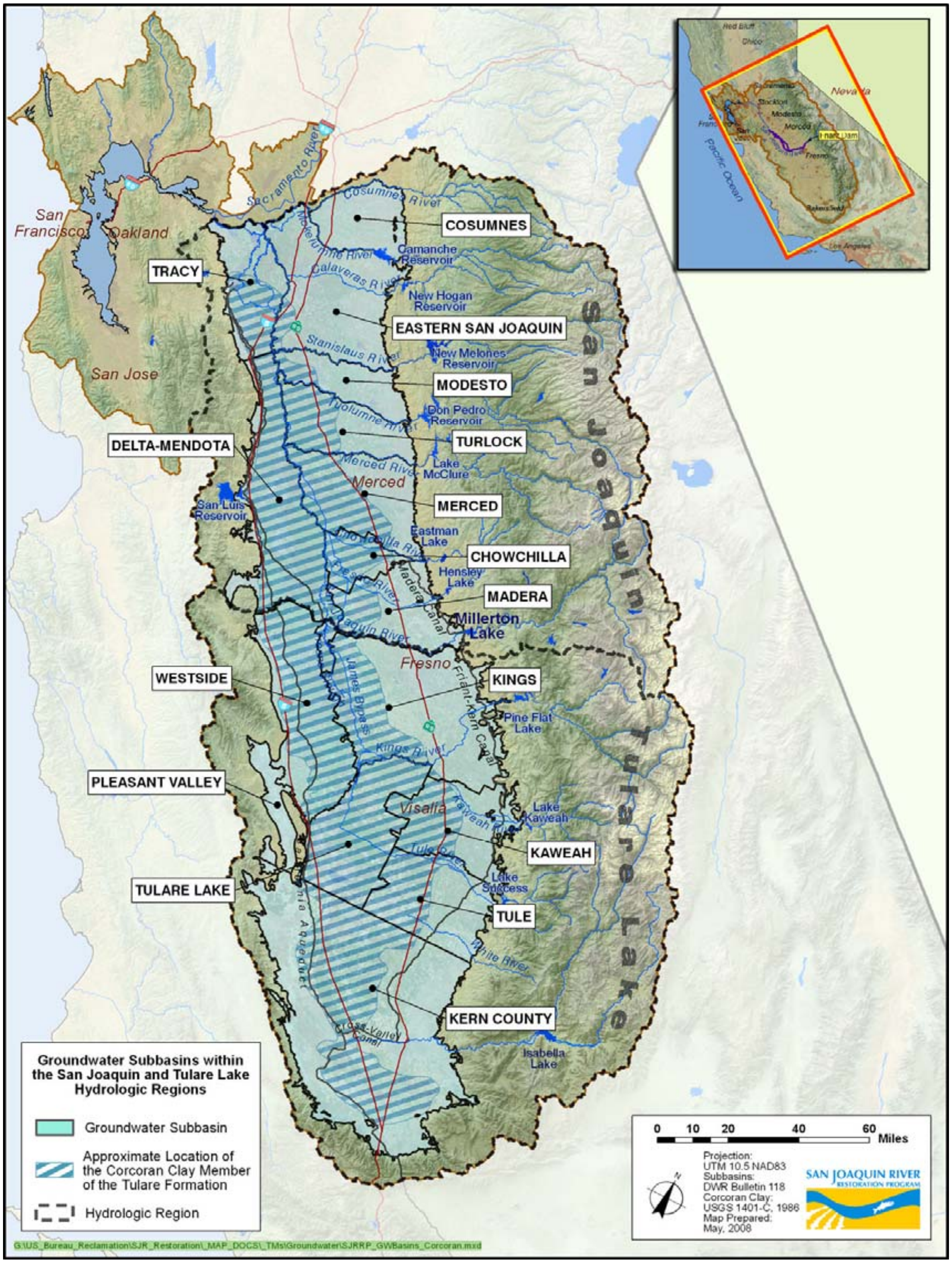


Figure 3-27.
Groundwater Subbasins of the San Joaquin and Tulare Lake Hydrologic Regions

Hydrogeology

The San Joaquin Valley is located in an asymmetric structural trough in the Central Valley of California. The San Joaquin Valley has accumulated up to 6 vertical miles of sediment, including marine and continental rocks and deposits (Page 1986). The eastern side of the valley is underlain by granitic and metamorphic rocks that slope gently from the outcrops of the Sierra Nevada. The western side and part of the eastern side of the valley are underlain by a mafic and ultramafic complex that is also part of the Sierra Nevada. The continental and marine rocks deposited in the San Joaquin Valley range in thickness from tens of feet to more than 2,000 feet (Page 1986). Although these sediments contain freshwater, the depth of the unit prevents it from being considered an important source of water (Page 1986).

On a regional scale, the E-clay, a thick zone of clay deposited as part of a sequence of lacustrine and marsh deposits underlying Tulare Lake, divides the groundwater system into two major aquifers: a confined aquifer beneath the E-clay and a semiconfined aquifer above the E-clay (Mitten et al. 1970, Williamson et al. 1989). The E-clay is considered equivalent to the Corcoran Clay member of the Tulare Formation, and is found ranging from zero to 160 feet thick and between 80 feet deep near Chowchilla, to 400 feet below the land surface to the southwest (Mitten et al. 1970).

Groundwater Storage and Production

Usable storage capacities for the San Joaquin River and Tulare Lake hydrologic regions are estimated to be 24 and 28 MAF, respectively, in DWR *Bulletin 160-93* (1994). DWR *Bulletin 160-93* defined perennial yield as "…the amount of groundwater that can be extracted without lowering groundwater levels over the long-term" (1994). Perennial yields of the San Joaquin River and Tulare Lake hydrologic regions are estimated to be 3.3 and 4.6 MAF, respectively (DWR 1994). The estimated perennial yield is directly dependent on the amount of recharge received by the groundwater basin, which can change over time. In 2000, approximately 33 percent of the water supply in the San Joaquin River and Tulare Lake hydrologic regions was provided by groundwater (DWR 2005).

Although a comprehensive assessment of overdraft in California's subbasins has not been completed since 1980, the *California Plan Update* reports that three of the subbasins in the San Joaquin River Hydrologic Region and five subbasins in the Tulare Lake Hydrologic Region are in a critical condition of overdraft. These subbasins include Chowchilla, Eastern San Joaquin, and Madera, in the San Joaquin Hydrologic Region, and Kings, Tulare Lake, Kern County, Kaweah, and Tule in the Tulare Lake Hydrologic Region (DWR 2005). Typical production in the subbasins in the San Joaquin River and Tulare Lake hydrologic region is shown in Tables 3-55 and 3-56 (DWR 1998, 2003).

Table 3-55.
Typical Groundwater Production in the San Joaquin River Hydrologic Region

Subbasin	Extraction (TAF/year)
Madera	570
Merced	560
Delta-Mendota	510
Turlock	450
Chowchilla	260
Modesto	230

Key:
TAF/year = thousand acre-feet per year

Table 3-56.
Typical Groundwater Production in the Tulare Lake Hydrologic Region

Subbasin	Extraction (TAF/year)
Kings	1,790
Kern County	1,400
Kaweah	760
Tulare Lake	670
Tule	660
Westside	210
Pleasant Valley	100

Key:
TAF/year = thousand acre-feet per year

Groundwater Levels

During the drought of the late 1980s and early 1990s (1987–1992), there were substantial deficiencies in surface water deliveries to water districts in the San Joaquin Valley Basin, resulting in increased groundwater pumping of the confined and semiconfined units of the aquifer system (McBain and Trush 2002, Reclamation 1997). A regional response to the drought was evident in the San Joaquin Valley Basin, with water levels in the central and eastern parts declining by 20 to 30 feet (Westlands Water District 1995). Following the drought, groundwater depression areas were present in the San Joaquin River Hydrologic Region in Merced and Madera counties, where groundwater was less than 50 feet above msl. The groundwater levels declined on the eastern side of the San Joaquin River Hydrologic Region until 1995 (DWR 2003).

Groundwater levels in the San Joaquin River Hydrologic Region began to recover in some of the subbasins in 1994 and continued through 2000 to water levels near 1970 predrought levels (DWR 2003). Figure 3-28 presents the most recent (2005) groundwater level conditions in the San Joaquin River and Tulare Lake hydrologic regions (DWR 2008). These groundwater contours, developed by DWR, illustrate groundwater elevations in the unconfined and semiconfined aquifers of the San Joaquin Valley. The groundwater elevations indicate that the San Joaquin Valley Groundwater Basin has generally recovered from the previous drought (1987–1992).

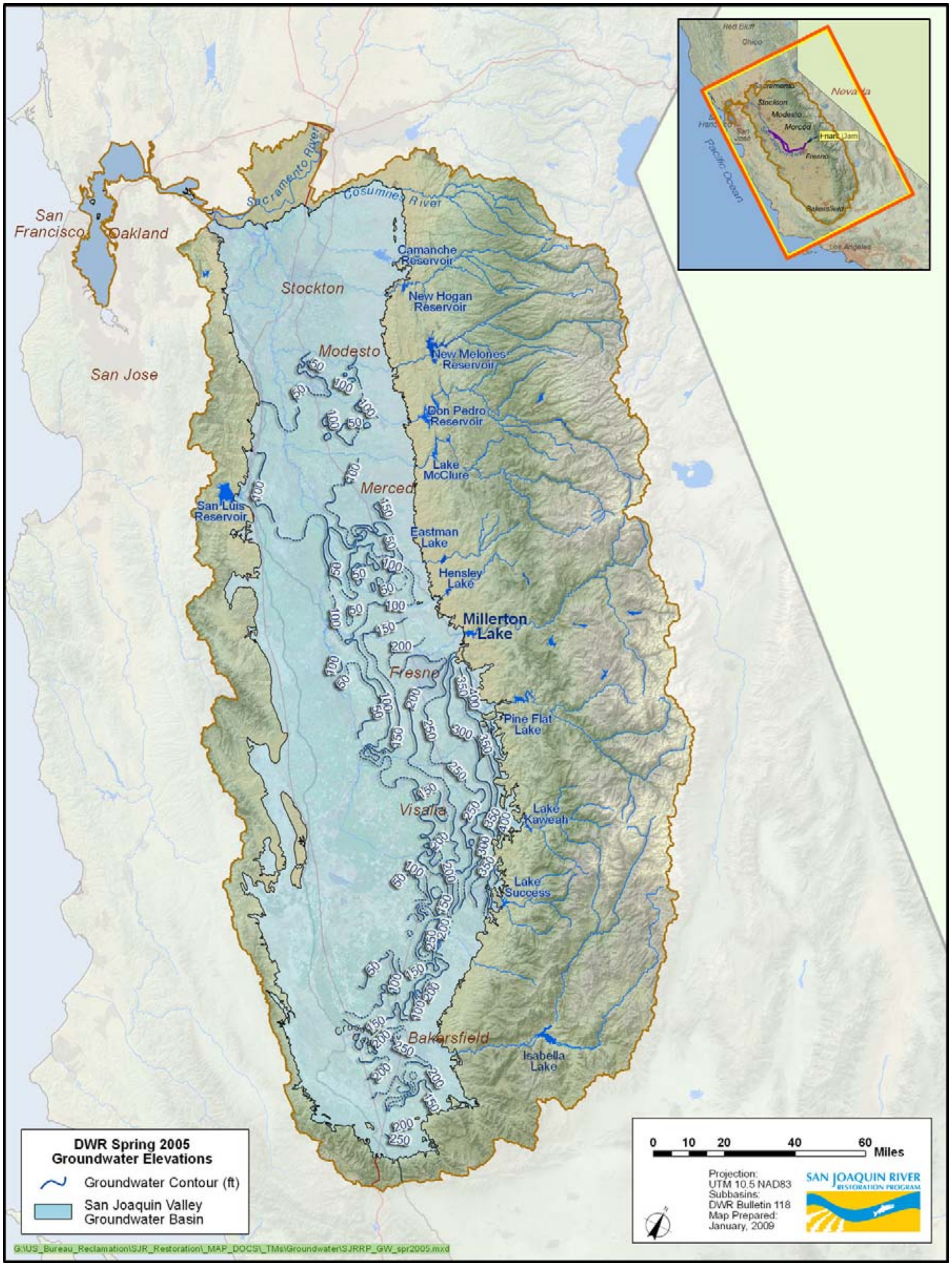


Figure 3-28.
Groundwater Elevations in Spring 2005

Groundwater Quality

Groundwater quality in the San Joaquin River and Tulare Lake hydrologic regions varies considerably. In general, groundwater quality is suitable for most urban and agricultural uses (DWR 2003). Primary constituents of concern include TDS, boron, chloride, nitrates, arsenic, selenium, dibromochloropropane (DBCP), and radon. Future site-specific projects relating to SJRRP implementation may require a more detailed assessment of local groundwater quality issues. USGS Groundwater Ambient Monitoring (GAMA) program data are currently available for the Southeast San Joaquin Valley and the Kern County Subbasin in the Tulare Lake Hydrologic Region (Burton and Belitz 2008; Shelton et al. 2008). The southeast San Joaquin Valley study area includes portions of Fresno, Tulare, and King counties, which in turn include the Kings, Kaweah, Tulare Lake, and Tule subbasins (Burton and Belitz 2008).

Seepage and Waterlogging

Seepage and waterlogging of crops in the lower reaches of the San Joaquin River has been an issue historically. High periodic streamflows and local flooding, combined with high groundwater levels in the San Joaquin River, and in the vicinity of its confluence with major tributaries, have resulted in seepage-induced waterlogging damage to low-lying farmland (Reclamation 1997). During flood-flow events, lateral seepage and structural stability issues with existing project and nonproject levees have been identified (RMC 2003, 2007).

McBain and Trush (2002) identified and classified different reaches of the San Joaquin River as “gaining” or “losing” reaches:

- **Reach 1 –** Outside the irrigation season, a minimum flow of 105 cfs is needed in Reach 1 at the Friant gaging station to obtain measurable flow at the Gravelly Ford gage, which suggests that this is a losing reach with a minimum loss of 105 cfs potentially due to seepage, pumping from the river, and vegetative consumptive use. During the summer and fall irrigation seasons, flow losses were estimated to increase to approximately 130 to 250 cfs when riparian diversions increased.

- **Reach 2 –** A minimum flow of 75 cfs is needed at the Gravelly Ford gage to have a measurable flow at the Chowchilla Bypass Bifurcation Structure gage, which suggests that this is a losing reach with a minimum seepage loss is 75 cfs outside the irrigation season, when riparian diversions are not in use. Reach 2A has historically had lower groundwater levels, increasing the potential for vertical seepage or infiltration losses within this reach between Gravelly Ford and the Mendota Pool (RMC 2003, 2005).

- **Reach 3 –** Downstream from Mendota Dam, seepage has been reported to occur in agricultural fields adjacent to the San Joaquin River near the town of Firebaugh (Steele 2008). Reach 3 of the San Joaquin River has been characterized as both a losing and gaining reach (McBain and Trush 2002). Shallow groundwater has contributed to lateral seepage resulting in waterlogging of the crop root-zones (RMC 2003, 2005).

- **Reach 4 –** A portion of Reach 4B, from the Mariposa Bypass downstream, was identified as potentially being a gaining reach. Observations of seepage along Reach 4A of the San Joaquin River have been reported between Sack Dam and Highway 152 (SJRRP 2007a). An *Opportunities and Constraints Analysis Report and Refuge Flow Delivery Study* (Moss 2002) presented a description of river conditions and seepage along Reach 4 using observations of landowners. In particular, riparian landowners along Reach 4A between Sack Dam and Highway 152, reported seepage problems on adjacent lands downstream from Sack Dam at flows in excess of 600 cfs (Moss 2002). Specific comments about Reach 4A raised concern regarding irrigation canals and drainage facilities. Shallow groundwater has contributed to lateral seepage resulting in waterlogging of the crop root-zones (RMC 2003, 2005).

- **Reach 5 –** Under current operating conditions, Reach 5 is identified as a gaining reach. Seepage has been reported to create waterlogging and/or salt problems on adjacent lands between the Sand Slough Control Structure and the San Luis NWR *in Reach 5 of the San Joaquin River (Moss 2002). Shallow groundwater has co*ntributed to lateral seepage resulting in waterlogging of the crop root-zones (RMC 2003, 2005).

3.11.4 Flood Management

The following is a description of flood management structures in the study area.

San Joaquin River Upstream from Friant Dam. Friant Dam serves dual purposes of storage for irrigation and flood control. Physical data pertaining to Friant Dam and Millerton Lake are presented in Table 3-17. Friant Dam is the principal flood storage facility on the San Joaquin River, with a dedicated flood management pool of up to 170 TAF dur**in**g the October through March flood season. Under present operating rules, up to 85 TAF of the flood control storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool. The dam is operated to maintain combined releases to the San Joaquin River at or below a flow objective of 8,000 cfs. Several flood events in the past few decades resulted in flows greater than 8,000 cfs downstream from Friant Dam and, in some cases, flood damages resulted.

San Joaquin River from Friant Dam to Merced River. Flood control structures and facilities within the Restoration Area include several flood bypasses and bypass structures, as follows:

- **Chowchilla Bypass and Chowchilla Bypass Bifurcation Structure** – As a component of the Lower San Joaquin River and Tributaries Project, the Chowchilla Bypass begins at the Chowchilla Bypass Bifurcation Structure in the San Joaquin River and runs northwest, parallel to the San Joaquin River, intercepting the Fresno River where the Chowchilla Bypass ends and essentially becomes the Eastside Bypass. The design channel capacity of the Chowchilla Bypass is 5,500 cfs. The bypass is constructed in highly permeable soils, and much of the initial flood flows infiltrate and recharge groundwater.

- **Eastside Bypass and Eastside Bypass Bifurcation Structure –** The Eastside Bypass extends from. the confluence of the Fresno River and the Chowchilla Bypass to its confluence with the San Joaquin River at the head of San Joaquin River Reach 5. The Eastside Bypass is subdivided into three reaches. Eastside Bypass Reach 1, with a design channel capacity ranging from 10,000 cfs to 17,000 cfs, extends from the Fresno River to the downstream end of the Sand Slough Bypass, and receives flows from, Berenda Slough, Ash Slough, and the Chowchilla River. Eastside Bypass Reach 2, with a design channel capacity of 16,500 cfs, extends from the Sand Slough Bypass confluence to the Mariposa Bypass Bifurcation Structure at the head of the Mariposa Bypass and the Eastside Bypass Bifurcation Structure. Eastside Bypass Reach 3, with a design channel capacity of 13,500 cfs at the Eastside Bypass Bifurcation Structure, and 18,500 cfs at its confluence with Bear Creek, extends from the Eastside Bypass Bifurcation Structure to the head of the San Joaquin River Reach 5, and receives flows from Deadman, Owens, and Bear creeks. The gated Eastside Bypass Bifurcation Structure works in coordination with the Mariposa Bypass Bifurcation Structure to direct flows to either Eastside Bypass Reach 3 or to the Mariposa Bypass. The channel capacities described above are design capacities; current capacities may be reduced because of subsidence of Eastside Bypass levees. Eastside Bypass Reach 3 ultimately joins with Bear Creek to return flows to the San Joaquin River.

- **Mariposa Bypass and Mariposa Bypass Bifurcation Structure –** The Mariposa Bypass Bifurcation Structure controls the proportion of flood flows that continue down the Eastside Bypass or leave through the Mariposa Bypass back into San Joaquin River Reach 4B. The Mariposa Bypass delivers flow back into the San Joaquin River from the Eastside Bypass at the head of Reach 4B2. Of 14 bays on the Mariposa Bypass Bifurcation Structure, 8 are gated. The operating rule for the Mariposa Bypass is to divert all flows to the San Joaquin River when the Eastside Bypass discharges reach 8,500 cfs, and higher flows remain in the Eastside Bypass, eventually discharging back into the San Joaquin River at the Bear Creek Confluence at the end of San Joaquin River Reach 4B2. However, actual operations have deviated from this rule; flows from 2,000 cfs to 3,000 cfs have historically remained in the Eastside Bypass, and approximately one-quarter to one-third of the additional flows are released to the Mariposa Bypass. Flood flows not diverted to the San Joaquin River via the Mariposa Bypass continue down the Eastside Bypass and are returned to the San Joaquin River via Bravel Slough and Bear Creek. Bravel Slough reenters the San Joaquin River at Mile Post 136 and is the ending point of the bypass system.

- **Sand Slough Control Structure/San Joaquin River Headgates –** The Sand Slough Control Structure, located in the short connection between the San Joaquin River at Mile Post 168.5 and the Eastside Bypass, between Eastside Bypass Reaches 1 and 2, is an uncontrolled weir working in coordination with the San Joaquin River Headgates to control the flow split between the mainstem San Joaquin River and Eastside Bypass. The Sand Slough Control Structure diverts flows from the San Joaquin River to the Eastside Bypass. The San Joaquin River

Headgates allow flows from San Joaquin River Reach 4A into Reach 4B. While there are no documented operating rules for the San Joaquin River Headgate structure during low flows, the headgates have not been opened for many years, including during the 1997 flood.

- **Mendota Dam –** Mendota Dam is located at the confluence of the San Joaquin River and Fresno Slough. Fresno Slough connects the Kings River to the San Joaquin River, and delivers water to the south from Mendota Pool during irrigation season, and delivers water to the Mendota Pool and San Joaquin River from the Kings River when the Kings River is flooding. If the flashboards are not pulled before a high flow from the San Joaquin River or Fresno Slough, the increased water surface elevations cause seepage problems on upstream and adjacent properties.

- **Sack Dam –** Sack Dam is operated in conjunction with Mendota Dam to deliver flows to Arroyo Canal for irrigation. Flood flows conveyed from the Mendota Pool are passed over Sack Dam.

Structures on Major San Joaquin River Tributaries – Each major tributary to the San Joaquin River has existing flood control facilities, which are described below:

- **Hidden Dam and Hensley Lake**. Hidden Dam on the Fresno River has a gross pool of 90 TAF and a flood management reservation of 65 TAF.

- **Buchanan Dam and H. V. Eastman Lake**. Buchanan Dam on the Chowchilla River has a gross pool of 150 TAF, a 45 TAF flood management reservation, and a combined downstream objective release of 7,000 cfs via Ash (5,000 cfs) and Berenda (2,000 cfs) sloughs.

- **Redbank and Fancher Creeks Flood Control Project**. The Redbank and Fancher Creeks Flood Control Project provides flood protection to the Fresno-Clovis Metropolitan area and nearby agricultural land.

- **Los Banos Detention Dam**. Los Banos Detention Dam on Los Banos Creek has a storage capacity of 34,600 acre-feet and a flood management reservation of 14,000 acre-feet to control flows to a maximum of 1,000 cfs. (USACE 1999).

- **Merced County Streams Group Project**. This project consists of five dry dams (Bear, Burns, Owens, Mariposa, and Castle), located in the foothills east of Merced on tributaries of the San Joaquin River; these dams provide flood protection to the City of Merced.

San Joaquin River from Merced River to the Delta. Flood management facilities on major tributaries that affect flood conditions in the San Joaquin River from the Merced River to the Delta include New Exchequer Dam and Lake McClure on the Merced River; Don Pedro Dam Lake on the Tuolumne River; and New Melones Dam and Lake on the Stanislaus River.

- **New Exchequer Dam and Lake McClure –** New Exchequer Dam on the Merced River has a top of active storage capacity of 1,024 TAF at Lake McClure, a maximum flood management reservation of 350 TAF, and a downstream objective release of 6,000 cfs or less in the Merced River at Stevinson.
- **Don Pedro Dam and Lake –** The new Don Pedro Dam on the Tuolumne River has a top of active storage capacity of 2,030 TAF at the lake, a maximum flood management reservation of 340 TAF, and a downstream objective release of 9,000 cfs or less in the Tuolumne River below Dry Creek.
- **New Melones Dam and Lake. –** New Melones Dam on the Stanislaus River has a top of active storage capacity of 2,420 TAF at the lake, and a maximum flood management reservation of 450 TAF, and a downstream objective release of 8,000 cfs or less at Orange Blossom Bridge in the Stanislaus River.

Project Levees

There are two classes of levees and dikes in the San Joaquin River study area: (1) those associated with the San Joaquin River Flood Control Project (project levees), and (2) those constructed by individual landowners to protect site-specific properties, and thus not associated with the San Joaquin River Flood Control Project (nonproject levees).

San Joaquin River from Friant Dam to Merced River. The San Joaquin River Flood Control Project consists of a parallel conveyance system: (1) a leveed bypass system in the San Joaquin Valley, and (2) a leveed flow conveyance system in the San Joaquin River. The mainstem San Joaquin River levee system within the study area is composed of approximately 192 miles of project levees (see Figure 3-29) and various nonproject levees located upstream from the Merced River confluence. Project levees are levees constructed as part of the San Joaquin River Flood Control Project by USACE, and occur in Reach 2A downstream from Gravelly Ford, and extend downstream to the Chowchilla Bypass Bifurcation Structure. A small section of project levees extends into Reach 4A upstream from Sand Slough. Project levees begin again in Reaches 4B and 5 at the Mariposa Bypass confluence downstream from the Merced River confluence.

The State has constructed a bypass system consisting of levees and channel improvements. These improvements were coordinated with the Federal Government for effectiveness of the Federal portion of the projects. The bypass system consists primarily of man-made channels (Eastside, Chowchilla, and Mariposa bypasses), which divert and carry flood flows from the San Joaquin River at Gravelly Ford, along with inflows from other eastside tributaries, downstream to the mainstem just above the Merced River. The system consists of about 193 miles of new levees, several control structures, and other appurtenant facilities, and about 80 miles of surfacing on existing levees. Construction of the original State system started in 1959 and was completed in 1966. O&M of the completed State upstream bypass features of the project is accomplished by the LSJLD.

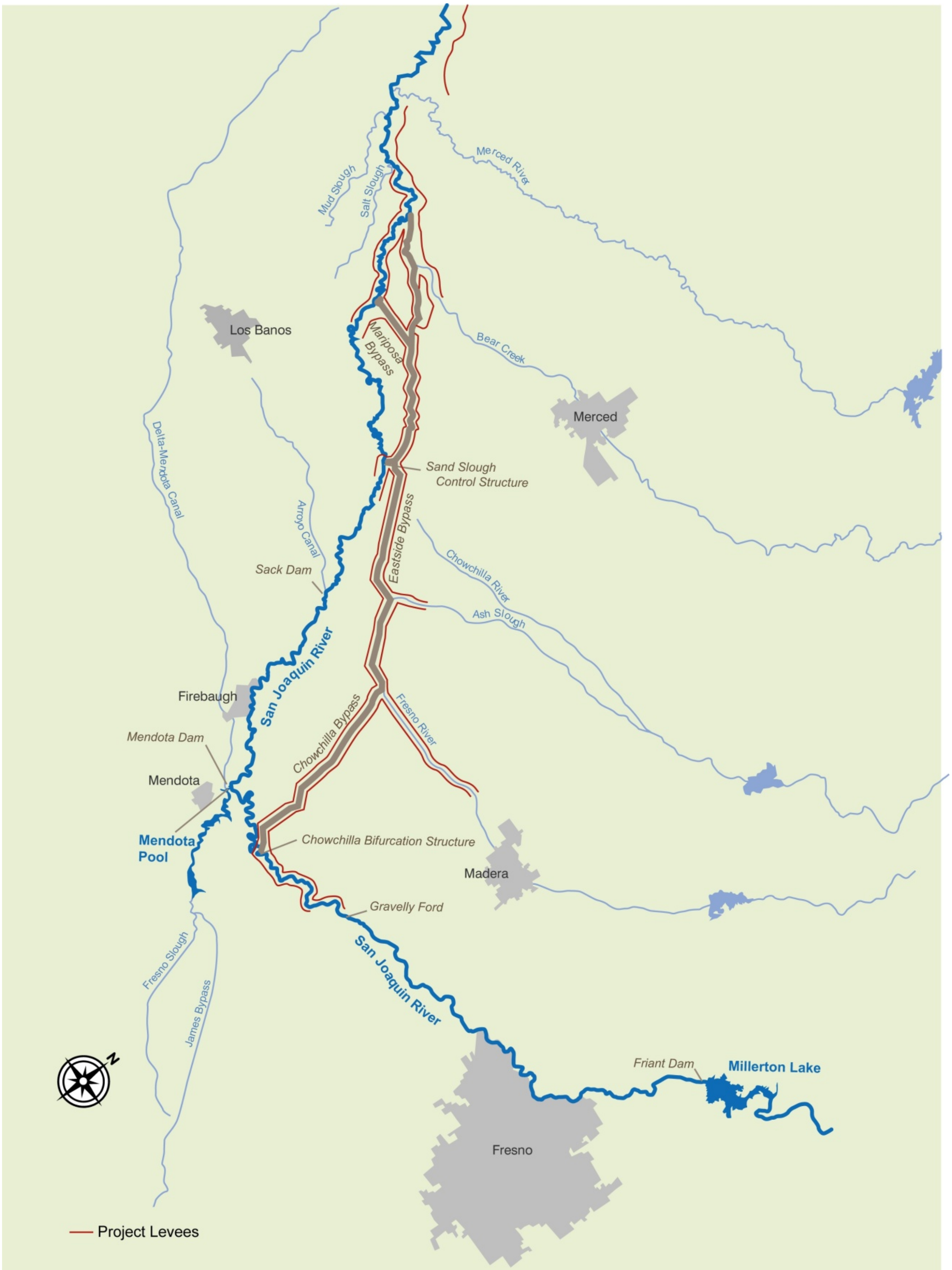


Figure 3-29.
Project Levees Along San Joaquin River from Friant Dam to Merced River Confluence

Design capacity was authorized as the amount of water that can pass through a given reach with a levee freeboard of 3 feet within the historical San Joaquin River and 4 feet of freeboard along the bypasses, except along the left side of the Eastside Bypass, which has 3 feet of design freeboard. Project design channel capacities were probably estimated to be similar to flows that produced little or no significant damage during the planning, design, construction, and initial operation phases of water resource facilities in the San Joaquin River system. However, over time, river stages in various reaches of the river have increased, and flood, seepage, and erosion damage has increased. Although some channel clearing work has been accomplished by USACE, Reclamation, and others, an adequate maintenance program has been difficult to sustain.

The intended design capacities for the various San Joaquin River reaches are illustrated in Table 3-57, which also summarizes USACE design flow capacities and modeled objective flow capacities for various reaches throughout the San Joaquin flood control system (McBain and Trush 2002).

Table 3-57.
Design Channel Capacities

Reach	Flow (cfs)
Reaches 1 and 2A	8,000
Chowchilla Bypass	5,500
Mariposa Bypass	8,500
Eastside Bypass	10,000 – 18,500
Kings River North	4,750
Reach 2B	2,500
Reaches 3 and 4A	4,500
Reach 4B1	1,500
Reaches 4B2 and 5	10,000 – 26,000
Merced River to Tuolumne River	45,000
Tuolumne River to Stanislaus River	46,000
Stanislaus River to Paradise Dam (at head of Paradise Cut)	52,000
Paradise Dam to Old River[1]	37,000
Old River to Stockton Deep Water Ship Channel	22,000

Source: California Resources Agency 1976.
Note:
[1] Diversion capacity of Paradise Cut is 15,000 cfs.
Key:
cfs = cubic feet per second

San Joaquin River from Merced River to the Delta. From about 1956 to 1972, USACE constructed the Lower San Joaquin River and Tributaries project from the Delta upstream to the Merced River, under authorization of the 1944 Flood Control Act. Additional modifications to the project were completed in the mid-1980s. The Federally constructed portion of the project consists of about 100 miles of intermittent levees along the San Joaquin River, Paradise Cut, Old River, and the lower Stanislaus River. The levees vary in height from about 15 feet at the downstream end to an average of 6 to 8 feet over much of the project. The project levees, along with the upstream flow regulation, were designed to contain floods varying from once in 60 years at the lower end of the project to about once in 100 years at the upper limits. Local levees are located along many reaches of the river in the gaps between the project levees.

Nonproject Levees

Nonproject levees are typically associated with levees and dikes constructed by early flood control districts and adjacent landowners between the Chowchilla Bypass Bifurcation Structure and the Mariposa Bypass confluence. Canal embankments bordering both sides of the San Joaquin River between Mendota Dam and approximately 2 miles upstream from the Sand Slough Control Structure effectively form a set of nonproject levees that have significantly reduced the width of the floodplain, primarily on the river. The existing channel capacity in this reach is approximately 4,500 cfs, but flows of this magnitude can cause seepage and levee stability problems (RMC 2007). In addition, local landowners have constructed other low-elevation berms within the reach, creating a narrower floodplain. Information on and dimensions of estimated channel capacities for locally constructed levees are difficult to obtain and, in some cases, currently unavailable.

Flood Management Operations and Conditions

USACE has established flood management objective flows for the San Joaquin River tributaries, bypasses, and flood management operations of reservoirs within the river system. Objective flows are generally considered to be safe carrying capacities, but some flood damages to adjacent land developments do occur when objective flows are passed. Design capacity is defined by USACE as the amount of water that can pass through reaches of the San Joaquin River with a levee freeboard of 3 feet. Design capacity was intended to provide protection against a 50-year storm (McBain and Trush 2002); intended design capacities are illustrated in Table 3-58.

The three mainstem tributaries of the lower San Joaquin River downstream from the Restoration Area include the Merced, Tuolumne, and Stanislaus rivers. Table 3-59 shows USACE objective flows for the San Joaquin River and its tributaries for use in flood control operations of the reservoirs within the system. Design capacity was authorized as the amount of water that can pass through a reach with a levee freeboard of 3 feet within the historical San Joaquin River, and 4 feet along the bypasses (USACE 1999).

Table 3-58.
Comparison of Objective Flow Capacity with Design Channel Capacities for San Joaquin River Flood Control Project

San Joaquin River Reach	Reach	USACE Design Capacity with 3-foot Freeboard (cfs)	Estimated Hydraulic Capacity with No Freeboard (top of levee) (cfs)
Friant Dam to Gravelly Ford	1	8,000	16,000
Gravelly Ford to the Chowchilla Bifurcation Structure	2A	8,000	Approximately 16,000
Chowchilla Bifurcation Structure to Mendota Dam	2B	2,500	Approximately 4,500
Mendota Dam to Sand Slough	3, 4A	4,500	6,000 to 8,000
Sand Slough to Mariposa Bypass Confluence	4B1	1,500	400 to 1,500
Mariposa Bypass confluence to Eastside Bypass Confluence	4B2	10,000	Exceeds 10,000
Eastside Bypass confluence to Merced River Confluence	5	26,000	Exceeds 26,000

Source: McBain and Trush 2002
Key:
cfs = cubic feet per second
USACE = U.S. Army Corps of Engineers

Table 3-59.
Comparison of Objective Flow Capacity
San Joaquin River Flood Control Project Below Merced River

San Joaquin River Reach	USACE Design Capacity with 3-foot Freeboard (cfs)
Merced River to Tuolumne River	45,000
Tuolumne River to Stanislaus River	46,000
Stanislaus River to Paradise Dam (at head of Paradise Cut)	52,000
Paradise Dam to Old River	37,000
Old River to Stockton Deep Water Ship Channel	22,000

Source: California Resources Agency 1976
Key:
cfs = cubic feet per second
USACE = U.S. Army Corps of Engineers

3.12 Noise

Noise is generally defined as sound that is loud, disagreeable, unexpected, or unwanted. Sound is characterized by two parameters: amplitude (loudness) and frequency (tone). Amplitude is the size of a sound wave. The frequency of a wave refers to the rate at which particles vibrate when a wave passes through a medium. Directly measuring sound pressure fluctuations would require a very large and cumbersome range of numbers. To have a more useable numbering system, the logarithmic decibel (dB) scale is commonly used. The normal range of human hearing extends from about 10 dB to about 140 dB.

This section describes the existing noise (and vibration) environment in the only areas potentially affected by the Proposed Action and the No-Action Alternatives: the Restoration Area and the San Joaquin River from the Merced River to the Delta.

3.12.1 San Joaquin River from Friant Dam to the Merced River

The existing noise (and vibration) environment in and surrounding the Restoration Area is influenced by transportation noise, agricultural activities, mining operations, urban uses, light industrial uses, commercial uses, and recreational uses. Sources of noise and sensitive receivers in the Restoration Area are described below.

Reach 1

The existing noise environment in and around Reach 1 is dominated by urban land uses (Reach 1A) and agricultural land uses (Reach 1B). Existing noise-sensitive land uses within Reach 1 include residential uses, churches, schools, hospitals, parks, and golf courses. The nearest residential receiver located in Reach 1 is approximately 100 feet from the centerline of the Restoration Area, and residential receivers are present within 1,000 feet of the centerline. The nearest church, school, and hospital are located 2,500 feet, 2,875 feet, and 3,500 feet, respectively, from the centerline of the Restoration Area.

Reach 2

The existing noise environment in and around Reach 2 is dominated by agricultural land uses (Reach 2A), but it is also influenced by urban land uses (Reach 2B). Urban use noise in Reach 2 emanates from the City of Mendota, an industrial use to the south, and the Mendota Municipal Airport. The nearest noise-sensitive receiver (residential) in Reach 2A is located 740 feet from the centerline of the Restoration Area. No other noise-sensitive land uses are present in Reach 2A. Reach 2B has a handful of sensitive receivers (residential) in close proximity to the Restoration Area; the nearest is located 460 feet from the centerline.

Reach 3

The existing noise environment in and around Reach 3 is primarily dominated by agricultural land uses. Urban land use noise in Reach 3 emanates from the City of Firebaugh, industrial uses located along the river and south of the City, and the Firebaugh Municipal Airport. The nearest noise-sensitive receiver (residential) in Reach 3 is located 200 feet from the centerline of the Restoration Area. The nearest church and school are located 570 feet and 300 feet, respectively, from the centerline of the Restoration Area.

Reaches 4 and 5

The existing noise environment in and around Reaches 4 and 5 is primarily dominated by agricultural land uses. Only three noise-sensitive receivers (residential) in Reaches 4 and 5 are located within 500 feet of the Restoration Area centerline. No other noise-sensitive land uses are present in Reaches 4 and 5.

Chowchilla Bypass, Eastside Bypass, Mariposa Bypass, and Tributaries

The existing noise environment in and around the Chowchilla, Eastside, and Mariposa bypass areas is primarily dominated by agricultural land uses. Noise-sensitive land uses near the Restoration Area are residences and a school. The nearest residential use is located 380 feet from the Restoration Area centerline. The school is located 4,400 feet from the Restoration Area centerline.

3.12.2 San Joaquin River from Merced River to the Delta

The existing noise environment in and around the San Joaquin River from the Merced River to the Delta area is primarily dominated by agricultural land uses. Traffic noise emanating from rural roads also contributes to the existing noise environment relative to the proximity of the roads to the San Joaquin River. Noise-sensitive land uses near the lower San Joaquin River area are residences and churches. The nearest residential use is located 200 feet from the river’s centerline. The nearest church is located 2,700 feet from the river’s centerline. The noise policies and standards that apply to this section of the San Joaquin River are Merced County (2000) and Stanislaus County (1994) general plans and ordinances.

3.13 Population and Housing

This section addresses population and housing for the three-county Restoration Area and the five-county Friant Division Water Contractors Service Areas (Friant Division Service Area), which are the portions of the study area that may experience population effects from the Proposed Action. Topics closely related to population and housing are described below in Section 3.17, Socioeconomics.

3.13.1 San Joaquin River from Friant Dam to Merced River

The following subsections describe population and housing trends of the three counties of the Restoration Area: Fresno, Madera, and Merced counties.

Population Trends

Between 2000 and 2006, the total population of Fresno, Madera, and Merced counties increased by 13.95 percent, with Madera and Merced counties growing at a faster rate (16.9 and 17.9 percent, respectively) than Fresno County (12.6 percent growth). From 2000 to 2006, nearly all cities in the three counties (with the exception of Fresno and Reedley) increased at a greater rate than Fresno, Madera, and Merced counties at large. Growth projections through 2050 indicate that all counties in the three-county area, as for the counties of the larger Friant Division service area, are projected to grow at a rate more than double the State's rate of growth (60.0 percent), with total growth in the three-county area projected to be 131.9 percent through 2050 (CDF 2007).

In 2006, Merced County had the highest percentage of minorities (64.8 percent) compared to the State (57.2 percent). Between 2000 and 2006, the minority population in the three-county area had a higher growth rate (20.8 percent) compared to the State (15.5 percent).

Housing Trends

As of 2006, the three-county area had a total of 379,527 housing units, representing 3.1 percent of the total number of housing units in the State. From 2000 to 2006, the three-county area experienced a 12.6 percent increase in the total number of housing units along with a 20.9 percent increase in the number of vacant housing units, which was greater than the State increase of 7.5 percent for the same time frame. During this 6-year period, Madera and Merced counties had the largest increase in the number of housing units in the three-county area (15.7 and 17.3 percent, respectively). Vacant housing units increased 87.8 percent in the three-county area. Overall, from 2000 to 2006, the vacancy of housing units in the three-county area outpaced the development of housing units.

3.13.2 Friant Division Water Contractors Service Areas and Vicinity

The Friant Division service area includes five counties: Fresno, Kern, Madera, Merced, and Tulare. The following section describes population and housing trends in the Friant Division service area and vicinity.

Population Trends

Demographic data were collected for Kings County to evaluate potential socioeconomic effects that the Proposed Action could have on the vicinity, especially the towns of Hanford and Corcoran. Because the county is adjacent to the Friant Division service area, it possible that some county residents would be employed by water users in the service area.

As of 2006, the population in the five counties and the two neighboring towns in Kings County was approximately 2.64 million people. Fresno County contributed 34.1 percent of the population of these counties, with more than half of the residents living in the City of Fresno. Between 2000 and 2006, the total population of the counties in the Friant Division increased by 15.1 percent, with all five counties growing at approximately the same rate (14.0 to 17.0 percent growth). Kern and Madera counties showed the highest growth rates, with 17.8 percent and 17.9 percent, respectively. From 2000 to 2006, all cities in Kern, and Tulare counties increased at a greater rate than the five-county area, with the exception of Lindsay and Wasco.

The five counties are an ethnically diverse part of the State, composed largely of Hispanic and Latino populations. In terms of racial diversity, Black/African-American and Asian populations in each county are less than State averages, and all the counties had a higher proportion of White/Caucasians than State averages.

Between 2000 and 2006, the minority population in counties of the Friant Division service area had a greater growth rate (24.4 percent) compared to the State (15.5 percent). The five counties had a slightly larger American Indian population than the State (ranging from 0.9 to 1.2 percent), and similar to the State, experienced a decrease between 2000 and 2006 (U.S. Census Bureau 2000, 2007).

Housing Trends

As of 2006, the five-county area had a total of 864,255 housing units, representing 6.5 percent of the total number of housing units in the State. From 2000 to 2006, these counties experienced a 12.6 percent increase in the total number of housing units, along with a 20.9 percent increase in the number of vacant housing units, which was higher than the State increase of 7.5 percent for the same time frame.

3.14 Recreation

The study area contains a number of parks and public lands offering diverse recreation opportunities, particularly associated with the many reservoirs, rivers, and other water bodies found throughout this portion of California. In addition, numerous recreational opportunities exist on private lands, including fishing, hunting, and other activities.

This section describes the existing recreation environment in the areas potentially affected by the Proposed Action and the No-action Alternatives: the San Joaquin River upstream from Friant Dam, the Restoration Area, the San Joaquin River from Friant Dam to the Merced River, the San Joaquin River from the Merced River to the Delta, and the Sacramento-San Joaquin Delta.

3.14.1 San Joaquin River Upstream from Friant Dam

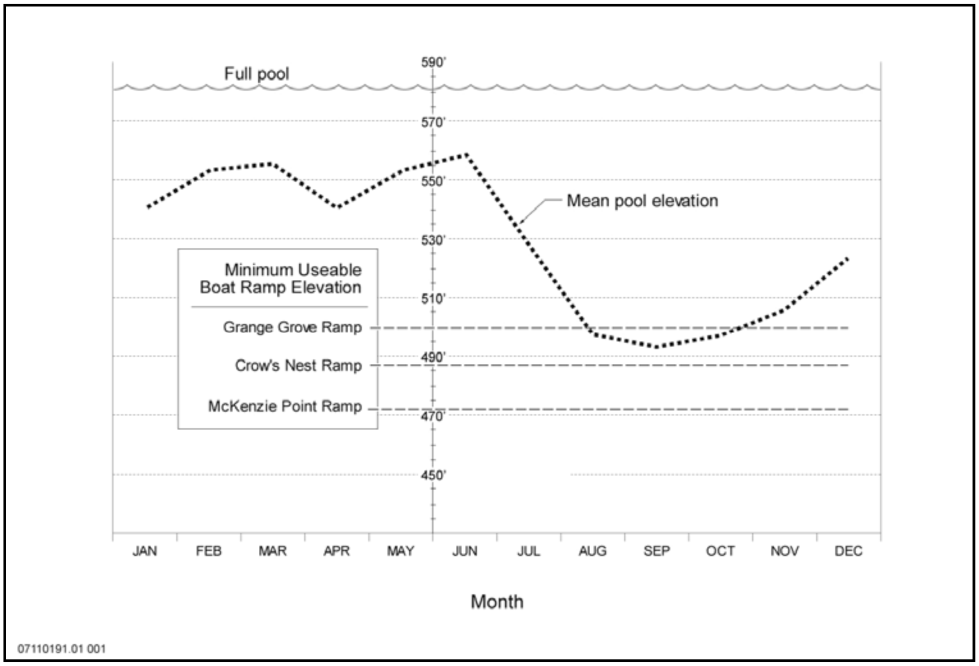
Millerton Lake, the centerpiece of the Millerton Lake SRA, has a surface area of approximately 4,900 acres, and approximately 44 miles of shoreline in the SRA at the lake's maximum elevation (580.6 feet above msl). The SRA encompasses approximately 10,500 acres in total (State Parks 2006) and is one of the most popular recreation areas in the San Joaquin Valley, with typically 300,000 to 500,000 visits annually (State Parks 2007a, 2007b). The City of Fresno, with a 2000 census population of 430,000, is located approximately 20 miles to the southwest (U.S. Census Bureau 2007).

Motorboating, sailing, waterskiing, jet-skiing, swimming, and tournament and recreational fishing are the primary water-based recreation activities. Shoreline activities include picnicking, hiking, biking, horseback riding, seasonal hunting, camping, fishing, and nature watching (State Parks 2007c). During winter, the lake also has special boat tours to view the San Joaquin Valley's largest population of bald eagles (Warszawski 2007).

Most recreational facilities for the SRA are located on the southern and northern shores of the lower portion of the lake, where they are closest to population centers. Facilities include boat ramps, picnic areas, drive-in and walk-in campgrounds, a marina, and trails. A few, more isolated facilities are at the upstream portion of the lake, including boat-in camping areas. Public access is widely available at Millerton Lake.

Seasonally, the reservoir fluctuates substantially under normal operations. The annual maximum water level typically occurs in May or June and is close to the gross pool elevation of 581 feet during most years. The reservoir is typically drawn down from 75 to 100 feet annually, with the minimum annual elevation occurring in October or November, before the reservoir begins to refill with the onset of winter rains. Boat ramps on the lake were designed to accommodate approximately 100 feet of fluctuation in surface elevation (Reclamation and State Parks 2008).

Figure 3-30 illustrates the minimum elevation at which the primary public boat ramps on Millerton Lake are usable in relation to the mean end-of-month pool level between April and August. This 4-month spring and summer period is when most boating activity occurs on the lake. The primary ramp at Grange Grove (actually consisting of four linked ramps used at progressively lower pool levels) is usable down to a pool elevation of 500 feet, which corresponds to the mean pool level at the end of August. Smaller ramps at Crow's Nest and McKenzie Point are usable down to an additional 13 feet and 28 feet of drawdown, respectively. A ramp on the north shore that primarily serves an adjacent campground is available at all pool levels.



Sources: Mean pool elevation - CalSim model run for Millerton Lake elevations under existing storage conditions; minimum useable elevation of ramps - Reclamation and State Parks 2005

Figure 3-30.
Millerton Lake Mean End-of-Month Pool Elevation vs.
Minimum Useable Elevations of Boat Ramps

3.14.2 San Joaquin River from Friant Dam to Merced River

The following text describes recreation facilities and activities located within each river reach of the Restoration Area. The facilities are described starting at the upstream end of the reach and continuing downstream. Nearly all existing recreation opportunities associated with the river are located in Reach 1. They consist of formal developed and constructed recreation facilities and services as well as user-defined opportunities, such as foot trails used to access fishing sites and concentrated use areas. Formal and informal recreational uses of the different reaches include hiking, fishing, bird-watching, canoeing, kayaking, and gold panning. Water-dependent uses such as boating and fishing occur throughout the year along the river, except in Reach 2 and portions of Reach 4 because of lack of flows.

The San Joaquin River Parkway is a mosaic of parks, trails, and ecological reserves located along the San Joaquin River between Friant Dam and Highway 145 and is managed by the San Joaquin River Parkway and Conservation Trust (Figure 3-31), a nonprofit entity, and several local and State partner agencies. The lands in the vicinity of the Restoration Area are primarily managed for agricultural land uses; however, several Federal wildlife refuges and State wildlife management areas are located within the valley, along with several State Park units. Some of these are directly adjacent to the San Joaquin River within the Restoration Area, while others are some distance away from the river, but within the San Joaquin Valley. All of the Federal refuges and State wildlife management areas are part of the 160,000-acre Grassland Ecological Area, which represents the largest remaining contiguous block of wetlands in California (Audubon Society 2004a).

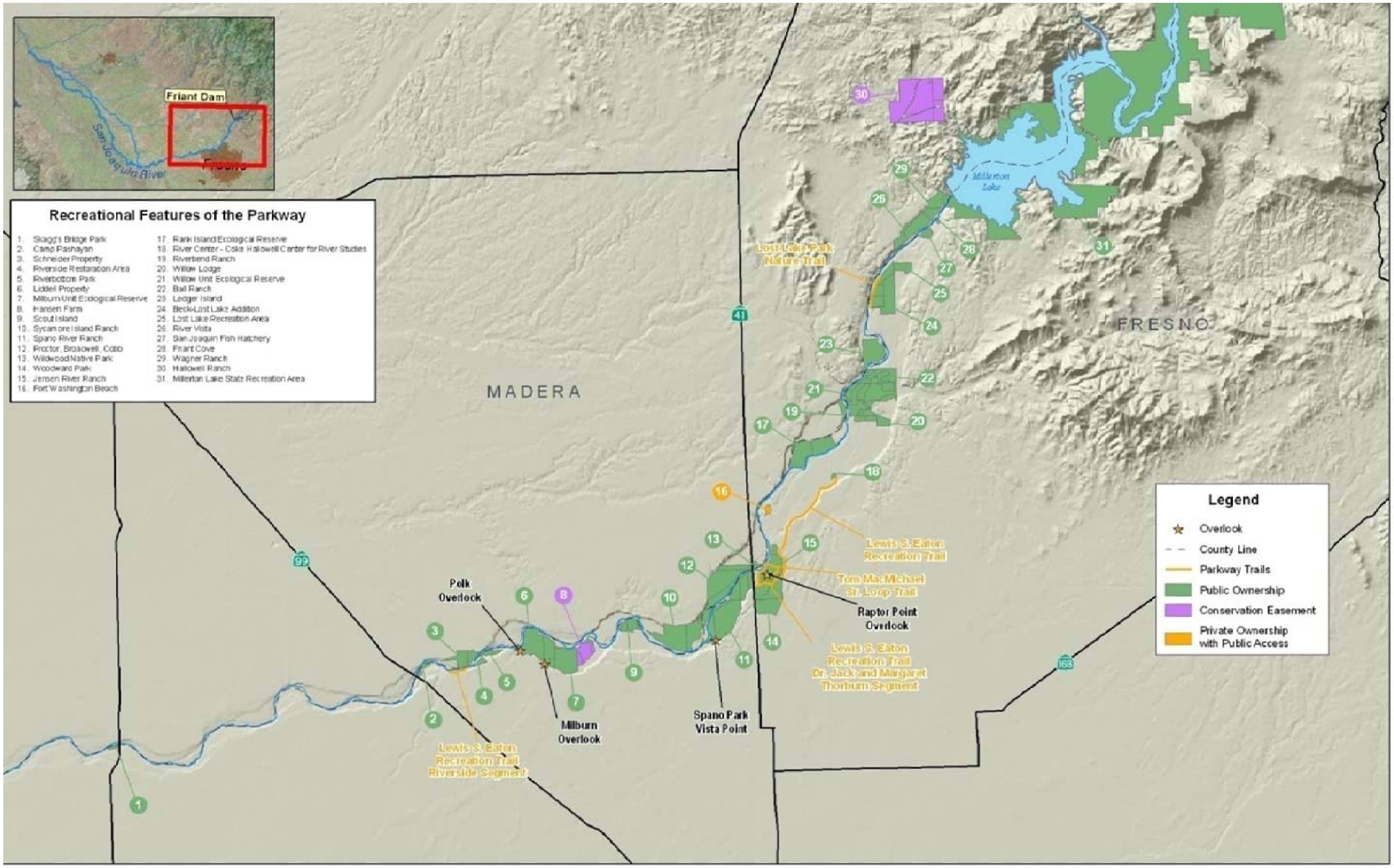


Figure 3-31.
San Joaquin River Parkway and Surrounding Areas

Both the San Luis and San Joaquin River NWRs are located on the San Joaquin River, but only the San Luis NWR is located in the Restoration Area. The largest of the Federal refuges is the San Luis NWR, a mixture of managed seasonal and permanent wetlands, riparian habitat associated with the San Joaquin and two tributary sloughs, and native grasslands, alkali sinks, and vernal pools. The refuge is managed primarily to provide habitat for migratory and wintering birds. Major public uses include interpretive wildlife observation programs and waterfowl and pheasant hunting. The San Luis NWR offers auto tour routes. Foot traffic is permitted on the auto tour routes and on trails in the San Luis NWR. Fishing, by rod and reel only, is also permitted (USFWS 2008a). The Merced NWR is located a few miles east of the San Joaquin River in Merced County. The San Luis NWR receives about 150,000 annual visits, and the Merced NWR receives about 100,000 annual visits (Grassland Water District 2001).

DFG administers several wildlife areas in the San Joaquin Valley in the vicinity of the Restoration Area. Mendota Wildlife Area, located a few miles south of the San Joaquin River and the City of Mendota in Fresno County, consists of nearly 12,000 acres of managed impoundments and wetland and upland habitat, providing opportunities for bird watching and waterfowl hunting. Just east of the Mendota Wildlife Area are two DFG-administered ecological reserves, Kerman and Alkali Sink ecological reserves, which also provide opportunities for hunting and wildlife viewing. Four wildlife areas are located west of the San Joaquin River, in Merced County: the 6,000-acre Los Banos Wildlife Area, 2,800-acre Volta Wildlife Area, 7,000-acre North Grasslands Wildlife Area, and 115-acre Dos Amigos Wildlife Area. These wildlife areas support opportunities for wildlife viewing, and for hunting, fishing, boating, and camping in designated areas. Wildlife viewing and hunting opportunities are also available at the boat-in only West Hilmar Wildlife Area, located on the Stanislaus/Merced County border, which receive a total of 30,000-50,000 visits annually (Grassland Water District 2001). Additional wildlife areas, including the San Luis Reservoir Wildlife Area and Cottonwood Creek Wildlife Area, are located at the west edge of the valley near San Luis Reservoir and the O'Neill Forebay. These areas encompass several thousand acres that support opportunities for wildlife and wildflower viewing, and hunting (DFG 2007).

On the western edge of the San Joaquin Valley, in Merced County, the DPR provides camping, boating, and day use facilities in the San Luis Reservoir SRA, which surrounds the 12,700-acre San Luis Reservoir and adjacent O'Neill Forebay. Pacheco State Park, located on the west side of the reservoir, provides numerous trails.

Reach 1

Approximately 12 developed and undeveloped park units in the San Joaquin River Parkway are owned and managed by several public and private entities. Table 3-60 shows information about each of these parks. Public lands totaling more than 3,000 acres have been acquired within the parkway. Most boating in the Restoration Area occurs in Reaches 1A and 1B, in the San Joaquin River Parkway, and downstream to SR 145, where boat access is provided at several locations. A flow of 200 cfs is the approximate minimum within the ideal range for boating. Although boating is possible at lower flows, disadvantages would include increased dragging of boats on the river bottom and walking boats through shallows and over gravel bars and other obstructions. Boating is possible above 1,000 cfs but becomes increasingly hazardous and unattractive to most boaters because of the strength of the current, flows moving through brushy and wooded areas, and increased "strainers" (flow through the branches of standing trees and downed trees in the channel that can trap boaters).

Table 3-60.
Existing Parks and Public Lands in San Joaquin River Parkway – Reach 1

Recreation Facility/ Park Unit	Owner[1]	Area (acres)	Primary Recreation Opportunities					
			Fishing	Boat Access to River	Outdoor Education	Trails/Trail Access	Camping	Picnicking
Camp Pashayan	DFG, SJRPCT	32	X	X		X		X
Coke Hallowell Center for River Studies	SJRPCT	20			X	X		
Fort Washington Beach	Private	NA	X	X			X	X
Friant Cove	SJRC	6	X	X				X
Jensen River Ranch	SJRC	167				X		X
Lost Lake Park	Fresno County, DFG	305	X	X	X	X	X	X
San Joaquin River Ecological Reserve	DFG	800[2]			X			
Scout Island	Fresno County	85		X	X		X	
Sycamore Island Ranch	SJRC	350	X	X		X		X
Wildwood Native Park	SJRC	22	X	X		X		
Willow Lodge (Willow Unit of Ecological Reserve)	DFG	88			X	X		
Woodward Regional Park	City of Fresno	300				X		X

Notes:
[1] Management of several of the parks is by an entity other than the owner, in some cases with the park owner. The San Joaquin River Conservancy owns and manages 2,541 acres in total, much of which is managed for conservation and future low-impact recreation. In addition, on land owned by the Conservancy, Islewood Golf Course is operated by a private entity. In addition to the properties providing the recreation opportunities in the table, DFG also owns and operates the San Joaquin Hatchery, below Friant Dam, where the public can view and feed trout in the hatchery raceways.
[2] The ecological reserve is composed of several widely dispersed units in the parkway, which in total equal 800 acres; access is by special permit only.

Key:
DFG = California Department of Fish and Game
NA = not applicable
SJRC = San Joaquin River Conservancy
SJRPCT = San Joaquin River Parkway and Conservation Trust

Skagg's Bridge Park is a Fresno County park located approximately 9 miles downstream from the lower end of the parkway, on the south bank of the river at SR 145 (Madera Avenue). This 17-acre park is used for picnicking, day use, and fishing activities and offers picnic units and playground area (Fresno County 2009).

The City of Fresno manages the 300-acre Woodward Regional Park, which is situated on the bluff above the river, on the south side of Reach 1 at Highway 41. The park does not provide direct access to the river, but serves as a trailhead for parkway trails.

Reach 2

The only public recreational facility near Reach 2 is the 85-acre Mendota Pool Park, managed by the City of Mendota, which provides a launch ramp, picnic area, and playground, about one-half mile south of Mendota Dam (City of Mendota 2007). Lone Willow Slough, an Audubon Society-designated Important Bird Area near the reach, provides bird-watching opportunities but is located on private property (Audubon Society 2004b) and does not provide access to the river.

Reach 3

An unpaved boat ramp on the river bank just below Mendota Dam provides access to Reach 3 for small boats, and the reach has been described as being especially suited for canoes and touring kayaks (American Whitewater 2007). Fishing is permitted atop Mendota Dam (American Whitewater 2007).

The community of Firebaugh manages two parks, Dunkle Park, also known as the City Park, and Maldonado Park. Dunkle Park, about 9 miles downstream from Mendota Dam, has a gazebo near the river and informal river access for anglers and boaters (American Whitewater 2007). An unnamed grassy area adjacent to Dunkle Park is also managed and available for recreational activities. Basketball, softball, and soccer fields and a skateboard park are planned for Maldonado Park.

This reach can support informal recreation uses, including fishing from the shore; however, this activity is not encouraged by adjacent landowners and may involve trespassing on private property.

Reach 4

The San Luis NWR, which is bisected by the San Joaquin River, has the only recreational facilities in Reach 4 (Figure 1-2). Three of the six contiguous units of the refuge border on the lower portion of Reach 4 within the Restoration Area: the San Luis, East Bear Creek, and West Bear Creek units. The Merced NWR is several miles east of the river on the Eastside Bypass (Figure 1-2). The two comanaged refuges, totaling more than 36,000 acres, are managed primarily for migratory and wintering bird habitat. An indigenous tule elk herd is located in the San Luis NWR, and both refuges host many endangered, threatened, and sensitive species, including sandhill cranes and vernal pool species.

There are two auto tour routes in the San Luis NWR: one for viewing waterfowl and one for viewing tule elk. Stops with interpretive information and wildlife observation platforms are provided along the routes. Hikers are also allowed on the auto tour routes, and hiking is encouraged along Salt Slough Road. There are two hiking trails and an additional spur trail to the river and a historical site. The Salt Slough Fishing Area is open for fishing during daylight hours; one fishing site is reserved for persons with disabilities. Several hunting blinds are available in the refuge for waterfowl and pheasant hunting (USFWS 2007).

Reach 5

Downstream from Bear Creek is the 2,800-acre Great Valley Grasslands State Park. This State Park includes one of the few intact examples of native grasslands on the floor of the Central Valley, and is part of the larger 160,000-acre Grassland Ecological Area, which includes Federal, State, and private lands managed for wildlife values and represents the largest remaining contiguous block of wetlands in California (Audubon Society 2004a). Although the State Park is undeveloped, people visit the park to view springtime wildflower displays and wildlife and to fish (State Parks 2007d).

A portion of the West Bear Creek Unit of the San Luis NWR, to the east of Great Valley Grasslands State Park, and the Kesterson Unit, to the west, are also in Reach 5. The 3,900-acre West Bear Creek Unit contains a wildlife observation tour route, a designated hunting area surrounding several ponds, and foot trails. The Kesterson Unit has 10,621 acres of seasonal and permanent wetlands, riparian habitat, native grasslands, and vernal pools. Mud Slough bisects the unit. Waterfowl hunting is a primary use of the Kesterson Unit. Many two- and three-person hunting blinds are located in the three areas of the unit. The unit is also used for wildlife viewing (USFWS 2007).

3.14.3 San Joaquin River from Merced River to the Delta

Two Stanislaus County parks provide the only developed recreation access to this segment of the San Joaquin River. The Las Palmas Fishing Access, a few miles east of the town of Patterson, is a 3-acre park with a concrete boat ramp and day use facilities (Stanislaus County 2009a). Laird Park, 2 miles east of the town of Grayson, is a 97-acre “community park” with river access and day use facilities (Stanislaus County 2009b).

The San Joaquin River NWR is located along the San Joaquin River between the Tuolumne and Stanislaus rivers, two major tributaries to the San Joaquin River. The refuge boundaries encompass over 7,000 acres of riparian woodlands, wetlands, and grasslands. Although the refuge is primarily undeveloped, a wildlife viewing platform has been constructed at a favored location for viewing geese and other water birds (USFWS 2009).

The West Hilmar Wildlife Area, on the west bank of the river a few miles downstream from the Merced River confluence, is a 340-acre State wildlife area, with no facilities and accessible only by boat (DFG 2009).

Although not on the San Joaquin River but in the vicinity, two small developed park units managed by DPR (each less than 75 acres) are located on the bank of the lower Merced River in Merced County. These units consist of one area near the confluence with the San Joaquin River and one area approximately 18 miles upstream from the confluence with the San Joaquin River. McConnell and George J. Hatfield SRAs give access to the Merced River for boating, fishing, swimming, picnicking, and hiking on short trails. McConnell SRA also offers family and group camping.

Farther north, the Turlock Lake SRA furnishes camping, boating, and day use facilities at the 3,500-acre Turlock Lake and adjacent Tuolumne River, on the eastern edge of the valley in Stanislaus County. Caswell Memorial State Park is located along the Stanislaus River in San Joaquin County, approximately 5 miles upstream from the confluence with the San Joaquin River. This 258-acre park offers opportunities for fishing and swimming in the Stanislaus River and camping facilities and nature trails through the park's riparian oak woodland.

3.14.4 Sacramento-San Joaquin Delta

At the southeast margin of the Delta on the San Joaquin River are two boating facilities that provide access both to the Delta to and the river upstream. The Mossdale Crossing Regional Park, operated by San Joaquin County, has a paved two-lane boat ramp and day use facilities. Across from the park is the privately operated Mossdale Marina, with 23 boat berths, and services such as fueling, a restaurant and bar, and a store. A few miles downstream are Dos Reis County Park, a facility operated by San Joaquin County that has a boat ramp and day use area as well as a 26-site recreational vehicle (RV) camp. Nearby is Haven Acres Marina, a small private facility with a boat ramp and bar and grill.

Numerous additional recreation opportunities are available in the Delta. The Delta has many miles of rivers and sloughs for boating and fishing, and recreation visitors have a choice of many private facilities, primarily small marinas and resorts, and two State Park units. Brannan Island SRA, in the central Delta on the Sacramento River, offers boat access to the river and sloughs, and camping, swimming, and day use facilities. Franks Tract SRA consists of a large flooded island that was formerly farmland, surrounded by remnant levees. There are no developed facilities in the Franks Tract SRA.

3.15 Transportation and Traffic

This section describes existing traffic conditions and the various roadway, railroad, and utility crossings in the study area that could be affected by the WY 2010 Interim Flows project. Roadways in Fresno, Madera, and Merced counties range from SRs with heavy truck and commuter traffic to local roads with a small amount of local agricultural equipment traffic. For the purpose of describing general conditions, roads are classified into the following groups:

- **State Routes** typically are four- to six-lane high-speed facilities (65 miles per hour (mph) or faster) with the primary purpose of connecting the local and county transportation system with those outside the region. These roadways are under the jurisdiction of the California Department of Transportation (Caltrans).
- **Expressways** typically are four-lane high-speed facilities (55 mph or faster) with the primary purpose of connecting county areas or cities in a county. Some expressways do not meet respective county standards and are designated for upgrade by their respective local (county) transportation authority.
- **Arterial** roads have the primary purpose of connecting major traffic generators to the freeway, expressway, and arterial street systems. They can be classified as either urban or rural, and are under the authority of the local (county) transportation authority.
- The purpose of **collectors** is to link the local road network to the arterial street system. Collectors are typically two- or four-lane roadways with low to moderate speeds (35 to 40 mph), and are under respective county jurisdictions.
- The purpose of **local roads** is to connect properties and the collector roadway system. These facilities typically are two-lane undivided roadways, and are under the respective county jurisdiction.

3.15.1 San Joaquin River from Friant Dam to Merced River

Transportation and infrastructure in the Restoration Area are described below.

Road, Railroad, and Utilities Crossings

This section describes the various roadway, railroad, and utility crossings of the San Joaquin River from Friant Dam to the Merced River.

Reach 1. Between Friant Dam and the SR 99 bridge that provides access across the San Joaquin River, several roads parallel the river in Reaches 1A and 1B. Additionally, six bridges (North Fork Road Bridge, Yosemite Freeway (SR 41), West Nees Bridge, and three unnamed bridges) cross the river in these reaches. State highways in this reach are SR 99, SR 41, and SR 145. Traffic on these State highways is generally the heaviest in the area, outside urban areas, because of truck and commuter traffic. The arterial in this reach is North Blackstone Avenue. Traffic appears to be composed of local agricultural trucks and residential commuters. The access road and bridge near Friant Road, Gravel

Haul Road, and unnamed roads are considered local roads and appear to be two-lane paved or unpaved roads under either the jurisdiction of Madera County or Fresno County. Traffic on these roads appears to be composed primarily of agricultural truck traffic or local residential commuters.

In Reach 1, three communication lines cross the river: two are AT&T lines and one is Level 3 communications. PG&E owns 13 natural gas transmission lines, 156 electrical distribution lines, and 14 electrical transmission lines. Of these, 152 of the electrical distribution lines are overhead, all of the natural gas transmission lines are underground, and all of the electrical transmission lines are overhead. Four electrical distribution lines are unknown.

Fresno Irrigation District has 11 outfall structures crossing the river. Also, six outlets to the river are owned by the Fresno Metropolitan Flood Control District. Fresno Irrigation District owns the Riverside Powell Spillway, Epstein Spillway, and Biola Spillway in this reach.

Reach 2. One bridge (Madera Avenue) provides access across the river along Reach 2A. Several roads parallel the river along this reach, and multiple confining levees protect agricultural land uses in this reach.

Several roads are located adjacent to the river along Reach 2B, although no bridges are present. Crossings in this reach, including San Mateo Road, are considered local roads under either the jurisdiction of Madera County or Fresno County, and these roads appear to have light local agricultural truck and commuter traffic. With the exception of the City of Mendota, no urbanized traffic areas, major SRs, arterials, or other roads appear to have heavy traffic in this reach.

There are 157 overhead PG&E-owned electrical distribution lines crossing the San Joaquin River in this reach. All of the electrical distribution lines are overhead. In addition, two underground gas transmission lines owned by PG&E cross the river.

Fresno Irrigation District owns the Big Sandridge Spillway and the Herndon Spillway in this reach.

Reach 3. The City of Firebaugh, located between the San Joaquin River and Helm Canal, is the only urban land use along Reach 3. Several roads provide access to or parallel the river, and one bridge (13 Street/Avenue 7½ bridge) provides access across the river in this reach. Roads in this area are generally rural in character except in Firebaugh, where they are typically urban. There are no state highways along Reach 3, although SR 33 and SR 152 skirt the edges of the reach and serve as transportation corridors from Firebaugh to other areas. Roads that cross the river are considered local roads under the jurisdiction of either Madera County or Fresno County, and appear to have light local traffic.

In this reach, AT&T owns one communication line that crosses the river. PG&E owns 7 underground gas transmission lines, 134 electrical distribution lines, and 4 underground electrical transmission lines that cross the river in this reach. Of these, 2 of the electrical distribution lines are underground, 132 are overhead, and the location of 2 lines is unknown.

Reach 4. Several roads are located adjacent or provide access to the river along Reach 4A, and the Brazil Road (SR 152) bridge provides access across the river. Several roads are located along Reach 4B. The primary heavy-traffic roads in Reach 4 are SR 33 (Reach 4A) and SR 152 (Reach 4B). Because there are no urbanized areas in this reach and agricultural production is moderate, traffic levels on arterials, collectors, and local roads are likely to be moderate, consisting of local agricultural trucks and commuters. With the exception of the SR 152 bridge, river crossings are arterials, collectors, or local roads under the jurisdiction of either Madera, Merced, or Fresno counties.

PG&E owns 2 overhead electrical transmission lines and 59 overhead electrical distribution lines that cross the river in Reach 4.

Reach 5. Several roads and two bridges (Lander Avenue bridge and the SR 140 bridge) are located along Reach 5. Roads correspond to local land uses and, thus, appear to have light traffic and be rural in nature. Besides SR 140 and SR 165/Lander Avenue, roads are mostly collectors and local roads with moderate-to-light traffic under the jurisdiction of Merced County.

PG&E owns five overhead electrical distribution lines in this river reach.

Chowchilla Bypass. Several roads parallel the Chowchilla Bypass, and four bridges provide access across it. No urban areas are located along the bypass. Accordingly, roads are primarily arterials, collectors, and local roads under the jurisdiction of Madera County.

There are no data regarding utility crossings in the Chowchilla Bypass.

Eastside Bypass, Mariposa Bypass, and Tributaries. Several access roads parallel the bypass south of the Mariposa Bypass, and 11 bridges provide access across the bypass. A number of crossings in this bypass area may be unusable during high-flow conditions, including West El Nido Road, Headquarters Road, Dan McNamara Road, and several unnamed crossings. Roads are collectors and local roads, and appear to have generally moderate-to-light traffic.

There are no data regarding utility crossings in the Eastside Bypass.

Existing Traffic Conditions

The following subsections describe existing traffic conditions in the Restoration Area, focusing on conditions in Fresno, Madera, and Merced counties.

Fresno County General Traffic Conditions. According to the Fresno County *General Plan Background Report (*2000*)*, the county's circulation system consists of a roadway network that is primarily rural in character, with the exception of the urbanized areas surrounding the Cities of Fresno and Clovis and various smaller communities in the southern and western parts of the county. The most important interregional roadways in the county are the SRs/highways, particularly SR 99, Interstate 5, and SR 41, which traverse the county from north to south. Interstate 5 is the primary north-south route for interregional and interstate business, freight, and tourist and recreational travel, linking Southern California to Northern California and the Pacific Northwest. On the regional level, SR 99 performs a similar function, connecting most of the cities of the San Joaquin Valley to Sacramento and Southern California. Fresno County is linked to Yosemite National Park and the Sierra communities to the north via SR 41, as well as to Kings County and the Central Coast to the south. In addition to Interstate 5, SR 99, and SR 41, Fresno County is served by SRs 33, 43, 63, 145, 168, 180, 198, and 269 (Fresno County 2000).

The county is also served by other major roadways that carry local and regional traffic, connect the cities and communities of Fresno County, and provide farm-to-market routes. These roadways provide critical freight and commercial linkages between production/manufacturing and the larger interregional distribution system.

Madera County General Traffic Conditions. Madera County's *General Plan Background Report* (1995) states that physical constraints on the county's circulation system are natural and human-made barriers to travel that limit existing and future roadway connections and alignments, and thus constrain the county's access and circulation capability.

Circulation constraints in Madera County vary between the valley region and the foothill/mountain region. In the flat valley of the western county, major circulation elements are the north/south-oriented SR 99 and railroad tracks that also run north/south, parallel to SR 99. SR 99 and railroad tracks facilitate north/south travel and hinder east/west travel. Access to the north, west, and south of the county is limited by the Chowchilla and San Joaquin rivers. The Fresno River, which runs generally in an east/west direction, also poses a constraint to north/south travel. In addition, numerous creeks and canals pose minor constraints to travel in the county.

Merced County General Traffic Conditions. The street and highway system in Merced County is composed of approximately 30 miles of Federal interstate highways, 220 miles of State highways, and 1,780 miles of county roads. Both traffic volume and traffic speeds are the principal determinants of travel quality on roadways. The traffic volumes on the major road system in Merced County vary from a high of 75,000 vehicles per day on SR 99 north of Delhi near Turlock to fewer than 1,000 vehicles per day. With a few exceptions, the highest volume roads in Merced County are State highways.

Point of Interest Traffic Counts. To quantitatively describe existing traffic conditions, points of interest (POI) were determined by reviewing traffic monitoring locations within 5 miles of the Restoration Area. No relevant traffic POIs were available for Reach 5, the Eastside Bypass, or the Chowchilla Bypass.

Caltrans annual average daily traffic data are the total volume of counts for the year divided by 365 days. The Caltrans traffic count year is from October 1 through September 30. Data regarding Madera and Fresno counties on State highways, interstate highways, and local and arterial roads consist of “raw” traffic counts, which are recorded at a particular location on a particular day for a period of 24 hours. These are not adjusted to reflect the day of the week or seasonal variations that could affect observed traffic volumes.

Traffic counts were researched from the following existing data sources at POIs: Caltrans 2006 Traffic and Vehicle Data Systems Unit (all data on California State Highway System) (Caltrans 2007), the *Madera County Transportation Commission Traffic Monitoring Program 2007 Traffic Volumes Report* (2007), the *Council of Fresno County Governments Fresno Regional Traffic Monitoring Report (1998–2002)* (2004), and the *Merced County Association of Governments’ Final Environmental Impact Report for Merced County’s 2004 Regional Transportation Plan* (2007).

3.15.2 San Joaquin River from Merced River to the Delta

A number of local rural roads parallel portions of the section of the San Joaquin River extending from the confluence of the Merced River to the Delta, located just north of SR 132 (Maze Road). Highways and roads with bridge crossings of the San Joaquin River include Hills Ferry Road at the Merced River confluence in Merced County, and Crows Landing Road, West Main Avenue, West Grayson Road, and SR 132, all in Stanislaus County.

3.16 Utilities and Public Service Systems

This section provides an overview of existing utilities and public service systems within the Restoration Area, focusing on fire protection services, law enforcement services, and emergency services. Buried utilities that cross under the San Joaquin River include (i.e., San Francisco Public Utilities Commission (SFPUC) Regional Water System San Joaquin Pipelines Nos. 1, 2, and 3, and various oil and gas underborings), as well as wastewater collection and solid waste services. Other portions of the study area and wastewater collection and solid waste management would not be affected by the Proposed Action and are not discussed. Many utilities and public service systems are covered to some degree in previous sections.

3.16.1 Fire Protection Services

This discussion identifies the general characteristics of fire protection facilities and services in the Restoration Area and the San Joaquin River from the Merced River to the Delta.

Fire protection services in Reaches 1 through 3 are provided by the Fresno County Fire Protection District, the City of Fresno Fire Department, and the Madera County Fire Department. The Fresno County Fire Protection District provides fire protection services to the communities of Calwa, Easton, Malaga, Del Rey, Caruthers, San Joaquin, Tranquility, Prather, Friant, Tollhouse, Wonder Valley, Cantua Creek, Three Rocks, Five Points, Centerville, Tivy Valley, and Sand Creek and to the Cities of San Joaquin, Parlier, Mendota, and Huron. The district has 13 fire stations and 48 personnel (Fresno County Fire Protection District 2009).

Fire protection services are provided to the City of Fresno by the City of Fresno Fire Department through a network of 22 fire stations, an airport rescue fire fighting station, 354 career firefighters, 39 apparatus and support vehicles, 2 personal watercrafts, and 2 aircraft rescue units (Fresno Fire Department 2009).

The Madera County Fire Department provides fire protection services to unincorporated areas of Madera County through a network of 15 fire stations, 19 career fire suppression personnel, 185 paid call firefighters, 11 support personnel, and 50 apparatus and support vehicles. The department is administered, and career suppression personnel are provided, through a contract with the California Department of Forestry and Fire Protection (CAL FIRE). Fire prevention, clerical, and automotive support personnel are county employees. The department assists with providing fire protection to the City of Madera through a mutual aid agreement and has a cooperative agreement with Central California Women's Facility for fire protection services in the north end of Madera County (Madera County Fire Department 2008).

Fire protection services in Reach 4A are provided by the Fresno County Fire Protection District and the Madera County Fire Department (see the discussion of these agencies above). Fire protection services in Reaches 4B1 and 4B2 are provided by the Merced County Fire Department. The Merced County Fire Department provides fire protection and emergency services to unincorporated areas of the county through a network of 20 fire stations, 227 paid call firefighters and volunteers, and a fleet of 80 vehicles. The department is administered, and suppression personnel are provided, through a contract with CAL FIRE. Support personnel are Merced County employees. The department also provides fire protection to the Cities of Gustine, Dos Palos, and Livingston through mutual aid agreements (Merced County 2007).

Fire protection services in Reach 5 are provided by the Merced County Fire Department. Fire protection services in the Chowchilla Bypass area are provided by the Madera County Fire Department and Merced County Fire Department. Fire protection services in the Eastside Bypass, Mariposa Bypass, and tributaries areas are provided by the Merced County Fire Department.

San Joaquin River from Merced River to the Delta

Fire protection services in the San Joaquin River system from the Merced River to the Delta are provided by the Stanislaus Consolidated Fire Protection District and the Merced County Fire Department.

3.16.2 Law Enforcement Services

This discussion identifies the general characteristics of law enforcement facilities and services in the Restoration Area and the San Joaquin River from the Merced River to the Delta.

San Joaquin River from Friant Dam to Merced River

The following sections describe law enforcement services within the Restoration Area.

Law enforcement services in Reach 1 are provided by the Fresno County Sheriff’s Department, the City of Fresno Police Department, and the Madera County Sheriff’s Department.

The Fresno County Sheriff’s Department provides law enforcement services to the unincorporated areas of the county and the Cities of Coalinga, Huron, San Joaquin, Kerman, Mendota, and Firebaugh. The Sheriff’s Department also provides the contract law enforcement for the Cities of San Joaquin and Mendota (Fresno County Sheriff’s Department 2008). The department serves four geographic areas and maintains four stations and one substation. Specialized members of the Sheriff’s Department also serve on additional specialty teams, including the Air Support Unit, Off-Road Safety Team, Forensics Laboratory, Boating Enforcement Unit, Special Weapons and Tactics (SWAT) Unit, Dive Team, and Search and Rescue Unit.

The Fresno Police Department provides law enforcement services to the City of Fresno. The department serves five policing districts (northeast, northwest, central, southeast, and southwest) and maintains four stations and one substation. Specialized members of the police department also serve on additional units, including the SWAT Team, K-9 Unit, Explosive Ordnance Disposal Unit, Skywatch, District Crime Suppression Teams, and Mounted Patrol (Fresno Police Department 2007).

Law enforcement in unincorporated Madera County is provided by the Madera County Sheriff's Department. The department is divided into three distinct divisions (Valley Division, Mountain Division, and Administrative Division), and has 116 personnel with 82 sworn law enforcement officers. Specialized members of the sheriff's department also serve on additional units, including the Agricultural Crimes Unit, Off-Highway Vehicle Unit, SWAT Team, Dive Team, and Search and Rescue Team (Madera County Sheriff's Department 2008).

Law enforcement services in Reaches 2 through 4 are provided by the Fresno County Sheriff's Department and the Madera County Sheriff's Department (see the discussion of the Fresno County Sheriff's Department and Madera County Sheriff's Department for Reach 1 above). Law enforcement services in Reaches 4B1 and 4B2 are provided by the Merced County Sheriff's Department. Law enforcement services in unincorporated areas of Merced County are also provided by the Merced County Sheriff's Department. The department maintains stations in Merced, Los Banos, and Delhi, and operates the John Lotorraca Correctional Center in El Nido and Sheriff's Community Law Enforcement Office stations in the communities of Merced, Planada, Santa Nella, Delhi, Hilmar, and Winton. The Merced County Sheriff's Department employs approximately 101 sworn officers and maintains 22 patrol vehicles and 4 additional unmarked nonpatrol vehicles. Specialized members of the Sheriff's Department also serve in additional units, including a narcotics task force, investigation unit, major-crimes unit, Federal drug trafficking task force, SWAT team, and Sheriff Tactical and Reconnaissance Team (Merced County).

Law enforcement services in Reach 5 are also provided by the Merced County Sheriff's Department. Law enforcement services in the Fresno Slough/James Bypass area are provided by the Fresno County Sheriff's Department. Law enforcement services in the vicinity of the Chowchilla, Eastside, and Mariposa bypasses are provided by the Madera County Sheriff's Department and Merced County Sheriff's Department.

San Joaquin River from Merced River to the Delta

Law enforcement services in the San Joaquin River system from the Merced River to the Delta are provided by the Stanislaus County Sheriff's Department and the Merced County Sheriff's Department (see the discussion of the Merced County Sheriff's Department above).

3.16.3 Emergency Services

This discussion identifies emergency service providers in the Restoration Area and the San Joaquin River from the Merced River to the Delta.

San Joaquin River from Friant Dam to Merced River

Emergency services in Reaches 1 through 3 are provided by the California Highway Patrol (CHP), Fresno County Sheriff's Department, and Madera County Sheriff's Department. The CHP Central Division provides ground and air support for emergencies along the Interstate 5 corridor, SR 99, and other State highways throughout Fresno, Madera, and Merced counties and the City of Fresno. The CHP Central Division has 15 area offices, 6 resident posts, 2 commercial inspection facilities, 667 uniformed officers, and 226 nonuniformed personnel (CHP 2008).

The Fresno County Sheriff's Department coordinates emergency evacuation routes and programs for residents and businesses in Fresno County. Large-scale emergency services are handled by the department in cooperation with the Federal Emergency Management Agency (FEMA); USFWS; the State emergency response network run by the California Office of Emergency Services (OES); CAL FIRE; CHP; and local fire departments, hospitals, and ambulance services.

The Madera County Sheriff's Department is responsible for coordinating emergency services in Madera County. Large-scale emergency services are handled by the department in cooperation with FEMA; USFWS; the State emergency response network run by OES; CAL FIRE; CHP; and local fire departments, hospitals, and ambulance services.

Emergency services in Reaches 4B1, 4B2, and 5 are provided by the CHP Central Division and the Merced County Fire Department (see the discussion of the CHP Central Division above). The Merced County Fire Department coordinates emergency evacuation routes and programs for residents and businesses in Merced County. Large-scale emergency services are handled by the Merced County Fire Department in cooperation with FEMA; USFWS; the State emergency response network run by OES; CAL FIRE; the Merced County Health Department; and local fire departments, hospitals, and ambulance services (Merced County 2007).

Emergency services in the Fresno Slough/James Bypass area are provided by the CHP Central Division and the Fresno County Sheriff's Department. Emergency services in the Chowchilla Bypass area are provided by the CHP Central Division, Madera County Sheriff's Department, and Merced County Fire Department. Emergency services in the Eastside Bypass, Mariposa Bypass, and tributary areas are provided by the CHP Central Division and Merced County Fire Department.

San Joaquin River from Merced River to the Delta

Emergency services in the Sacramento River System for the Merced River to the Delta are provided by the CHP Central Division, Merced County Fire Department, and Stanislaus County OES (see the discussion of these agencies above).

3.17 Socioeconomics

This section addresses current socioeconomic conditions for the three-county Restoration Area and the five-county Friant Division service area, which are the portions of the study area that may experience socioeconomic effects from the Proposed Action. Topics closely related to Socioeconomics are described in Section 3.13, Population and Housing and Section 3.14, Recreation.

3.17.1 San Joaquin River from Friant Dam to Merced River

The following section describes socioeconomic trends of the three counties in the Restoration Area: Fresno, Madera, and Merced counties.

Income Trends

In 1999, annual per capita incomes for counties in the three-county area were generally similar for each county, ranging between $14,257 and $15,495 annually. Madera and Merced counties had similar per capita incomes at $14,682 and $14,257, respectively, and Fresno County had the highest at $15,495. This range is substantially lower than the per capita income for the State ($22,711). Overall, the three-county area had a less affluent population than in the State overall in 1999.

Labor Force, Employment, and Industry

For a discussion of the labor force, employment, and industry in the three counties of the Restoration Area, see “Friant Division Water Contractors Service Areas.”

3.17.2 Friant Division Water Contractors Service Areas

The following section describes population and housing trends in the Friant Division service area, which includes five counties: Fresno, Kern, Madera, Merced, and Tulare.

Income Trends

In 1999, annual per capita incomes were generally similar for each county, ranging between $14,006 and $15,848 annually. Kern County had the highest annual per capita incomes at $15,760. This range is substantially lower than the per capita income for the State, which falls at $22,711.

Labor Force. According to the California Employment Development Department (EDD), California had a labor force of 18,244,000 in January 2008. The labor force in the Friant Division service area counties accounts for 6.6 percent of California’s total labor force. In total, the five counties of the Friant Division service area have a labor force of 1,212,400; this is an increase of 36.6 percent in the 18-year period from 1990 to 2008.

Employment

Since 1990, unemployment rates in all five counties have been consistently and substantially higher than State trends. EDD reports that the unadjusted unemployment rate for the State was 6.3 percent. Similar to historical trends, unemployment rates in the five-county Friant Division service area are higher than the State as a whole. Kern County had an unemployment rate of 9.9 percent in January 2008. The unemployment rate was 11.4 percent in Tulare, and EDD data ranked Merced 55th for unemployment with an unemployment rate of 13.3 percent, the highest rate of all the counties in the Friant Division service area. Fresno County ranked 41st of all California counties, with an unemployment rate of 10.5 percent, and Madera County ranked 36th, with an unemployment rate of 9.4 percent, the lowest of the three counties.

Industry

For the majority of the counties in the Friant Division service area, the top five industries based on the number of employees are the government sector, trade, transportation, and utilities; and farm jobs (Table 3-61). The agricultural industry sector (farm jobs) ranked in the top three industries in all counties in the Friant Division service area.

Table 3-61.
Friant Division Water Contractors Service Area Counties – Number Employed and Percentage of Employment by Industry Sector – 2008
(Number Employed/Percentage of Employment)

Industry Sector	Fresno County	Kern County	Madera County	Merced County	Tulare County
Government	68,500 19.7%	61,500 2.2%	10,700 24.4%	15,700 23.0%	31,400 22.0%
Trade, Transportation, and Utilities	60,900 17.5%	46,600 16.8%	5,300 12.2%	11,600 17.0%	24,600 17.3%
Farm Jobs	44,500 12.8%	37,900 13.7%	9,000 20.5%	10,100 14.8%	30,200 21.2%
Natural Resources and Mining	200 0.1%	9,900 3.6%	2,100 4.8%	2,900 4.2%	7,200 5.0%
Construction	19,800 5.7%	17,200 6.2%	Included in mining category	Included in mining category	Included in mining category
Manufacturing	26,600 7.7%	13,600 4.9%	3,200 7.3%	9,000 13.2%	12,000 8.4%
Information	4,100 1.2%	2,700 1.0%	500 1.1%	1,300 1.9%	1,000 0.7%
Financial Activities	15,000 4.3%	8,900 3.2%	800 1.8%	1,900 2.8%	4,000 2.8%
Professional and Business Services	30,100 8.7%	26,100 9.4%	3,000 6.8%	4,200 6.1%	9,900 6.9%
Educational and Health Services	39,200 11.3%	24,600 8.9%	5,800 13.2%	5,500 8.0%	10,900 7.6%
Leisure and Hospitality	27,700 8.0%	20,900 7.5%	2,600 5.9%	4,800 7.0%	8,500 6.0%
Other Services	11,000 3.2%	7,100 2.6%	800 1.8%	1,400 2.0%	2,900 2.0%

Source: EDD 2008

Agricultural Water Use in the Friant Division

The Friant Division supports conjunctive water management in an area that was subject to groundwater overdraft before construction of Friant Dam. Reclamation employs a two-class system of water allocation, as described in Section 3.11. From 1965 to 2006, the Friant Division delivered an average of approximately 1,336,404 acre-feet of water annually, which is approximately 61.0 percent of the full contract amount. Between 1965 and 2006, an average of 93.0 percent of Class 1 water was delivered to contractors, with the full 800,000 acre-feet delivered in many years.

Agricultural Production

The San Joaquin Valley is one of the world's most productive agricultural areas, with 8 million acres of land producing more that 250 crops. The Friant Division includes 28 member districts spread among five counties that make up the Friant Division service area. Four of the districts (Chowchilla, Delano-Earlimart, Madera, and Orange Cove) each straddle more than one county. In total, the Friant Division includes over 1 million acres of land.

The most consistent and generally reliable sources of agricultural crop production in the region containing the Friant Division service area are the annual County Agricultural Commissioner's Reports. These reports are prepared in coordination with the California Agricultural Statistical Service and National Agricultural Statistics Service, and data collection methods follow generally accepted procedures (USDA 2007). Crop production and value information is reported using county-level data (Table 3-62).

Table 3-62.
Agricultural Production Values in 2006

County	Average Value in 2006 Constant Dollars
Fresno	$4,192,224,293
Kern	$2,881,556,321
Madera	$948,156,958
Merced	$2,130,654,039
Tulare	$3,893,036,989

Source: USDA 2007

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