RECLAMATION

Managing Water in the West

Draft Environmental Assessment

EXECUTION OF WARREN ACT CONTRACTS FOR STORAGE AND CONVEYANCE OF NON-CVP WATER FROM PLACER COUNTY WATER AGENCY TO WESTLANDS WATER DISTRICT

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

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitment to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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List of Acronyms

AF	acre-feet
AFRP	Anadromous Fish Restoration Program
BA	Biological Assessment
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
BO	Biological Opinion
CALFED	CALFED Bay-Delta Program
CC	Coalinga Canal
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife formally California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CESA	California Endangered Species Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Data Base
COA	Coordinated Operations Agreement
Corps	U.S. Army Corps of Engineers
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
D-1641	State Water Resources Control Board Decision 1641
D-893	State Water Resources Control Board Decision 893
Delta	Sacramento-San Joaquin Delta
DOI	Department of Interior
DWR	Department of Water Resources
EA	Environmental Assessment
EC	Economic Criterion
E/I	export/import
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERPP	Ecosystem Restoration Program Plan
ESA	Federal Endangered Species Act of 1973, as amended
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FONSI	Finding Of No Significant Impact
GWh	gigawatt hours
I-5	Interstate 5
ITA	Indian Trust Asset
JPOD	Joint Point of Operation
M&I	municipal and industrial
MFP	Middle Fork Project
MSCS	Multi-Species Conservation Strategy
msl	Mean sea level
MW	Megawatts
MWh	Megawatt hours

NCCPA	Natural Community Conservation Planning Act
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuges
OCAP	Operations Criteria and Plan
OEHHA	Office of Environmental Health Hazard Assessment
Parkway	American River Parkway
PCWA	Placer County Water Agency
PG&E	Pacific Gas and Electric Company
PL	Public law
PCWA	Placer County Water Agency
Reclamation	U.S. Bureau of Reclamation
RM	River mile
ROD	Record of Decision
RWA	Regional Water Authority
SLC	San Luis Canal
SRA	State Recreation Area
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total dissolved substances
TOC	Total organic carbons
USFWS	U.S. Fish and Wildlife Service
VELB	Valley Elderberry Longhorn Beetle
WA	Warren Act
Western	Western Area Power Administration
WWD	Westlands Water District
WMA	Wildlife Management Area
WQCP	Bay Delta Water Quality Control Plan
X2	2 ppt salinity isopleth

Section 1 Introduction

1.1 Background

In the San Joaquin Valley, one of the nation's most productive agricultural areas, the dry conditions have contributed to increased water demands for crops and current water supplies are not sufficient. Westlands Water District (WWD) provides water supply to over 600,000 acres of farmland within Fresno and Kings Counties (see Figure 1). WWD's long-term source of water supply is the Central Valley Project (CVP), operated by the United States Bureau of Reclamation (Reclamation). Reclamation's 2013 allocation to WWD was initially 25 percent of WWD's contract amount, but was subsequently reduced to 20 percent. Furthermore, dry conditions and operational constraints limited CVP deliveries to WWD during a crucial part of the growing season this past summer. Given very low State-wide reservoir storages entering into this coming water year, Central Valley growers are experiencing another year of reduced allocations.

Water transfers have become an important component in WWD's water supply. Transfers from other districts are pursued each year to supplement reduced contract deliveries when the price is reasonable. Transfers within WWD are used to supplement a water user's allocation from supplies currently available.

Placer County Water Agency (PCWA) has implemented several temporary water transfers over the past 25 years to enhance water supply, water quality, and environmental conditions. In response to the low allocations

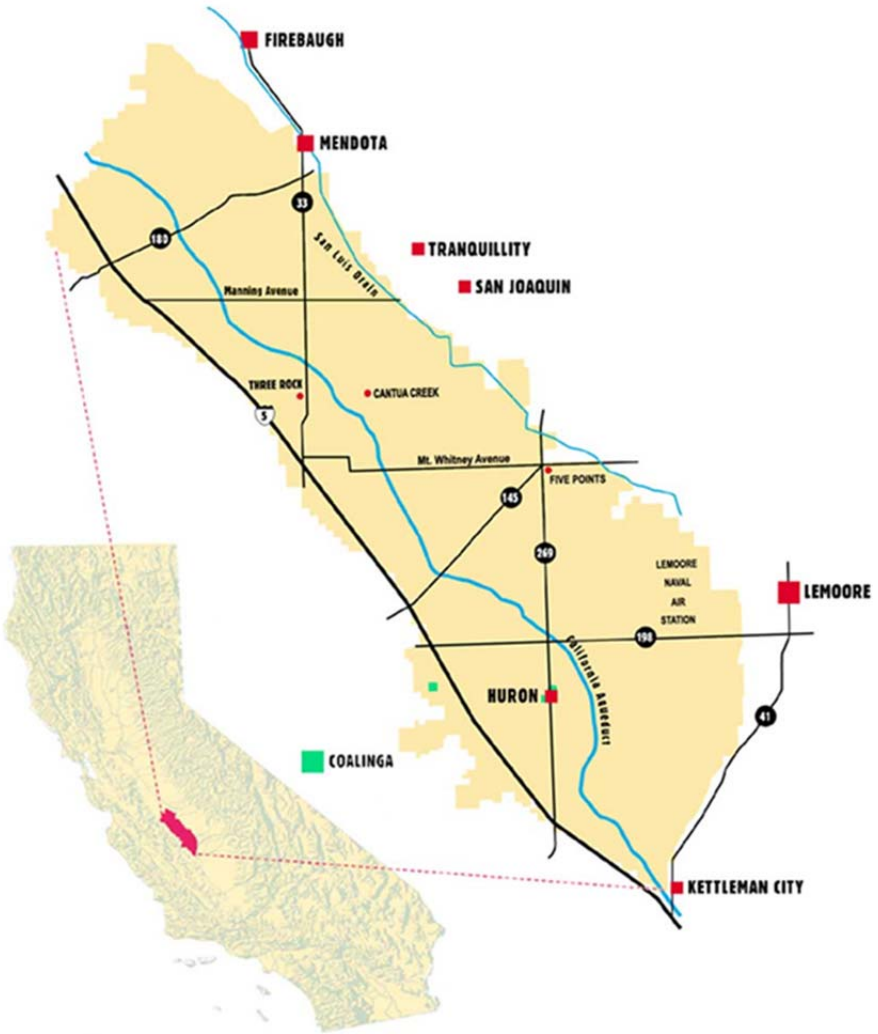


Figure 1: Westlands Water District

and to move water to an area of high need, PCWA is proposing a temporary water transfer of 20,000 acre-feet (AF) of its 2013 water supplies currently stored in its Middle Fork Project (MFP) reservoirs on the Rubicon and American Rivers to WWD for irrigation use within the WWD service areas. To facilitate the transfer, Reclamation proposes to execute a Warren Act (WA) contract for a total of 20,000 AF of PCWA water to be stored and conveyed through Federal and State facilities.

The WA (43 U.S.C. §523) of 1911 provides authorization to the Secretary of the Interior to enter into WA contracts with water purveyors to carry non-CVP water (i.e., water not developed as part of the CVP) through Federal facilities. These contracts provide for the impounding, storage, and conveyance of non-CVP water for domestic, municipal, fish and wildlife, industrial, and other beneficial uses using any CVP facilities identified in the law, including Shasta Reservoir, Folsom Reservoir, Jones Pumping Plant the Delta-Mendota Canal, San Luis Reservoir, O'Neill Forebay, and the San Luis Canal. In addition, the Banks Pumping Plant (a State facility) could be utilized if no additional capacity is available in the Jones Pumping Plant. WWD submitted a transfer proposal to DWR's State Water Projects Analysis Office for a conveyance agreement. This agreement allows DWR to convey the transfer water through State Facilities.

1.2 Need for the Proposal

Due to water shortages, WWD does not have sufficient water to meet the current demands within its service area. WWD has entered into a transfer agreement with PCWA, and this Proposed Action is needed to allow use of CVP facilities to store and convey non-CVP water supply to WWD.

WWD faces deficits in their water supplies in 2013, and similar conditions are envisioned for 2014. The result of this shortfall would be the loss of agricultural crops and potential damage to perennial crops. The potential loss of permanent crops such as orchards or vineyards represents a disruption because such crops require years of investment and planning, making their loss effectively irreparable. This transfer would prevent some of the potential damage from the low allocations this year.

Section 2 Proposed Action and Alternatives

2.1 No Action Alternative

Under the No Action Alternative, Reclamation would not enter into a one-year WA contract with WWD. Therefore, WWD would not receive 20,000 AF of PCWA transfer water. As a result, there would be no change to instream flow releases in the Middle Fork and North Fork American River, Lower American River, Sacramento River, and the Delta. Furthermore, there would be no addition to the coldwater pool in the Folsom Reservoir.

2.2 Proposed Action

Reclamation proposes to enter into a one-year WA contract, for storage and conveyance of up to 20,000 AF of non-CVP water from PCWA to WWD for non-CVP water to be stored and conveyed through Federal and State facilities. Federal facilities potentially involved in the storage and conveyance include Folsom Reservoir, Jones Pumping Plant, Delta-Mendota Canal and San Luis Reservoir. If no additional capacity is available at the Jones Pumping Plant, the State pumping plant at Banks and the California Aqueduct would be utilized to convey the water to O'Neill Forebay.

Under the proposed transfer, PCWA would release water from its MFP reservoirs into the Middle Fork American River, which subsequently flows into the North Fork American River. From the North Fork American River, the released water would flow into Folsom Reservoir, as shown in Figure 2. The water released from the MFP reservoirs will reach Folsom Lake by June 1, 2013. However, it may be possible to receive water in Folsom Reservoir later than June 1, 2013, dependent on water temperatures. The date of receipt is determined solely by Reclamation and set to avoid impacts on the cold water pool in Folsom Reservoir for fish habitat. Reclamation would release water from Folsom Reservoir into the Lower American River, the Sacramento River, and through the Delta to Banks or Jones Pumping Plant, where the amount transferred is subject to an estimated 30% carriage loss. From Jones Pumping Plant, water would be conveyed through the Delta-Mendota Canal and pumped into O'Neill Forebay where it would be diverted either for immediate WWD use or for storage in the federal share of San Luis Reservoir for later release to the federal side of the San Luis Canal for conveyance to the Coalinga Canal for WWD use. If the Banks Pumping Plant is used instead of Jones Pumping Plant, water would be conveyed through the California Aqueduct to the O'Neill Forebay where it would be diverted either for immediate WWD use or for storage in the federal share of San Luis Reservoir for later release to the federal side of the San Luis Canal for conveyance to the Coalinga Canal for WWD use. In addition to the estimated 30% carriage loss through the Delta, the transferred water is subject to 5% conveyance loss for use of the Delta-Mendota and San Luis Canal.

Figure 2: PCWA Middle Fork Project

The 20,000 AF proposed to be released for transfer to WWD is currently in MFP storage and would not be released in the absence of this transfer. Reclamation has agreed that the release of this water from storage is Non-Project water that otherwise would not be available to WWD.

In order to refill MFP reservoirs, without injury to downstream vested water rights holders following the transfer, PCWA would enter into a refill agreement with Reclamation, similar to refill agreements that PCWA and Reclamation have entered into on other PCWA transfers.

The Proposed Action would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and redivert water. Land uses within the PCWA and WWD service areas would not change as a result of the transfer.

The Proposed Action can only occur after the State Water Resources Control Board issues an approval to PCWA for the change in place of use order.

2.2.1 Project Operations

The plan for transferring 20,000 AF of water from PCWA to WWD is to release all of the water from MFP reservoirs into the Middle Fork and North Fork American Rivers, via a series of tunnels, the Middle Fork Interbay Diversion Dam, and several powerhouses into the Oxbow Reservoir (Ralston Afterbay). The water would be released from Oxbow Reservoir into the Middle Fork American River below the Oxbow Powerhouse, where it would flow down the

Middle Fork American River into the North Fork American River and subsequently into Folsom Reservoir by June 1, 2013.

The water would be released from Folsom Reservoir into Lake Natoma, which is impounded by Nimbus Dam. Lake Natoma serves as the re-regulating afterbay for Folsom Reservoir. The water would be released at a steady rate from July through September 2013, from Nimbus Dam into the

Figure 3: State and Federal Facilities

Lower American River, and subsequently would flow into the Sacramento River and the Delta.

The transfer water would be conveyed from the Banks/Jones Pumping Plant in the southern portion of the Delta into their respective conveyance channels, and either stored in the federal share of the San Luis Reservoir or transported to WWD via San Luis and Coalinga Canals for immediate use (Figure 3).

The release of transfer water from Nimbus Dam would end on September 30, 2013. A total of 20,000 AF would be released from the MFP reservoirs. Releases from Folsom Reservoir will be scheduled to accommodate pumping plant requirements, which will be an approximate release of 100 cfs from Nimbus Dam.

Section 3 Affected Environment and Environmental Consequences

This section identifies the potentially affected environmental resources and the environmental consequences that could result from the Proposed Action and the No Action Alternative.

3.1 Resources Not Analyzed in Detail

Impacts on the following resources were considered and found to be minor, but require brief explanations due to administrative requirements.

Air Quality

Since the Proposed Action has no potential to cause direct or indirect emissions of criteria pollutants that equal or exceed *de minimis* thresholds, a conformity analysis is not required pursuant to the Clean Air Act.

Cultural Resources

The Proposed Action Alternative would involve the redistribution of water through existing Federal facilities. There would be no modification of water conveyance facilities and no activities that would result in ground disturbance. This action is administrative in nature and has no potential to affect historic properties pursuant to the regulations at 36 CFR Part 800.3(a)(1). Because there is no potential to affect historic properties, no cultural resources would be affected as a result of implementing the Proposed Action. (See Appendix C)

Indian Sacred Sites

Since no modification of the existing State and Federal facilities is necessary and use of these facilities will remain within capacity, no Indian sacred sites will be infringed. The proposed action will not result in any ground disturbance and therefore would have no effect on Indian sacred sites.

Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property or rights held in trust by the United States for Indian Tribes or individual Indians. Indian reservations, Rancherias, and Public Domain Allotments are common ITAs in California. The proposed action does not have a potential to affect Indian Trust Assets (See Appendix B, Indian Trust Assets Compliance Memo.)

Global Climate Change

The Proposed Action would not emit greenhouse gasses that would exceed the 25,000 metric ton/year threshold. Trends in climate change would not be affected. In addition climate change would not have an impact to the Proposed Action. The Proposed Action will not cause any State or Federal facility to exceed capacity which will not have any added activities that would produce surplus greenhouse gas emissions.

Environmental Justice

The action alternatives would not have any impact on minority or low-income populations within the Action Area relative to the No Action alternative. The action alternatives would benefit the

low-income agricultural workers because an increased water supply would keep land from being fallowed and would allow them employment.

3.2 Water Supply and Hydrology

3.2.1 Affected Environment

Middle Fork and North Fork American Rivers

PCWA has water rights allowing for power generation and recreational uses, as well as for irrigation and incidental domestic and municipal and industrial (M&I) uses. PCWA's water rights authorize 120,000 AF of consumptive uses of the combined waters of the North and Middle Fork American rivers.

The American River is a major tributary to the Lower Sacramento River. The Middle Fork American River watershed extends westward to the confluence with the North Fork American River, east of Auburn (elevation 650 feet). The average annual yield for the Middle Fork American River for the period of 1959 through 1991 was 805,000 AF. The Rubicon River is the main tributary to the Middle Fork American River. The main reservoirs in the Middle Fork watershed are French Meadows, Hell Hole, Rubicon, Loon Lake, Gerle Creek, and Stumpy Meadows Lake. PCWA and PG&E operate most of the reservoirs in the Middle Fork watershed.

The Middle Fork joins the North Fork American River before flowing into Folsom Reservoir. Downstream of its confluence with the Middle Fork American River, the North Fork American River flows are a combination of regulated and unregulated flows. Flows in the North Fork below its confluence with the Middle Fork are directly affected by fluctuations in Ralston Afterbay releases, but are attenuated by the unregulated flows from the North Fork, which exhibit less diurnal fluctuation.

The North Fork flows are altered by the North Fork Dam at Lake Clementine, upstream of its confluence with the Middle Fork American River. Average annual runoff in the North Fork American River from 1942 through 1992 was 594,000 AF. North Fork American River flows have been estimated based upon upstream gage measurements.

French Meadows and Hell Hole Reservoirs

Construction of French Meadows and Hell Hole reservoirs was completed in 1966 and 1965, respectively. Maximum storage capacity is 136,000 AF in French Meadows Reservoir and 208,000 AF in Hell Hole Reservoir. French Meadows Reservoir is located in the upper Middle Fork American River watershed, about 16 miles west of Lake Tahoe. Hell Hole Reservoir is located about three miles southeast of French Meadows Reservoir on the Rubicon River. Water is released from these storage reservoirs downstream to a re-regulating reservoir, Ralston Afterbay, which reflect upstream regulation to maximize hydropower generation while meeting an instream flow requirement of 75 cfs on the Middle Fork American River.

Lower American River

The Lower American River consists of the 23-mile stretch of river from Nimbus Dam to the confluence of the American and Sacramento rivers in the City of Sacramento. Average Lower American River annual flows downstream of Folsom Dam at Fair Oaks are approximately 2,650,000 AF (Reclamation 2004).

Folsom Reservoir and Dam

Folsom Reservoir is the principal reservoir on the American River, with a maximum storage capacity of 977,000 AF. Reclamation operates Folsom Dam and Reservoir for the purposes of flood control, meeting water contract water right obligations, providing downstream releases for the Lower American River and helping to meet Delta water quality standards. The El Dorado Irrigation District, City of Roseville, San Juan Water District, California State Prison, and the City of Folsom are the main entities that divert water from Folsom Reservoir.

Lake Natoma and Nimbus Dam

Lake Natoma serves as the Folsom Dam afterbay and was formed as a result of Nimbus Dam. Lake Natoma has a maximum storage capacity of 9,000 AF, and inundates approximately 500 acres. Lake Natoma is operated as a re-regulating reservoir that accommodates the diurnal flow fluctuations caused by the power peaking operations at Folsom Power Plant. Nimbus Dam, along with Folsom Dam, regulates water releases to the Lower American River.

Nimbus Dam releases are nearly always controlled during significant portions of a water year by either flood control requirements, fishery requirements under Central Valley Project Improvement Act (CVPIA) 3406(b)(2), or through coordination with other CVP and SWP releases to meet downstream SWRCB Decision 1641 requirements in the Delta and CVP water supply objectives (Reclamation 2004).

Sacramento River

The Sacramento River originates near the slopes of Mount Shasta and flows southward to Suisun Bay. Sacramento River flows are controlled primarily by Reclamation's Shasta Dam. Flows in the Sacramento River normally peak during December through February. The drainage area upstream of Sacramento is 23,502 square miles. The historical average annual flow for the Sacramento River at Freeport is 16,677,000 AF. The Feather and American rivers are the two largest contributors to the Sacramento River. The Lower Sacramento River is defined as that section of the river downstream of its confluence with the Lower American River.

Sacramento-San Joaquin Delta

The Delta lies at the confluence of the Sacramento and San Joaquin rivers. The Delta boundary extends north along the Sacramento River to just south of the American River, south along the San Joaquin River to just north of the Stanislaus River, east to the City of Stockton, and west to Suisun Bay. Runoff from a variety of Central Valley streams accounts for approximately 95 percent of the inflows into the Delta. The Delta receives flows directly from the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers. Inflows to the Delta averaged 27,800,000 AF annually from 1980 through 1991 and outflows to Suisun Bay averaged 21,020,000 AF (DWR 1993 as cited *in*: Reclamation 2001a). Releases from Shasta, Folsom, New Melones, and Millerton reservoirs of the CVP and Lake Oroville of the SWP, and several locally operated reservoirs in the San Joaquin River Basin control, to a large extent, how much and when freshwater enters the Delta.

The Delta serves as a major operational focus for SWP and CVP project facilities. The CVP operates the Jones Pumping Plant to lift water from the southern Delta into the Delta-Mendota Canal to service CVP contractors in the San Joaquin Valley and the Tulare Basin. The SWP

operates the Banks Pumping Plant, which lifts the water to the California Aqueduct. Current CVP and SWP operations in the Delta are governed by a series of regulations and agreements with the SWRCB, USFWS, National Marine Fisheries Service (NMFS), and CDFW. The current operating standards can be found at http://www.water.ca.gov/swp/operationscontrol/docs/bay_deltastandards.htm

CVP Facilities and Operations

The CVP Delta Division facilities include the Delta Cross Channel, the Contra Costa Canal, the Jones Pumping Plant and associated fish collection facility, and the Delta-Mendota Canal.

The Jones Pumping Plant, located in the south Delta about five miles from the City of Tracy, is used to lift water from the Delta into the Delta-Mendota Canal. The pumping plant is located at the end of a 2.5-mile intake channel. At the head of the intake channel, louver screens intercept fish, which are collected and transported by tanker to release sites away from the pumps. Jones Pumping Plant consists of six pumps with a collective maximum rated capacity of about 5,100 cfs, although the permitted capacity is 4,600 cfs.

Water exported at the pumps of the Jones Pumping Plant is conveyed via the Delta-Mendota Canal and via the joint reach of the California Aqueduct (San Luis Canal) to M&I and agricultural contractors in the San Joaquin Valley. Water from the Delta-Mendota Canal also may be pumped into San Luis Reservoir, where the water commingles with SWP water exported at Banks Pumping Plant. CVP water in San Luis Reservoir is subsequently released back into the Delta-Mendota Canal or the San Luis Canal via O'Neill Forebay.

CVP demands typically exceed pumping limitations at Jones Pumping Plant capacity in the spring and summer months. During this period, the CVP depends on releases from San Luis Reservoir to augment pumping at Jones Pumping Plant. In all but the driest years, there is limited or no unused pumping capacity at Jones Pumping Plant. In years that the capacity of Jones Pumping Plant is fully utilized, the CVP may wheel water through the SWP system using excess capacity at Banks Pumping Plant and the California Aqueduct.

SWP Facilities and Operation

SWP facilities in the Delta include the North Bay Aqueduct, Clifton Court Forebay, John E. Skinner Delta Fish Protection Facility, Harvey O. Banks Delta Pumping Plant, and the intake channel to the pumping plant. The North Bay Aqueduct would not be affected by the action alternatives, and therefore, is not discussed further. Banks Pumping Plant lifts water 244 feet to the beginning of the California Aqueduct. An open intake channel conveys water to Banks Pumping Plant from Clifton Court Forebay. The forebay provides storage for off-peak pumping and permits regulation of flows into the pumping plant. All water arriving at Banks Pumping Plant flows first through the primary intake channel of the John E. Skinner Delta Fish Protective Facility. Fish screens (louvers) across the intake channel direct fish into bypass openings leading into the salvage facilities. The main purpose of the fish facility is to reduce the number of fish adversely impacted by entrainment at the export facility and to reduce the amount of floating debris conveyed to the pumps.

Banks Pumping Plant facilities has a total of elevens pumps with a total capacity of 10,668 cfs; two pumps are rated at 375 cfs, five at 1,130 cfs, and four at 1,067 cfs. Water is pumped into the California Aqueduct, which extends 444 miles into southern California.

Delta-Mendota Canal

The Delta-Mendota Canal, completed in 1951, carries water southeasterly from the Jones Pumping Plant along the west side of the San Joaquin Valley for irrigation supply, for use in the San Luis Unit, and to replace San Joaquin River water stored at Friant Dam and used in the Friant-Kern and Madera systems. The canal is about 117 miles long and terminates at the Mendota Pool, about 30 miles west of Fresno. The initial diversion capacity is 4,600 cfs, which is gradually decreased to 3,211 cfs at the terminus.

San Luis Reservoir

San Luis Reservoir is a storage facility south of the Delta, operated jointly by the CVP and SWP. Water is stored during the fall and winter months when Delta pumps can export more water than is needed for scheduled water demands. Similarly, water is released from San Luis Reservoir during spring and summer months when water demands are greater than the project's Delta export capacity. The total storage of San Luis Reservoir is 2,041,000 AF, of which 972,000 AF is dedicated to the CVP and 1,069,000 AF is dedicated to the SWP. San Luis Reservoir receives water from and releases water to O'Neill Forebay through the Gianelli Pumping-Generating Plant. The O'Neill Forebay also receives CVP supplies from the Delta-Mendota Canal via the Federal O'Neill Pump-Generating Plant, and SWP supplies from the California Aqueduct.

San Luis Canal

This joint CVP/SWP facility is a concrete-lined canal with a capacity ranging from 8,350 to 13,100 cfs. The San Luis Canal is operated by DWR and extends 102.5 miles from the O'Neill Forebay, near Los Banos, in a southeasterly direction to a point west of Kettleman City. The 138-foot-wide channel is 36 feet deep, 40 feet wide at the bottom, and lined with concrete.

Coalinga Canal

This Federal facility, formerly called Pleasant Valley Canal, carries water from the turnout structure on the San Luis Canal to the Coalinga area in Fresno County. The 12-mile concrete-lined system includes a 1.6-mile intake channel to the Pleasant Valley Pumping Plant and 11.6 miles of canal. The initial capacity of the canal is 1,100 cfs, decreasing to 425 cfs at the terminus. Reaches 1 and 2 of the canal are operated by WWD. (Reclamation, WWD and HDR/SWRI Inc. 2008.)

3.2.2 Environmental Consequences

No Action

Under the No Action Alternative, WWD would not receive the additional water supply which would not change the amount of instream flow. Likewise, there would be no benefits to the Folsom Reservoir coldwater pool.

Proposed Action

The analysis of the potential effects on water resources associated with the alternatives was based on reductions in reservoir storage or river flows, relative to the No Action Alternative, of sufficient magnitude, to affect the water supply availability to CVP and PCWA contractors.

Middle Fork American River below Oxbow Powerhouse and North Fork American River

Water in storage at Hell Hole Reservoir would be sufficient to meet all of PCWA contractual obligations, including PCWA's own use, with the implementation of the Proposed Action Alternative. The transfer water would be used to irrigate lands in WWD. To transfer this water, additional on-peak generation would be needed. The minimum and maximum flow rates for the day would remain the same as under the No Action Alternative, although the duration of the maximum flow would increase during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow. Therefore, because water storage in Hell Hole Reservoir is sufficient to meet contractual obligations, and flows would not be reduced in the Middle Fork River below Oxbow Powerhouse or in the North Fork American River, water availability or the capability to divert the water would not change.

French Meadow and Hell Hole Reservoir

Under the Proposed Action Alternative, storage at French Meadow and Hell Hole Reservoir would be reduced relative to the No Action Alternative, by up to 20,000 AF at the beginning of June 2013. PCWA has identified combined carryover storage of 150,000 AF under the No Action Alternative. The Proposed Action Alternative would reduce the carryover storage to 130,000 AF.

No legal user of water would be injured because PCWA's transfer of water would only slightly increase, not decrease, streamflows below PCWA's MFP reservoirs. Any increase would be minor and would not cause any water flows to increase above normal seasonal levels, or to violate any regulatory requirements. The released water was stored by PCWA in accordance with its water rights and would not otherwise be available to any legal user of water. Additionally, PCWA would sign a reservoir refill agreement with Reclamation, ensuring that future refill of any storage space in PCWA's MFP reservoirs created by the transfer would not be with water that PCWA would not otherwise have been entitled to in accordance with its water rights.

The decrease in reservoir storage is equal to the water available for transfer. The volume of water made available under the Proposed Action Alternative would not be of substantial magnitude, relative to the No Action Alternative, and therefore would not substantially affect water supply availability at Hell Hole Reservoir.

Folsom Reservoir

Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 20,000 AF by June 1, 2013. Folsom Reservoir storage is estimated for the beginning of June to be 700,000 AF under the No Action Alternative, and 720,000 AF under the Proposed Action Alternative. Because no decreases in reservoir storage would occur under Proposed Action Alternative, water supply availability for CVP customers would not be decreased and there would be no effect to CVP customers.

Lower American River

Lower American River below Nimbus Dam under the Proposed Action Alternative, the total release would be approximately 100 cfs higher from July to September than flows expected under the No Action Alternative in the lower American River below Nimbus Dam. Because no

decreases in flow would occur under the Proposed Action Alternative, water supply availability to CVP customers or other legal users of water would not decrease and there would be no affect to CVP customers.

Sacramento River
Flows on the Lower Sacramento River (below the confluence with the Lower American River) would not change significantly under the Proposed Action Alternative, relative to the No Action Alternative. Also, water supply availability to CVP customers and other legal users of water would not decrease and there would be no affect to these customers.

Sacramento-San Joaquin Delta Inflows and Export Pumping
Under the Proposed Action Alternative, inflows into the Delta would increase slightly relative to the No Action Alternative, because flows below the confluence of the Lower American River and Sacramento River would increase by approximately 100 cfs for the July through September period. In addition, export pumping from the Jones and/or Banks pumping plants would only increase slightly. The Proposed Action Alternative would give Reclamation some increased flexibility in managing river and reservoir temperatures and summertime flows. Therefore, changes in water supply availability to CVP customers would not occur under the Proposed Action Alternative relative to the No Action Alternative.

San Luis Reservoir
Under the Proposed Action Alternative, total storage in San Luis Reservoir could possibly increase slightly relative to the No Action Alternative. Currently there is excess storage capacity in San Luis Reservoir. In the event that the San Luis Reservoir is used to store the transferred water, the proposed transfer would use only excess storage capacity available in the Federal share and would have no effect on CVP or SWP customers. . (Reclamation, WWD and HDR/SWRI Inc. 2008.)

3.3 Water Quality

3.3.1 Affected Environment

Middle Fork and North Fork American River
Water quality in the American River is considered to be good, although historical water quality data for the North and Middle Forks American rivers are sparse (Corps 1991). Information on sediment in the river is not readily available; however, turbidity results indicate that the river carries relatively little sediment during low flows. Several wastewater sources discharge into the North and Middle Fork American rivers or to their tributaries. Sources of wastewater discharge include two sawmills located at Foresthill; one is on a tributary to Devil's Canyon and the North Fork American River, and the other discharges directly into the Middle Fork American River. Levels of pH have exceeded objectives in the Middle Fork American River. This exceedance is attributable to photosynthetic activity (Placer County 1994a).

French Meadows Reservoir

Due to its position high in the watershed, its inflow mainly comes from snowmelt and as a result the reservoir does not receive a high level of contaminants. Water quality in French Meadows Reservoir is generally considered to be of good quality.

Hell Hole Reservoir

Hell Hole Reservoir, located within the El Dorado National Forest, receives flows from the Rubicon River, a tributary of the Middle Fork American River. Because it is high in the watershed, its inflow mainly comes from snowmelt and as a result does not receive a high concentration of contaminants. Water quality in Hell Hole Reservoir is generally considered to be of good quality.

Folsom and Natoma Reservoirs

Water quality in Folsom Reservoir and Lake Natoma is generally acceptable for the beneficial uses currently defined for these waterbodies. Temperature, dissolved oxygen, conductivity, and toxic metals concentrations generally do not exceed recommended limits.

However, comments about taste and odor have occurred in municipal water supplies diverted from Folsom Reservoir, which were attributed to blue-green algae blooms that occasionally occur in the reservoir as a result of elevated water temperatures during late summer.

Lower American River

Water quality parameters for the Lower American River have typically been well within acceptable limits to achieve water quality objectives and beneficial uses identified for this waterbody (SWRCB 1998). Principal water quality parameters of concern for the river (i.e., pathogens, nutrients, total dissolved solids (TDS), total organic carbon (TOC), priority pollutants, and turbidity) are primarily affected by urban land use practices and associated runoff and stormwater discharges. TOC and TDS levels in the Lower American River are relatively low compared to Sacramento River and Delta and thus are generally not of substantial concern. Heavy metal concentrations in the river are typically within the range of drinking water standards (City of Sacramento 1993). Comments on taste and odor can occur in water taken from the Lower American River, primarily during late summer. The problems are attributable to increased concentrations of an actinomyces microorganism, which is associated with elevated summer temperatures.

Sacramento River

Water originating from the Sacramento River drainages represents a significant component of the total CVP supply, which provides high quality water to meet downstream urban and agricultural demands. The Sacramento River Watershed Program has identified mercury, organophosphate pesticides, toxicity, and drinking water parameters as chemicals of concern in the Sacramento River watershed, which includes the Sacramento and Feather rivers, and the Delta (Sacramento River Watershed Program 2001).

The Lower Sacramento River receives urban runoff, either directly or indirectly (through tributary inflow) from the cities of Sacramento, Roseville, Folsom, and their surrounding communities. The Natomas East Main Drainage Canal discharges to the American River immediately upstream of its confluence with the Sacramento River. This canal transfers both agricultural discharges and urban runoff into the Sacramento River.

Sacramento-San Joaquin Delta

The Delta is the source of drinking water for more than 23 million Californians in the San Francisco Bay area, Central Valley, and Southern California. Recognized water quality issues in the Delta include the following (Reclamation and DWR 2005):

- High salinity from Suisun Bay intrudes into the Delta during periods of low Delta outflow. Salinity can adversely affect agricultural, M&I, and recreational uses. Delta exports contain elevated concentrations of disinfection by-product precursors (e.g., dissolved organic carbon [DOC]) and bromide that increases the potential for the formation of brominated compounds in treated drinking water).
- Agricultural drainage in the Delta contains high levels of nutrients, suspended solids, DOC, minerals (salinity), and pesticides. Synthetic and natural contaminants have bioaccumulated in Delta fish and other aquatic organisms. Synthetic organic chemicals and heavy metals are found in Delta fish in quantities occasionally exceeding acceptable standards for food consumption.
- The San Joaquin River flows are of relatively poorer quality than flows from the Sacramento River, with agricultural and refuge drainage to the river being a major source of salts and pollutants. Because the south Delta receives a substantial portion of water from the San Joaquin River, the influence of San Joaquin River water quality is greatest in the south Delta channels and in the CVP and SWP exports.

Prolonged reverse flow has the potential to adversely affect water quality in the Delta and at the export pumps by increasing salinity unless Delta outflow is increased by the CVP and SWP to offset that effect (DWR and Reclamation 1996; SWRCB 1997; CALFED 2000).

The existing water quality constituents of concern in the Delta can be categorized broadly as metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon. Water quality constituents that are of specific concern with respect to drinking water, including salinity, bromide, and organic carbon.

San Luis Reservoir

Because the reservoirs within the CVP/SWP system are operated in a coordinated manner to the various demands throughout California, changes in the timing and magnitude of exports from the Delta, if they were to occur, could indirectly result in changes to Delta flows and water surface elevations in San Luis Reservoir.

During the summer months when water levels are low, water quality in San Luis Reservoir may deteriorate due to a combination of higher water temperatures, wind-induced nutrient mixing, and algal blooms near the reservoir surface. The reservoir also has an unusual configuration with a very large surface area and a relatively shallow depth, which contributes to algal blooms. (Reclamation, WWD and HDR/SWRI Inc. 2008.)

3.3.2 Environmental Consequences

No Action

Under the No Action Alternative no additional flow would contribute to the dilution of contaminates in the Middle and North Fork American Rivers, the Sacramento River, Folsom and Natoma Reserviors.

Proposed Action

The analysis of potential changes in water quality associated with the proposed water transfer within the Middle Fork American River Basin was based on the following criteria:

- Decrease in end-of-month reservoir storage, of sufficient magnitude or duration relative to the No Action Alternative, to result in an increase in the concentration of contaminants.
- Decrease in monthly mean river flow, of sufficient magnitude or duration relative to the No Action Alternative, to result in an increase in the concentration of contaminants.

Middle Fork and North Fork American Rivers

The Proposed Action Alternative would provide additional on-peak generation, so the minimum and maximum flow rates for the day would remain the same as under the No Action Alternative, although the duration of the maximum flow would increase during the daily on-peak generation period. The volume of flow in the Middle Fork and North Fork American rivers during the time of release would increase relative to the No Action Alternative. Therefore, flows would not decrease and would not result in an increase in the concentration of contaminants in the Middle Fork American River below Oxbow Powerhouse, or in the North Fork American River downstream of the confluence with the Middle Fork American River. Changes to water quality would not occur.

Hell Hole Reservoir

Under the Proposed Action Alternative, storage at Hell Hole Reservoir would be reduced by up to 20,000 AF by June 1, 2013 relative to the No Action Alternative. Due to its position high in the watershed its inflow mainly comes from snowmelt, the reservoir does not receive a high level of contaminants, and water quality in Hell Hole Reservoir is generally considered to be good. Therefore, under the Proposed Action Alternative, water quality changes in Hell Hole Reservoir would not occur.

Historically, water quality parameters for the Lower American River have typically been well within acceptable limits to achieve water quality objectives and beneficial uses identified for this waterbody (SWRCB 1998), and remain so today.

Folsom Reservoir

Because no decreases in reservoir storage would occur under the Proposed Action Alternative relative to the No Action Alternative, there would be no notable degradation to the water quality in Folsom Reservoir. Moreover, the increases in reservoir storage may provide a slight improvement to the water quality in Folsom Reservoir by increasing the dilution of contaminants.

Lower American River below Nimbus Dam

Under the Proposed Action Alternative there would be no decrease in flows along the Lower American River below Nimbus Dam, relative to the No Action Alternative. Because no decreases in flows would occur under the proposed water transfer, there would be no change to the water quality in the Lower American River below Nimbus Dam. Moreover, the increases in flows may provide slightly better water quality in the Lower American River by increasing the dilution of contaminants.

Sacramento River

Flows on the Lower Sacramento River (below the confluence with the Lower American River) would not change significantly under the Proposed Action Alternative, relative to the No Action Alternative. Since inflows from the American River provide a slightly better quality, the implementation of the Proposed Action Alternative relative to the No Action Alternative is not expected to affect water quality in the Sacramento River.

Sacramento-San Joaquin Delta Inflows and Export Pumping

Currently the SWRCB D-1641 requires the implementation of the 2006 Bay-Delta Water Quality Control Plan, in which DWR and Reclamation are responsible for mitigating its water quality effects. Under the Proposed Action Alternative relative to the No Action Alternative, there would be no significant change to Delta inflows or export pumping during any of the months evaluated. Therefore, DWR and Reclamation's ability to meet the 2006 Bay-Delta Water Quality Control Plan objectives would not be compromised. No changes to water quality are expected to occur as a result of the Proposed Action Alternative relative to the No Action Alternative.

San Luis Reservoir

Under the Proposed Action Alternative, San Luis Reservoir storage would not change significantly relative to the No Action Alternative. Therefore, the concentration of contaminants in San Luis Reservoir could diminish under the Proposed Action Alternative relative to the No Action Alternative. (Reclamation, WWD and HDR/SWRI Inc. 2008.)

3.4 Biology

3.4.1 Affected Environment

Fisheries and Aquatic Resources

Species of primary management concern include those that are recreationally or commercially important (fall-run Chinook salmon [Oncorhynchus tshawytscha], steelhead [Oncorhynchus mykiss], American shad [Alosa sapidissima], and striped bass [Morone saxatilis]); Federal- and/or State-listed species within the Action Area (winter- and spring-run Chinook salmon, steelhead, delta smelt [Hypomesus transpacificus], and green sturgeon [Acipenser medirostris]); and State species of special concern (late fall-run Chinook salmon, green sturgeon, hardhead [*Mylopharodon conocephalus*], longfin smelt [*Spirinchus thaleichthys*], river lamprey [*Lamptera ayresi*], Sacramento perch [*Archoplites interruptu*], Sacramento splittail [*Pogonichthys macrolepidotus*], and California roach [*Hesperoleucus symmetricus*]).

Special emphasis is placed on these species of primary management concern to facilitate compliance with the State and Federal ESAs. This focus is consistent with: (1) CALFED's 2000 Ecosystem Restoration Program Plan (ERPP) and Multi-Species Conservation Strategy (MSCS); (2) the programmatic determinations for the CALFED program, which include CDFW's Natural Community Conservation Planning Act (NCCPA) approval and the 2009 NMFS, 2008 USFW; (3) USFWS's 1997 Draft Anadromous Fish Restoration Program (AFRP), which identifies specific actions to protect anadromous salmonids; (4) CDFW's 1996 Steelhead Restoration and Management Plan for California, which identifies specific actions to protect steelhead; and (5) CDFW's Restoring Central Valley Streams, A Plan for Action (1993), which identifies specific actions to protect salmonids.

Evaluating potential impacts on fishery resources within the Action Area requires an understanding of fish species' life histories and life stage-specific environmental requirements. Time periods associated with individual species life stages are derived from a combination of literature review and analyses of survey data. Appendix A contains detailed accounts for the special-status fish species in the Action Area. (Reclamation, WWD and HDR/SWRI Inc. 2008.)

Terrestrial and Riparian Resources

This section describes the existing conditions of terrestrial and riparian resources and consists of identification of communities and associated special-status plant and wildlife species with the potential to occur in the Action Area.

Middle Fork and North Fork American Rivers

Habitats associated with this area include montane woodland and forests (mixed conifer and oak), montane riparian, upland scrub, urban-agriculture, montane riverine aquatic, and non-tidal freshwater permanent emergent wetlands. Montane woodlands and forests are predominantly ponderosa pine (*Pinus ponderosa*) forests. At least 238 species of birds, 47 mammals, 10 amphibians, and 20 species of reptiles are supported by the American River Canyon ecosystem and its habitats.

French Meadows and Hell Hole Reservoirs

Higher elevations along the Middle Fork American River display montane woodlands and forests (mixed conifer (*Pinus* spp. and *Pseudotsuga menziesii*), oak (*Quercus* spp.), and montane hardwoods). These zones are essentially devoid of vegetation and therefore, do not provide valuable plant communities or animal habitats.

Folsom Reservoir and Lake Natoma

Habitats associated with Folsom Reservoir include non-native grassland, blue oak-pine woodland, and mixed oak woodland. Oak-pine woodlands and non-native grasslands in the reservoir area support a variety of birds. A number of raptor species also utilize oak woodland habitats for nesting, foraging, and roosting. Many mammal species occur in the woodland. Amphibians and reptiles are found in oak woodlands. The primary vegetation around Lake Natoma consists of cottonwoods, poison oak, and wild grape (*Vitis californica*). Wildlife communities found at Lake Natoma are similar to those found at Folsom Reservoir. Federal and state listed and proposed candidate species of the area include the valley elderberry longhorn beetle, California red-legged frog, mountain yellow-legged frog, pallid bat, northwestern pond turtle, giant garter snake, tricolored blackbird, bald eagle, California black rail, purple martin, Boggs Lake hedge-hyssop and Stanford's arrowhead.

Lower American River

The lower American River provides a diverse assemblage of vegetation communities, including freshwater marsh and emergent wetland, riparian scrub, riparian forest, and in the upper, drier areas farther away from the river, oak woodland and non-native grassland. More than 220 species of birds have been recorded along the lower American River and more than 60 species are known to nest in the riparian habitats (USFWS 1991). Additionally, more than 30 species of mammals reside along the river. The most common reptiles and amphibians that depend on the riparian habitats along the river include western toad (*Bufo boreas*), Pacific tree frog (*Hyla regilla*), bullfrog (*Rana catesbeiana*), western pond turtle (*Clemmys marmorata*), western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), and gopher snake (*Pituophis catenifer*).

Sacramento River

Agricultural land (rice, dry grains, pastures, orchards, vineyards, and row and truck crops) is common along the lower reaches of the Sacramento River. Mammals such as river otters and muskrats utilize riverine habitats for foraging and cover. Many amphibians and some reptiles (e.g., western pond turtles) inhabit riverine habitats for at least part of their life cycles. The freshwater/emergent wetlands represent habitat for many wildlife species, including reptiles and amphibians such as the western pond turtle, bullfrog, and Pacific tree frog. Agricultural areas adjacent to the river also represent foraging habitat for many raptor species.

Wildlife refuges along the Sacramento River provide habitat for resident and migratory waterfowl, threatened and endangered species, and wetland dependent aquatic biota. These refuges include the Sacramento, Colusa, Sutter, and Delevan National Wildlife Refuges (NWRs) and Gray Lodge Wildlife Management Area (WMA). Water supplies for certain wildlife refuges within the Central Valley are administered through CVPIA programs that acquire and convey water.

Sacramento-San Joaquin Delta

Most of the vegetation in the Delta consists of irrigated agricultural fields and associated ruderal (disturbed) non-native vegetation fringes that border cultivated fields. Throughout much of the Delta, these areas border the levees of various sloughs, channels, and other waterways within the historic floodplain. Native habitats include remnant riparian vegetation that persists in some areas, with brackish and freshwater marshes also being present. The remaining areas of emergent marsh provide important habitat for many resident and migratory species. Specific species of this area that are federal and state listed as well as proposed candidates include the valley elderberry longhorn beetle, California red-legged frog, northwestern pond turtle, giant garter snake, tricolored blackbird, Swainson's hawk, northern harrier and the Mason's lilaeopsis.

San Luis Reservoir

Riparian vegetation along the shoreline of San Luis Reservoir likely would remain in an early successional stage under normal operating conditions because the fluctuation of the water surface elevation (reportedly 100 feet or more) either inundates the vegetation for extended periods or desiccates the vegetation for extended periods during the dry season. Federal and state listed and proposed candidate species of the area include the valley elderberry longhorn beetle, California

red-legged frog, Northwestern pond turtle, giant garter snake, northern goshawk, tricolored blackbird, Swainson's hawk and the northern harrier, (Reclamation, WWD and HDR/SWRI Inc. 2008.)

3.4.2 Environmental Consequences

No Action

The No Action Alternative will have no increase in flows in the summer months of 2013 in the rivers or added coldwater benefits in Folsom Reservoir.

Proposed Action

The analysis of the potential effects on fisheries and aquatic resources associated with the action alternatives was based on criteria specific for reservoirs, rivers and the Sacramento-San Joaquin Delta. Refer to Appendix A for a detailed analysis of the potential effects the proposed action would have on fisheries.

Flows under the proposed action would not fluctuate beyond existing minimum and maximum ranges. Furthermore, the amount of water being transferred would not increase the magnitude of the velocity and flow above the peaking levels. Therefore, the proposed action would not adversely affect biological resources. In addition, the anticipated 20,000 AF increase to Folsom Reservoir by June 1, 2013, from the North Fork American River may benefit the coldwater fishery habitat in the reservoir.

3.5 Agriculture

3.5.1 Affected Environment

Land use in the Action Area along the Sacramento River and downstream is primarily of an agricultural nature (e.g., livestock grazing, irrigated crop production, and orchard and vineyard operations). Almost 80 percent of the irrigated land in California is located in the Central Valley. Water deliveries for agriculture average about 22.5 million acre-feet per year, with the CVP providing about 25 percent, the SWP about 10 percent, local surface water rights about 30 percent, and groundwater about 35 percent. Farmers in irrigation districts that receive CVP supplies also use other supplies such as groundwater. Use of non-CVP sources varies annually because of changes in weather and crop market conditions (Reclamation Website 2008).

Likewise, the land use within WWD is predominantly agriculture, with approximately 600,000 acres of farmland within Fresno and Kings Counties. Farmers within WWD produce a variety of over 60 types of high quality food and fiber. Table 1 shows the amount of acres of each crop grown within WWD in 2012.

Table 1: Westlands Water District 2012 Crop Data

Crop	Acres	Crop	Acres	Crop	Acres	Crop	Acres
Alfalfa-Hay	7,178	Celery	13	Lettuce-Spring	6,853	Prunes	148
Alfalfa-Seed	1,252	Cherries	831	Lettuce-Fall	9,000	Pumpkins	15
Almonds	82,366	Corn-Field	1,089	Nectarines	386	Safflower	1,179
Apples	110	Corn-Sweet	8,911	Nursery	338	Seed Crop	644
Apricots	696	Cotton-Acala	7,487	Oats	1,122	Spinach	389

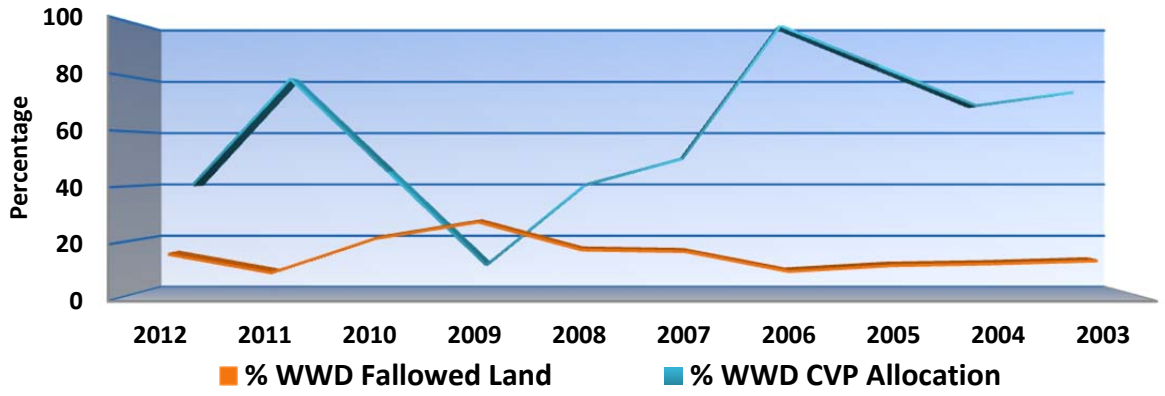
Artichokes	5	Cotton-Pima	65,950	Onions-Dehy	8,323	Squish	95
Asparagus	592	Flowers	40	Onions-Fresh	7,077	Stevia	56
Barley	8,659	Garlic	12,685	Oranges	1,872	Sugar Beets	1
Beans-Dry	1,188	Grain-Hay	117	Parsley	1,041	Tangerines	1,165
Beans-Garbanzo	3,915	Grains-Sorghum	198	Pasture	442	Tomatoes-Fresh	3,865
Beans-Green	33	Grapefruit	20	Peaches	1,119	Tomatoes-Proc	79,246
Beans-Jojoba	47	Grapes-Raisin	770	Peas	133	Walnuts	447
Blueberries	199	Grapes-Table	836	Peppers	1,433	Watermelons	2,466
Broccoli	2,452	Grapes-Wine	14,480	Pistachios	39,228	Wheat	74,497
Cantaloupes	13,185	Honeydew	4,244	Plums	401	Fallow	90,781
Carrots	532	Lemons	406	Pomegranates	3,375		
						Total	**577,623**

3.5.2 Environmental Consequences

No Action

Under the No Action alternative the PCWA water would not be available to WWD and would cause land to be put out of production. As shown in Figure 1, the amount of water supply available to customers within WWD directly affects the amount of land that is productive. Without the Proposed Action Alternative, agricultural land use would be affected by a lack of water supply.

Figure 4: WWD Fallowed Land vs. CVP Allocation



Proposed Action

The Proposed Action Alternative would provide an additional water supply to agricultural lands in WWD, which would allow lands to be productive rather than fallow. WWD is anticipating

that 100,000 to 150,000 acres will be fallowed in 2013 due to the 20% water allocation. Therefore, the Proposed Action Alternative relative to the No Action Alternative would be a beneficial effect.

The additional water provided in the Proposed Action would be used for agriculture and therefore would not generate any population growth or cause any existing land uses to be converted.

3.6 Cumulative Impacts

Cumulative impacts are defined in Council on Environmental Quality Regulations (40 CFR 1508.7 and 1508.25) as follows:

"Cumulative impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The Proposed Action would only occur within the timeframe specified. The Proposed Action, along with other water transfers, do not contribute to adverse increases or decreases in environmental conditions. Overall, there would be no adverse cumulative impacts caused by the Proposed Action and other water transfers because of the use of existing conveyance and storage facilities that will not exceed their existing capacities.

Section 4 Consultation and Coordination

4.1 Public Review Period

Reclamation intends to sign a Finding of No Significant Impact for this project, and will make the environmental assessment available for public comment. All comments will be addressed in the Finding of No Significant Impact. Additional analysis will be prepared if substantive comments identify impacts that were not previously analyzed or considered.

4.2 Endangered Species Act (16 USC § 1531 et seq.)

Section 7 of the ESA requires Federal agencies, in consultation with the Secretary of the Interior, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species.

The Proposed Action is consistent with: (1) CALFED's 2000 Ecosystem Restoration Program Plan (ERPP) and Multi-Species Conservation Strategy (MSCS); (2) the programmatic determinations for the CALFED program, which include CDFW's Natural Community Conservation Planning Act (NCCPA) approval and the 2009 NMFS, 2008 USFW; (3) USFWS's 1997 Draft Anadromous Fish Restoration Program (AFRP), which identifies specific actions to protect anadromous salmonids; (4) CDFW's 1996 Steelhead Restoration and Management Plan for California, which identifies specific actions to protect steelhead; and (5) CDFW's Restoring Central Valley Streams, A Plan for Action (1993), which identifies specific actions to protect salmonids.

4.3 Persons and agencies consulted during preparation of this EA

- Westlands Water District
- Placer County Water Agency
- Bureau of Reclamation

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Appendix A: Fisheries and Aquatic Resources

Appendix A: Fisheries and Aquatic Resources

This section describes the affected environment related to fisheries and aquatic resources in water bodies that may be influenced by implementation of the proposed temporary water transfer to WWD. The following sections describe the aquatic habitats and fish populations within the North Fork and Middle Fork American rivers, lower American River, Sacramento River, and the Delta.

Life histories and life stage-specific environmental considerations for several species may differ slightly among the water bodies. Any differences are noted in the discussions of the individual water bodies. If there are not any noted differences, the species life history and general environmental considerations are assumed to be identical to the general discussions in the following section.

Species of primary management concern include those that are recreationally or commercially important (fall-run Chinook salmon [*Oncorhynchus tshawytscha*], steelhead [Oncorhynchus mykiss], American shad [*Alosa sapidissima*], and striped bass [*Morone saxatilis*]); Federal- and/or State-listed species within the Action Area (winter- and spring-run Chinook salmon, steelhead, delta smelt [*Hypomesus transpacificus*], and green sturgeon [*Acipenser medirostris*]); and State species of special concern (late fall-run Chinook salmon,[1] green sturgeon, hardhead [*Mylopharodon conocephalus*], longfin smelt [*Spirinchus thaleichthys*], river lamprey [*Lamptera ayresi*], Sacramento perch [*Archoplites interruptu*], Sacramento splittail [*Pogonichthys macrolepidotus*], and California roach [*Hesperoleucus symmetricus*]). **Table A-1** presents the special-status fish species that could occur within the Action Area, their regulatory status, and the water body where each species is anticipated to occur.

[1] NMFS recognizes the late-fall-run Chinook salmon in the Central Valley fall-run ESU (Moyle 2002). On April 15, 2004, NMFS published a notice in the Federal Register acknowledging establishment of a species of concern list, addition of species to the species of concern list, description of factors for identifying species of concern, and revision of the candidate species list. In this notice, NMFS announced the Central Valley fall-run and late fall-run Chinook salmon ESU change in status from a candidate species to a species of concern. In 1999, the Central Valley ESU underwent a status review after NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under the ESA, but sufficient concerns remained to justify addition to the candidate species list. Therefore, according to NMFS' April 15, 2004 interpretation of the ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

Table A-1. Special-Status Fish Species within the Action Area

Common Name	Scientific Name	Status*	Location
Central Valley fall-/late fall-run Chinook salmon	Oncorhynchus tshawytscha	CSC	Lower American River, Sacramento River, and the Delta
Central Valley spring-run Chinook salmon	Oncorhynchus tshawytscha	T, ST	Lower American River, Sacramento River, and the Delta
Central Valley winter-run Chinook salmon	Oncorhynchus tshawytscha	E, SE	Sacramento River and the Delta
Central Valley steelhead	Oncorhynchus mykiss	T	Lower American River, Sacramento River, and the Delta
Delta smelt	Hypomesus transpacificus	T, ST	Delta
Southern Distinct Population Segment of North American green sturgeon	Acipenser medirostris	T, CSC	Sacramento River and the Delta
Hardhead	Mylopharodon conocephalus	CSC	Lower American River and Sacramento River
Longfin smelt	Spirinchus thaleichthys	CSC	Delta
River lamprey	Lampetra ayresi	CSC	Lower American River, Sacramento River,and the Delta
Sacramento perch	Archoplites interruptus	CSC	Sacramento River and the Delta
Sacramento splittail	Pogonichthys macrolepidotus	CSC	Lower American River, Sacramento River, and the Delta
California roach	Hesperoleucus symmetricus	CSC	Lower American River and Sacramento River

*Status Key:	
E = Endangered	Officially listed (in the Federal Register) as being endangered
T = Threatened	Federally listed as likely to become endangered within the foreseeable future
SE = State Endangered	State listed as endangered
ST = State Threatened	State listed as likely to become endangered
CSC = State Species of Special Concern	CDFW species of special concern

Special emphasis is placed on these species of primary management concern to facilitate compliance with applicable laws, particularly the State and Federal ESAs, and NMFS and USFWS BOs. This focus is consistent with: (1) CALFED's 2000 Ecosystem Restoration Program Plan (ERPP) and Multi-Species Conservation Strategy (MSCS); (2) the programmatic determinations for the CALFED program, which include CDFW's Natural Community Conservation Planning Act (NCCPA) approval and the programmatic BOs issued by NMFS and USFWS; (3) USFWS's 1997 Draft Anadromous Fish Restoration Program (AFRP), which identifies specific actions to protect anadromous salmonids; (4) CDFW's 1996 Steelhead Restoration and Management Plan for California, which identifies specific actions to protect

steelhead; and (5) CDFW's Restoring Central Valley Streams, A Plan for Action (1993), which identifies specific actions to protect salmonids. Improvement of habitat conditions for these species of primary management concern could protect or enhance conditions for other fish resources, including native resident species.

Evaluating potential impacts on fishery resources within the Action Area requires an understanding of fish species' life histories and life stage-specific environmental requirements. General information is provided below regarding life histories of fish species of primary management concern occurring within the study area. Time periods associated with individual species life stages are derived from a combination of literature review and analyses of survey data.

Environmental Setting

Middle Fork and North Fork American Rivers

The Middle Fork American River supports coldwater fish species year-round. The primary sport species in the Middle Fork American River are resident rainbow and brown trout (*Oncorhynchus mykiss* and *Salmo trutta*) (PCWA 2001). In addition to rainbow and brown trout, fish sampling surveys of the Middle Fork American River conducted by the USFWS in 1989 from Ralston Afterbay downstream to the confluence with the North Fork American River, documented the presence of hitch (*Lavinia exilicauda*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), and riffle sculpin (*Cottus gulosus*) (Corps 1991). No special-status fish species are reported to occur in the Middle Fork American River.

Brown trout are resident stream fish, spending their entire life cycle in fresh water. Spawning generally occurs during November and December in California. Brown trout fry typically hatch in seven to eight weeks, depending on water temperature, with emergence of young three to six weeks later (Moyle 2002). Optimal riverine habitat for brown trout reportedly consists of cool to coldwater, silt-free rocky substrate, an approximate 1:1 pool-to-riffle ratio, and relatively stable water flow and temperature regimes (Raleigh et al. 1986). Moyle (2002) reported that while brown trout will survive for short periods at temperatures in excess of 82.4°F to 84.2°F (28C to 29°C), optimum temperatures for growth range from 62.6°F to 64.4°F (17°C to 18°C). Brown trout tend to utilize lower reaches of low to moderate gradient areas (less than one percent) in suitable, high gradient rivers (Raleigh et al. 1986).

Warmwater species generally have wider thermal tolerance ranges and generally broader habitat preferences than salmonids and other coldwater species. Specifically, warmwater species such as Sacramento pikeminnow and Sacramento sucker typically are found together in low- to mid-elevation streams and rivers with deep pools, long runs, undercut banks, and overhanging vegetation. They generally live in waters with summer water temperatures of approximately 59°F to 64.4°F (15°C to 18°C), to 82.4°F to 86°F (28°C to 30°C) (Moyle 2002). Many other warmwater species including a variety of minnow and bass species exhibit similarly wide ranges within their habitat and thermal requirements.

Little information is available on fish populations in the Middle Fork American River below Oxbow Reservoir. Trout production has been suggested to be relatively low because of large daily fluctuations in flow associated with hydroelectric peaking operations at Oxbow Powerhouse (PCWA 2001). The current FERC license for the MFP provides that the Oxbow

Power Plant releases to the Middle Fork American River shall not cause vertical fluctuations in stream stages (measured in a representative section) greater than one foot per hour. However, such fluctuations have the potential to affect stream productivity, especially during periods when flows would otherwise be fairly stable (i.e., summer and early fall).

Hydropower peaking operations can adversely affect stream communities because of unstable habitat conditions in which benthic algae, invertebrates, and fish are frequently subjected to exposure, stranding, and/or displacement from preferred habitats. Stranding and isolation of aquatic organisms from the flowing portion of the stream can lead to increased mortality due to exposure to direct solar radiation, elevated water temperatures, low dissolved oxygen, and predation (PCWA 2001).

Downstream of its confluence with the Middle Fork American River, the North Fork American River supports warmwater fish species year-round. These species include smallmouth bass (*Micropterus dolomieu*), Sacramento pikeminnow, Sacramento sucker, riffle sculpin, brown bullhead (*Ictalurus nebulosus*), and green sunfish (*Lepomis cyanellus*). Although some rainbow and brown trout are present, summer and fall water temperatures are generally too warm for significant spawning and early-life stage rearing of trout. The majority of trout that do occur in the North Fork American River below the confluence with the Middle Fork American River are believed to be transitory downstream adult and/or sub-adult migrants that have dispersed into the area from upstream habitats (i.e., Middle Fork American River). No special-status fish species are reported to occur in the North Fork American River.

There is little available information on fish populations and benthic macroinvertebrate communities in this reach of the North Fork American River. However, aquatic habitat requirements for cold and warmwater fish species are similar to those previously described for the Middle Fork American River.

French Meadows Reservoir

French Meadows Reservoir supports coldwater recreational fisheries for resident rainbow and brown trout, sustained largely by annual stocking of catchable trout. CDFW stocks French Meadows Reservoir with rainbow and brown trout during June and July. The reservoir also supports a self-sustaining population of brown trout that migrates from the reservoir to spawning areas in the Middle Fork American River above the reservoir during the fall. No physical barriers to brown trout migration are present in the Middle Fork American River within two miles above the reservoir during the fall. Fish production in the reservoir is believed to be limited by its high elevation, large seasonal fluctuations in water levels, and low productivity compared to natural lakes (Jones and Stokes 2001).

For general public information, CDFW lists on their website, Fisheries Program Branch California Fisheries Information (CDFW 2003), that the prevalent sport fish species are rainbow and brown trout. The website also suggests that warmwater species such as largemouth bass, sunfish and catfish also may be present in French Meadows Reservoir.

Hell Hole Reservoir

Hell Hole Reservoir is a mid-elevation, oligotrophic Sierra Nevada reservoir (having elevations of approximately 5,000 feet above mean sea level [msl]) that supports coldwater recreational fisheries for resident rainbow and brown trout. CDFW stocks Hell Hole Reservoir with resident rainbow and brown trout once a year. Hell Hole Reservoir may also support lake trout and Kokanee salmon populations. Warmwater fisheries also exist, including smallmouth bass, catfish, and sunfish. Fish production in the reservoir is believed to be limited by large seasonal fluctuations in water levels and low productivity compared to natural lakes (Jones and Stokes 2001).

Middle Fork Interbay Reservoir

The Middle Fork Interbay Reservoir is located between the Hell Hole-Middle Fork Tunnel and the Middle Fork-Ralston Tunnel. Fish assemblages found in the reservoir include some or all of the species known to occur in the Middle Fork American River and the Rubicon River (e.g., rainbow and brown trout). The reservoir also may provide habitat for native nongame species and possibly overwintering habitat for trout (Jones and Stokes 2001). Cold and warmwater fisheries habitat utilization is expected to be similar to that found in other previously discussed waterbodies.

As a regulating afterbay, its monthly storage and elevation fluctuate significantly on a daily and hourly basis. Therefore, changes in releases from Hell Hole and French Meadows reservoirs would not affect monthly mean storage or elevation. Therefore, no quantitative discussion of potential storage- or elevation-related impacts to fishery resources in this water body is warranted.

Oxbow Reservoir

Fish assemblages found in Oxbow Reservoir include some or all of the species known to occur in the Middle Fork American River and the Rubicon River (e.g., rainbow and brown trout). The reservoir may provide habitat for native nongame species and possibly overwintering habitat for trout (Jones and Stokes 2001). Cold and warmwater fisheries habitat utilization is expected to be similar to that found in other previously discussed waterbodies.

Lower American River

At least 43 species of fish have been reported to occur in the lower American River system, including numerous resident native and introduced species, as well as several anadromous species. Although each fish species fulfills an ecological niche, several species are of primary management concern either as a result of their declining status or because of their importance as a recreational and/or commercial fishery. Steelhead is listed as "threatened" under the Federal ESA. Current recreationally and/or commercially important anadromous species include fall-run Chinook salmon, steelhead, striped bass, American shad, and Sacramento splittail.

Currently, the river supports a mixed run of hatchery and naturally produced fish. From 1967 through 1991 (the AFRP restoration goal baseline period), lower American River fall-run Chinook salmon spawning comprised approximately 21 percent (i.e., 41,040 fish) of the total fall-run Chinook salmon spawning (i.e., 197,740 fish) in the Sacramento Valley river system, including the Sacramento River and its tributary rivers and creeks.

The lower American River currently provides spawning and rearing habitat for fall-run Chinook salmon and steelhead below Nimbus Dam. The majority of the steelhead run is believed to be of hatchery origin. However, with the exception of an emergency release during January of 1997 resulting from poor water quality caused by flooding, no steelhead have been stocked directly into the lower American River since 1990 (Barngrover 1997).

Special-status[2] fish species within the lower American River include Central Valley steelhead, spring-run Chinook salmon, and fall-run/late-fall-run Chinook salmon. Central Valley steelhead are listed as a threatened species under the Federal ESA and have no State ESA or CDFW status. The lower 10 miles of the American River has been designated as critical habitat for spring-run Chinook salmon. Fall-run/late fall-run Chinook salmon[3] is a Federal species of concern, and late fall-run Chinook salmon is considered a State species of special concern. Chinook salmon also is a federally managed fish species under the MSFCMA. Recreationally and/or commercially important anadromous species include fall-run Chinook salmon, steelhead, striped bass, and American shad. A variety of centrarchid species including black bass also are recreationally important.

Folsom Reservoir

Folsom Reservoir has a maximum storage capacity of approximately 977,000 AF, and has a maximum depth of approximately 266 feet (streambed elevation at the main dam is about 200 feet). Strong thermal stratification occurs within Folsom Reservoir annually between April and November. Thermal stratification establishes a warm surface water layer (epilimnion), a middle water layer characterized by decreasing water temperature with increasing depth (metalimnion or thermocline), and a bottom, coldwater layer (hypolimnion) within the reservoir. In terms of aquatic habitat, the warm epilimnion of Folsom Reservoir provides habitat for warmwater fishes, whereas the reservoir's lower metalimnion and hypolimnion form a "coldwater pool" that provides habitat for coldwater fish species throughout the summer and fall portions of the year. Hence, Folsom Reservoir supports a "two-story" fishery during the stratified portion of the year (April through November), with warmwater species using the upper, warmwater layer and coldwater species using the deeper, colder portion of the reservoir.

Native species that occur in the reservoir include hardhead (*Mylopharodon conocephalus*) and Sacramento pikeminnow. However, introduced largemouth bass (*Micropterus salmoides*), smallmouth bass, spotted bass (*Micropterus punctulatus*), bluegill (*Lepomis macrochirus*), black and white crappie (*Pomoxis nigromaculatus* and *P. annularis*), and catfish (*Ictalurus* spp. and

[2] Special-status fish species are those having designated critical habitat and/or are listed, proposed for listing, or candidate species under the Federal or State Endangered Species Acts, a managed species under the MSFCMA, and/or a Federal or State species of concern.

[3] NMFS recognizes the late-fall-run Chinook salmon in the Central Valley fall-run Evolutionarily Significant Unit (ESU) (Moyle 2002). On April 15, 2004, NMFS published a notice in the Federal Register acknowledging establishment of a species of concern list, addition of species to the species of concern list, description of factors for identifying species of concern, and revision of the candidate species list. In this notice, NMFS announced the Central Valley Fall-run and Late Fall-run Chinook Salmon ESU change in status from a candidate species to a species of concern. In 1999, the Central Valley ESU underwent a status review after NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under the ESA, but sufficient concerns remained to justify addition to the candidate species list. Therefore, according to NMFS' April 15, 2004 interpretation of the ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

Ameiurus spp.) constitute the primary warmwater sport fisheries of Folsom Reservoir. The coldwater sport species present in the reservoir include rainbow and brown trout, kokanee salmon (*Oncorhynchus nerka*), and Chinook salmon, all of which are currently or have been stocked by CDFW. Although brown trout are no longer stocked, a population still remains in the reservoir. Because these coldwater salmonid species are stream spawners, they do not reproduce within Folsom Reservoir. However some spawning by one or more of these species may occur in the North Fork American River upstream of Folsom Reservoir.

Folsom Reservoir's coldwater pool is important not only to the reservoir's coldwater fish species identified above, but also is important to lower American River fall-run Chinook salmon and Central Valley steelhead. Seasonal releases from the reservoir's coldwater pool provide thermal conditions in the lower American River that support annual in-river production of these salmonid species. However, Folsom Reservoir's coldwater pool is not large enough to facilitate coldwater releases during the warmest months (July through September) to provide maximum thermal benefits to over-summering juvenile steelhead rearing in the lower American River, and coldwater releases during October and November that would maximally benefit fall-run Chinook salmon immigration, spawning, and embryo incubation. Consequently, management of the reservoir's coldwater pool on an annual basis is essential to providing thermal benefits to both fall-run Chinook salmon and steelhead, within the constraints of coldwater pool availability.

Lake Natoma

Lake Natoma supports many of the same fisheries found in Folsom Reservoir (rainbow trout, bass, sunfish, and catfish). Some recruitment of warmwater and coldwater fishes likely comes from Folsom Reservoir. In addition, CDFW stocks Lake Natoma with catchable-sized rainbow trout annually. Although supporting many of the same fish species found in Folsom Reservoir, Lake Natoma's limited primary and secondary production, colder epilimnetic water temperatures (relative to Folsom Reservoir), and daily elevation fluctuations are believed to reduce the size and annual production of many of its fish populations, relative to Folsom Reservoir (USFWS 1991). Lake Natoma's characteristics, coupled with limited public access, result in its lower angler use compared to Folsom Reservoir.

Lake Natoma was constructed to serve as a regulating afterbay for Folsom Reservoir and is located at an elevation of 132 feet above msl. Despite its size (an operating range of 2,800 AF), Lake Natoma can influence the temperature of water flowing through it. High residence times in the lake, particularly during summer months, have a warming effect on water released from Folsom Reservoir. Water is released from Lake Natoma into the lower American River below Nimbus Dam.

Nimbus Fish Hatchery

CDFW, under contract with Reclamation, operates the Nimbus Salmon and Steelhead Hatchery and the American River Trout Hatchery, which produce anadromous fall-run Chinook salmon and steelhead, and non-anadromous rainbow trout, respectively. Both of these hatcheries are located at the same facility immediately downstream of Nimbus Dam. Each year, nearly four million salmon produced by the Nimbus Hatchery are trucked and released into the Sacramento River-San Joaquin Estuary. Steelhead are released into the Sacramento River at either Miller Park or Garcia Bend. Trout are stocked in numerous water bodies throughout the region.

The Nimbus Hatchery receives water for its operations directly from Lake Natoma via a 60-inch-diameter pipeline. Water temperatures in the hatchery are dictated by the temperature of water diverted from Lake Natoma, which in turn, is primarily dependent upon several factors including the temperature of water released from Folsom Reservoir, ambient air temperature, and retention time in Lake Natoma. The temperature of water diverted from Lake Natoma for hatchery operations is frequently higher than that which is generally desired for hatchery production of salmonids. Under such conditions, more suitable water temperatures may be achieved by increasing releases at Folsom Dam and/or releasing colder water from a lower elevation within Folsom Reservoir. However, seasonal releases from Folsom Reservoir's limited coldwater pool to benefit hatchery operations must be considered in conjunction with seasonal in-river benefits from such releases.

Sacramento River

The lower Sacramento River is generally defined as the portion of the river from Princeton to the Delta at approximately Chipps Island (near Pittsburg). The lower Sacramento River is predominantly channelized, leveed and bordered by agricultural lands. Aquatic habitat in the lower Sacramento River is characterized primarily by slow-water glides and pools, is depositional in nature, and has lower water clarity and habitat diversity, relative to the upper portion of the river.

Many of the fish species utilizing the upper Sacramento River also use the lower river to some degree, even if only as a migratory pathway to and from upstream spawning and rearing grounds. For example, adult Chinook salmon and steelhead primarily use the lower Sacramento River as an immigration route to upstream spawning habitats and an emigration route to the Delta. The lower river also is used by other fish species (e.g., Sacramento splittail and striped bass) that make little to no use of the upper river (upstream of RM 163). Overall, fish species composition in the lower portion of the Sacramento River is quite similar to that of the upper Sacramento River and includes resident and anadromous cold- and warmwater species. Many fish species that spawn in the Sacramento River and its tributaries depend on river flows to carry their larval and juvenile life stages to downstream nursery habitats. Native and introduced warmwater fish species primarily use the lower river for spawning and rearing, with juvenile anadromous fish species also using the lower river and non-natal tributaries, to some degree, for rearing.

Over 30 species of fish are known to use the Sacramento River. Of these, a number of both native and introduced species are anadromous. These species include Chinook salmon, steelhead, green and white sturgeon, striped bass and American shad. The majority of adult immigration into the Sacramento River and the subsequent period of holding occurs from December through July for winter-run Chinook salmon (Moyle 2002; USFWS 1995), from February through September for spring-run Chinook salmon (CDFW 1998; Lindley et al. 2004; Moyle 2002) from July through December for fall-run Chinook salmon (NMFS 2004; Snider et al. 1999; Vogel and Marine 1991), from October through April for late fall-run Chinook salmon (Moyle 2002), and from August through March for steelhead (McEwan 2001; NMFS 2004).

Most winter-run sized Chinook salmon fry and juveniles collected in a rotary screw trap located at RM 205 have been captured from July through April (pers. comm., Coulon 2004). However,

NMFS (1993; 1997) reports juvenile rearing and outmigration extending from June through April. CDFW (1998) and Moyle (2002) report that spring-run Chinook salmon juveniles rear and move downstream year-round in the Sacramento River. Moyle (2002) and Vogel and Marine (1991) report that the majority of the juvenile rearing and downstream movement life stage occur from December through June for fall-run Chinook salmon and April through December for late fall-run Chinook salmon. McEwan (2001) reports that steelhead fry and fingerlings rear and move downstream in the Sacramento River year-round. Most steelhead smolts reportedly emigrate from January through June (McEwan 2001; Newcomb and Coon 2001; Snider and Titus 2000a; USFWS 1995a). Other Sacramento River fishes are considered resident species, which complete their lifecycles entirely within freshwater, often in a localized area. Resident species include rainbow and brown trout, largemouth and smallmouth bass, channel catfish, sculpin, Sacramento pikeminnow, Sacramento sucker, hardhead, and common carp (Moyle 2002).

Adult striped bass are present in the Sacramento River throughout the year, with peak abundance occurring during the spring months (i.e., April through June) (CDFW 1971; DeHaven 1977; DeHaven 1978). In the Sacramento River, most striped bass spawning is believed to occur between Colusa and the mouth of the Feather River.

The Yolo and Sutter bypasses, floodwater bypasses from the Sacramento River, serve as important Sacramento splittail spawning and early rearing habitat (Sommer et al. 1997). Sacramento splittail spawning can occur anytime between late February and early July but peak spawning occurs in March and April (Moyle 2002). A gradual upstream migration begins in the winter months to forage and spawn, although some spawning activity has been observed in Suisun Marsh (Moyle 2002). Eggs normally incubate for three to seven days depending on water temperature (Moyle 2002). After hatching, splittail larvae remain in shallow weedy areas until water recedes, and they migrate downstream (Meng and Moyle 1995). Downstream movement of juvenile splittail appears to coincide with drainage from the floodplains between May and July (Caywood 1974; Meng and Moyle 1995; Sommer et al. 1997).

Sacramento–San Joaquin Delta

The Sacramento-San Joaquin Delta, the most upstream portion of the Bay-Delta estuary, is a triangle-shaped area composed of islands, river channels, and sloughs at the confluence of the Sacramento and San Joaquin rivers. The northern Delta is dominated by the waters of the Sacramento River, which are of relatively low salinity; whereas the relatively higher salinity waters of the San Joaquin River dominate the southern Delta. The central Delta includes many channels where waters from the Sacramento and San Joaquin rivers and their tributaries converge. The Delta includes the river channels and sloughs at the confluence of the Sacramento and San Joaquin rivers.

The Delta's tidally influenced channels and sloughs cover a surface area of approximately 75 square miles. Data suggest that these intertidal waters favor a number of resident freshwater fish and invertebrate species at the deepest, most subsided sites. Marsh plains and tidal channels formed within these intertidal regions continuously drain and fill with the ocean tide allowing movement of fishes, in addition to primary and secondary production, inshore and offshore. Therefore, tidal action may be important for pelagic organisms as inundation allows increased foraging success and opportunity resulting from the larger abundance of phytoplankton and zooplankton inshore. Intertidal habitats may also provide reduced predation for young fishes

(Brown 2003). These waters may also be used as migration corridors and rearing areas for anadromous fish species and as spawning and rearing grounds for many estuarine species. Similarly to intertidal regions, shallow-water habitats, defined as areas that are less than three meters in depth (mean low water), are considered particularly important forage, reproduction, rearing, and refuge areas for numerous fish and invertebrate species.

The Bay-Delta estuary provides habitat for a diverse assemblage of fish and macroinvertebrates. Many of the fish and macroinvertebrate species inhabit the estuary year-round, while other species inhabit the system on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing.

There have been over 100 documented introductions of exotic species to the Bay-Delta estuary. These include intentionally introduced game fishes such as striped bass and American shad, and inadvertent introductions of undesirable organisms such as Asiatic clams. **Table A-2** presents common and scientific names for all known native and exotic fish species found in the Delta, including species no longer present.

Table A-2. Fishes of the Sacramento-San Joaquin Delta

Common Name	Scientific Name	Life History	Status
Pacific lamprey*	Lampetra tridentata	A	Declining
River lamprey*	Lampetra ayresi	A	SC
White sturgeon*	Acipenser transmontanus	A	Declining; fishery
Green sturgeon*	Acipenser medirostris	A	SC; FT
American shad	Alosa sapidissima	A	Fishery
Threadfin shad	Dorosoma petenense	A	Common
Steelhead*	Oncorhynchus mykiss	A	SC; FT; fishery
Brown Trout	Salmo trutta	R	Non-native
Chum salmon*	*Oncorhynchus keta*	A	SC; rare
Kokanee salmon	*Oncorhynchus nerka*	R	Non-native
Chinook salmon*	*Oncorhynchus tshawytscha*	A	Fishery
Sacramento fall-run			Fishery
late fall-run			SC
winter-run			FE, SE
spring-run			ST; FT
Longfin smelt*	Spirinchus thaleichthys	A-R	SC
Delta smelt*	Hypomesus transpacificus	R	FT,ST
Wakasagi	Hypomesus nipponensis	R?	Invading
Hitch*	Lavinia exilicauda	R	Unknown

Common Name	Scientific Name	Life History	Status
Sacramento blackfish*	Orthodon microlepidotus	R	Unknown
Sacramento splittail*	Pogonichthys macrolepidotus	R	SC
Hardhead*	Mylopharodon conocephalus	N	SC
Speckled dace	Rhinichthys osculus	R	SC
California roach	Lavinia symmetricus	R	SC
Sacramento pikeminnow*	Ptychocheilus grandis	R	Common
Fathead minnow	Pimephales promelas	N	Rare
Golden shiner	Notemigonus crysoleucas	R?	Uncommon
Common carp	Cyprinus carpio	R	Common
Goldfish	Carassius auratus	R	Uncommon
Sacramento sucker*	Catostomus occidentalis	R	Common
Black bullhead	Ameiurus melas	R	Common
Brown bullhead	Ameiurus nebulosus	R	Uncommon
White catfish	Ameiurus catus	R	Abundant
Channel catfish	Ictalurus punctatus	R	Common
Western mosquitofish	Gambusia affinis	R	Abundant
Striped bass	Morone saxatilis	R-A	Abundant
Inland silverside	Menidia beryllina	R	Abundant
Sacramento perch*	Archoplites interruptus	N	SC
Bluegill	Lepomis macrochirus	R	Common
Redear sunfish	Lepomis microlophus	R	Uncommon
Green sunfish	Lepomis cyanellus	R	Uncommon
Warmouth	Lepomis gulosus	R	Uncommon
White crappie	Pomoxis annularis	R	Common
Black crappie	Pomoxis nigromaculatus	R	Uncommon
Largemouth bass	Micropterus salmoides	R	Common
Smallmouth bass	Micropterus dolomieu	R	Uncommon
Redeye bass	Micropterus coosae	R	Non-native
Spotted Bass	Micropterus punctulatus	R	Non-native
Bigscale logperch	Percina macrolepida	R	Common
Yellow perch	Perca flavescens	N	Rare
Tule perch*	Hysterocarpus traski	R	Common

Common Name	Scientific Name	Life History	Status
Threespine stickleback*	Gasterosteus aculeatus	R	Common
Yellowfin goby	Acanthogobius flavimanus	R	Common
Chameleon goby	Tridentiger trigonocephalus	R	Invading
Staghorn sculpin*	Leptocottus armatus	M	Common
Prickly sculpin*	Cottus asper	R	Abundant
Starry flounder*	Platichthys stellatus	M	Common

Source: Modified from (USFWS, 1994 as cited in SDIP (Reclamation and DWR 2005)

An asterisk (*) indicates a native species; A = anadromous; R = resident; N = non-resident visitor; M = marine; SC = species of special concern; FT = Federal threatened; ST = State threatened; FE = Federal endangered; SE = State endangered

Migratory (e.g., anadromous) fish species which inhabit the Bay-Delta system and its tributaries include, but are not limited to, white sturgeon, green sturgeon, Chinook salmon (including fall-run, spring-run, winter-run, and late-fall-run Chinook salmon), steelhead, American shad, Pacific lamprey, and river lamprey (Moyle 2002). The Bay-Delta estuary and tributaries also support a diverse community of resident fish which includes, but is not limited to, Sacramento sucker, prickly and riffle sculpin, California roach, hardhead, hitch, Sacramento blackfish, Sacramento pikeminnow, speckled dace, Sacramento splittail, tule perch, inland silverside, black crappie, bluegill, green sunfish, largemouth bass, smallmouth bass, white crappie, threadfin shad, carp, golden shiner, black and brown bullhead, channel catfish, white catfish, and a variety of other species which inhabit the more estuarine and freshwater portions of the Bay-Delta system (Moyle 2002).

The geographic distribution of species within the estuary is determined, in part, by salinity gradients, which range from freshwater within the Sacramento and San Joaquin River systems to marine conditions near the Golden Gate Bridge. The abundance, distribution, and habitat use by these fish and macroinvertebrates has been monitored over a number of years through investigations conducted by CDFW, NMFS, USFWS, Reclamation, and several other investigators. Results of these monitoring programs have shown changes in species composition and abundance within the system over the past several decades. Many of the fish and macroinvertebrate species have experienced generally declining trends in abundance (Moyle et al. 1995) with several native species, including winter-run and spring-run Chinook salmon, steelhead, and delta smelt either listed or being considered for listing under the Federal ESA or State ESA. A number of fish and macroinvertebrate species inhabiting the estuary also support recreational and commercial fisheries, such as fall-run Chinook salmon, Bay shrimp, Pacific herring, northern anchovy, starry flounder, striped bass, largemouth bass, sturgeon, and many others, and hence the estuary also has been identified as essential fish habitat (EFH) for many of these species.

Many factors have contributed to the decline of fish species within the Delta (Moyle et al. 1995), including changes in hydrologic patterns resulting from water project operations, loss of habitat, contaminant input, entrainment in diversions, and introduction of non-native species. The Delta is a network of channels through which water, nutrients, and aquatic food resources are moved and mixed by tidal action. Pumps and siphons divert water for Delta irrigation and municipal and industrial use or into CVP and SWP canals. River inflow, Delta Cross Channel operations, and diversions (including agricultural and municipal diversions and export pumping) affect Delta species through changes in habitat conditions (e.g., salinity intrusion), and mortality attributable to entrainment in diversions. Since 2002, routine fish surveys have registered sharp declines in several pelagic (open-water) species, including the delta smelt, a species listed as a threatened species under the Federal and State Endangered Species Acts.

Interagency Ecological Program (IEP) surveys also have observed record low abundances for striped bass, and near record lows for longfin shad and threadfin shad (IEP 2007). Subsequent surveys in 2006 and 2007 have confirmed this trend, raising concerns that the delta smelt, which is seen as an indicator of ecosystem health in the Delta, risks extinction if a solution is not found quickly (Public Policy Institute of California 2007). Several hypotheses have been put forward to potentially explain the reason behind the recent changes in Delta conditions and species declines, and multiple factors are currently being investigated by a combination of Federal, State, and academic researchers.

Tracy Fish Collection Facility

Fish salvage facilities at the Jones Pumping Plant are composed of a system of primary and secondary louvers (Brown and Greene 1992 *as cited in* DWR and Reclamation 1996a). Four bypasses placed equidistantly along the screen face direct fish from the primary louvers to a secondary set of louvers, where they are concentrated and bypassed to holding tanks. Salvaged fish are periodically transferred by truck to a release point in the Delta.

The pumps at Jones Pumping Plant are usually operated continuously, and because water is drawn directly from the Delta, pumping is subject to tidal influence, causing variation in channel velocity and approach velocities to fish screens (Brown and Greene 1992 *as cited in* DWR and Reclamation 1996a). In 1998, Reclamation published a report concerning fish collections and secondary louver efficiency from October 1993 to September 1995 at the Tracy Fish Collecting Facility (TFCF). The objectives of this study were to identify the fish populations moving through the secondary louvers and into the fish holding tanks (as a percent compared to the number of fish entering the channel), in addition to evaluating the efficiency of the secondary louvers relative to environmental and operational parameters. During the evaluation only two delta smelt were caught, while splittail was the species most routinely observed. The report concluded that the entrainment susceptibilities of several species are largely dependent on seasonal variation, suggesting that life history is associated with screen entrainment at the TFCF for species such as splittail and Chinook salmon. The mean efficiency for Chinook salmon was found to be 83 percent, the efficiency for white catfish to be 89 percent, the efficiency for splittail to be 63 percent, and the efficiency for striped bass to be 86 percent. However, screen efficiency may be lower since the facilities reconstruction (Reclamation 1998). Entrainment for American shad was most likely to occur during May through December when young American shad were moving downstream. In addition, American shad are two or more times more likely to move through the louvers during the day than at night. CDFW conducted efficiency tests on the

primary louver system, which revealed that striped bass longer than 24 mm were effectively screened and bypassed. Similar results were observed for striped bass by Reclamation with an average screened fork length of 116 mm. However, planktonic eggs, larvae, and juveniles less than 24 mm in length received no protection from entrainment (Hallock et al. 1968 *as cited in* DWR and Reclamation 1996a). The tests also indicated that juvenile Chinook salmon would be effectively screened because they would be greater than 24 mm in length by the time they were exposed to the screens and pumps. Screening efficiency for delta smelt has yet to be determined.

John E. Skinner Fish Facility

The John E. Skinner Fish Facility includes primary and secondary louvers (screens) designed to guide fish to bypass and salvage facilities before they are drawn into the Banks Pumping Plant (Brown and Greene, 1992 *as cited in* (DWR and Reclamation 1996a). The primary fish screens are composed of a series of V-shaped bays containing louver systems resembling Venetian blinds that act as a behavioral barrier to fish. The secondary fish screen is a perforated plate, positive-pressure screen, which removes fish greater than about 20 mm in length. Salvaged fish are transported in trucks to one of several Delta release sites. Despite recent improvements in salvage operations, survival of species that are more sensitive to handling, such as delta smelt, is believed to be low (DWR and Reclamation 1994 *as cited in* (DWR and Reclamation 1996a).

The fish screening and salvage facilities began operating in 1968. In the early 1970s, CDFW and DWR initiated extensive evaluations of the facility that have led to improved performance and reduced fish losses. Most of this effort focused on fall-run Chinook salmon, striped bass, and American shad.

DWR conducts daily fish monitoring and fish salvage operations at the SWP Skinner Fish Facility. As part of the monitoring program at the Skinner Fish Facility, operations are monitored and information recorded on water velocities that affect louver guidance efficiency for various species and life stages of fish, species composition, the occurrence of coded-wire tag (CWT) and other marked fish released as part of experimental investigations, the length-frequency distribution for various species, and other information used to evaluate and monitor fish salvage operations. Fish entering the salvage facilities are subsampled, identified and measured, and subsequently returned to the Delta through a trucking and release operation. The numbers of various fish species salvaged at the SWP Skinner Fish Facility and CVP Tracy Fish Facility show high variability on a seasonal basis and between years, reflecting variation in both the life history characteristics of many of the species and their vulnerability to salvage at the facility.

In general, the majority of juvenile Chinook salmon (primarily fall-run Chinook salmon) are observed in salvage operations during the late winter and early spring (February through May), although juvenile salmonids are also observed during the late fall and winter (November through January), which may include yearling spring-run and fall-run salmon, late-fall-run salmon smolts, and pre-smolt winter-run juvenile salmon. Steelhead are primarily observed in salvage during the spring months (March and April), which is consistent with the general seasonal timing for steelhead smolt out migration. Striped bass are observed in salvage operations throughout the year, with the majority of juvenile striped bass occurring during the summer months (May through July). Similarly, delta smelt are observed in the salvage operations throughout the year,

with the majority of juvenile delta smelt occurring during the late spring and early summer (May through July). Larger sub-adult and adult delta smelt are typically observed in the salvage operation more predominantly during the fall, winter, and early spring. Longfin smelt are primarily observed in the salvage operations during the spring (March through May) as juveniles, although larger sub-adult longfin smelt are also observed in the salvage operations during the fall. Sacramento splittail are also observed in salvage operations throughout the year, although the majority of splittail (young-of-the-year) occur during the spring and early summer (March through July). A variety of other resident and migratory fish species are also collected as part of both CVP and SWP salvage operations.

Combined Downstream Effects of the CVP and SWP Facilities

Local effects of the CVP facilities on fish, such as export losses and Cross Channel and Georgiana Slough diversions, are included in the above discussions of the facilities. In addition to these effects, the CVP facilities also influence downstream habitat conditions. These conditions include Delta outflow, salinity levels in the western Delta and the bays, the location of X2, and the levels of flow reversals in the lower San Joaquin River.

Delta Outflow

Water development has changed the volume and timing of freshwater flows through the Bay-Delta estuary. Each year, diversions reduce the volume of fresh water that otherwise would flow through the estuary (CALFED 2000). During this century, the volume of the estuary's fresh water supply that has been depleted each year by upstream diversions, in-Delta use, and Delta exports have grown from about 1,500,000 AF to nearly 16,000,000 AF. As a result, the proportion of Delta outflow depleted by upstream and Delta diversions has grown substantially.

Water development has also greatly altered seasonal flows into and through the estuary. Flows have decreased substantially in April, May, and June and have increased slightly during the summer and fall (USEPA 1992). Seasonal flows influence the transport of eggs and young organisms through the Delta and into San Francisco Bay. Flows during the months of April, May, and June play an especially important role in the reproductive success and survival of many estuarine species including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983; Stevens et al. 1985; Herbold 1994; Meng and Moyle 1995).

Salinity

In many segments of the estuary, and particularly in Suisun Bay and the Delta, salinity is controlled primarily by freshwater flow. By altering the timing and volume of flows, water development has affected salinity patterns in the Delta and parts of San Francisco Bay (SFEP 1992 as cited *in* DWR and Reclamation 1996a).

Under natural conditions, the Carquinez Strait/Suisun Bay area marked the approximate boundary between salt and fresh water in the estuary during much of the year. In the late summer and fall of drier years, when Delta outflow was minimal, seawater moved into the Delta from San Francisco Bay. Beginning in the 1920s, following several dry years and because of increased upstream storage and diversions, salinity intrusions became more frequent and extensive.

Since the 1940s, releases of fresh water from upstream storage facilities have increased Delta outflows during summer and fall. These flows have correspondingly limited the extent of salinity intrusion into the Delta. Reservoir releases have helped to ensure that the salinity of water diverted from the Delta is acceptable during the summer and late fall for farming, municipal, and industrial uses (SFEP 1992 *as cited in* DWR and Reclamation 1996a).

Salinity is an important habitat factor in the estuary. Estuarine species characteristically have optimal salinity ranges, and their survival may be affected by the amount of available habitat within the species' optimal salinity range. Because the salinity field in the estuary is largely controlled by freshwater outflows, the level of outflow may determine the surface area of optimal salinity habitat that is available to the species (Hieb and Baxter 1993; Unger 1994).

Entrapment Zone Location and X2

The entrapment zone is an area of the estuary characterized by higher levels of particulates, higher abundances of several types of organisms, and maximal turbidity. It is commonly associated with the position of the 2 ppt salinity isopleth (X2), but actually occurs over a broader range of salinities (Kimmerer 1992). Originally, the primary mechanism responsible for this area was thought to be gravitational circulation, a circulation pattern formed when freshwater flows seaward over a dense, landward-flowing marine tidal current. However, recent studies have shown that gravitational circulation does not occur in the entrapment zone in all years, nor is it always associated with X2 (Reclamation et al. 1995 *as cited in* DWR and Reclamation 1996a). Lateral circulation within the estuary and chemical flocculation may play roles in the formation of the turbidity maximum of the entrapment zone.

As a consequence of higher levels of particulates, the entrapment zone may be biologically significant to some species. Mixing and circulation in this zone concentrates plankton and other organic material, thus increasing food biomass and production. Larval fish such as striped bass, delta smelt, and longfin smelt may benefit from enhanced food resources. Since about 1987, however, the introduced Asian clam population has reduced much of the primary production in the estuary and there has been virtually no enhancement of phytoplankton production or biomass in the entrapment zone (CUWA 1994 *as cited in* DWR and Reclamation 1996a).

Although little to no enhancement of the base of the food chain in the entrapment zone may have occurred during the past decade, this area continues to have relatively high levels of invertebrates and larval fish. Vertical migration of these organisms through the water column at different parts of the tidal cycle has been proposed as a possible mechanism that is maintaining high abundances in this area, but recent evidence suggests that vertical migration does not provide a complete explanation (Kimmerer 1992).

Although recent evidence indicates that X2 and the entrapment zone are not as closely related as previously believed (Reclamation et al. 1995; DWR and Reclamation 1996a), X2 continues to be used as an index of the location of the entrapment zone or area of increased biological productivity. Historically, the location of X2 has varied between San Pablo Bay (RK 50) during high Delta outflow and Rio Vista (RK 100) during low Delta outflow. In recent years, it has typically been located between approximately Honker Bay and Sherman Island (River km 70 to 85). X2 is controlled directly by the rate of Delta outflow, although changes in X2 lag behind

changes in outflow. Minor modifications in outflow do not greatly alter the X2 location. The location of X2 during the late winter through spring (February through June) is included as a water quality objective in the 1995 Bay/Delta Water Quality Control Plan.

Jassby et al. (1995) showed that when X2 is in the vicinity of Suisun Bay, several estuarine organisms tend to show increased abundances. However, it is by no means certain that X2 has a direct effect on any of the species. The observed correlations may result from a close relationship between X2 and other factors that affect these species.

San Luis Reservoir

San Luis Reservoir provides habitat for both coldwater and warmwater fish species which include largemouth bass, striped bass, crappie, bluegill, bullhead catfish, shad, yellow perch and occasional white sturgeon (California State Parks Website 2003). Fish production in San Luis Reservoir is generally limited by changes in water elevations during critical spawning periods, overall reservoir levels, and the availability of shallow near-shore rearing habitat. Stocking by CDFW keeps the reservoir well supplied with trout. Bass fishing derbies are often held here, and crappie and bluegill are also caught.

Regulatory Setting

Federal Endangered Species Act

The ESA requires that both USFWS and NMFS maintain lists of threatened species and endangered species. An "endangered species" is defined as "…any species which is in danger of extinction throughout all or a significant portion of its range." A "threatened species" is defined as"…any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 USC 1532). Section 9 of the ESA makes it illegal to "take" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) any endangered species of fish or wildlife, and regulations contain similar provisions for most threatened species of fish and wildlife (16 USC 1538).

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each Federal agency must consult with USFWS or NMFS, or both, if the Federal agency determines that its action might impact a listed species. NMFS jurisdiction under the ESA is limited to the protection of marine mammals and fishes and anadromous fishes; all other species are within USFWS jurisdiction.

Critical Habitat

Critical habitat for listed species consists of (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of Section 4 of the Endangered Species Act, on which are found those physical or biological features (constituent elements0 (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provision of Section 4 of the Act, upon a determination by the Secretary of the Department of the Interior that such areas are essential for the conservation of the species.

Essential Fish Habitat

Section 305(b)(2) of the 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) added a provision for Federal agencies to consult with National Marine Fisheries Service (NMFS) on impacts to EFH. EFH only applies to Chinook salmon habitat that includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding, or growing to maturity. Consultation on any activity that might adversely affect EFH is required by NMFS under the MSFCMA, as amended by the Sustainable Fisheries Act of 1996. EFH includes all habitats necessary to allow the production of commercially valuable aquatic species, to support a long-term sustainable fishery, and contribute to a healthy ecosystem.

Central Valley Project Improvement Act and Anadromous Fish Restoration Program

The CVPIA (Title 34 of P.L. 102-575) amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water. It also elevates fish and wildlife enhancement to a level having equal purpose with power generation.

The CVPIA identifies several goals to meet these new purposes. Significant among these is the broad goal of restoring natural populations of anadromous fish, green and white sturgeon American shad, and striped bass in Central Valley rivers and streams to double their recent average levels.

Section 3406(b)(1) jointly imparted the responsibilities of implementing the CVPIA to the USFWS and Reclamation, although the USFWS has assumed the lead role in the development of the AFRP. The Final Restoration Plan for the AFRP was adopted on January 9, 2001 and will be used to guide the long-term development of the AFRP. Additionally, under USFWS direction, technical teams have assisted in the establishment of components of the AFRP. A key element of the program is instream flow recommendations, including objectives for the lower American River and upper Sacramento River.

Long-Term Central Valley Project and State Water Project Operations Criteria and Plan

The Long-Term CVP and SWP OCAP serves as the operational standard by which Reclamation operates the integrated CVP/SWP system. The OCAP describes how Reclamation and DWR operate the CVP and the SWP to divert, store, and convey water consistent with applicable law (Reclamation 2004). Reclamation and DWR completed an update to the OCAP in 2004 to reflect recent operational and environmental changes occurring throughout the CVP/SWP system. The terms and conditions identified in the current USFWS and NMFS BOs establish the instream habitat conditions and operational requirements that Reclamation and DWR must maintain as part of integrated CVP/SWP operations.

CALFED Bay-Delta Program

The CALFED Program is a collaborative effort of 23 Federal and State agencies focusing on restoring the ecological health of the Bay-Delta Estuary while ensuring water quality improvements and water supply reliability to all users of the Bay-Delta water resources (CALFED 2000b). The CALFED Program includes a range of balanced actions that can be taken forward to a comprehensive, multi-agency approach to managing Bay-Delta resources. The Bay-Delta watershed includes the Sacramento and San Joaquin rivers and tributaries (e.g., Feather and lower American rivers).

Environmental Water Account

The Environmental Water Account (EWA), as described in the CALFED ROD, is a key component of CALFED's water management strategy. Created to address the problems of declining fish populations and water supply reliability, the EWA is an adaptive management tool that aims to protect both fish and water users as it modifies water project operations in the Bay-Delta. The EWA provides water for the protection and recovery of fish beyond that which would be available through the existing baseline of regulatory protection related to project operations. The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers and releases it as needed to protect fish and compensate water users for deferred diversions (USFWS 2004b).

To date, EWA actions taken to benefit at-risk native fish species range from CVP/SWP export pumping curtailments, which directly reduce incidental take at the CVP and SWP pumps in the South Delta, to augmenting instream flows and Delta outflows. Beneficial changes in SWP and CVP operations could include changing the timing of water exports from Delta pumping plants to coincide with periods of greater or lesser vulnerability of various fish species to environmental conditions in the Delta. For example, EWA or its functional equivalent might alter the timing of water diversions from the Delta and carry out water transfers to reduce fish entrainment at the pumps and provide for migratory cues for specific anadromous fish species.

Potential Effects

Reservoirs

To evaluate the potential effects of the proposed water transfer on reservoir fisheries, seasonal changes in storage under the No Action Alternative (i.e., without transfer) and the action alternatives (i.e., with transfer) conditions was examined. The values for reservoir end-of-month storage at French Meadows and Hell Hole reservoirs were determined from the PG&E monthly operations forecast. End-of-month storage at Folsom, Shasta, and San Luis reservoirs under the No Action Alternative was obtained from Reclamation's operations forecast. Differences in end of month storages between the action alternatives and the No Action Alternative were used to evaluate the potential for reduced physical habitat availability and coldwater pool volume in Action Area reservoirs. Also, using reservoir specific area–capacity curves, estimates for storage changes were translated into relative changes in water surface evaluations. The estimated values for changes in water surface elevations were used to examine the potential for increases in the frequency of warmwater fish nest-dewatering events.

Cold Water Fisheries

During the period when Action Area reservoirs are thermally stratified (generally April to November), coldwater fish in the reservoir reside primarily within the reservoir's metalimnion (middle of the reservoir) and hypolimnion (near bottom) where water temperatures remain suitable. Reduced reservoir storage during this period could reduce the reservoir's coldwater pool volume, thereby reducing the quantity of habitat available to coldwater fish species during these months. Reservoir coldwater pool size generally decreases as reservoir storage decreases, although not always in direct proportion because of the influence of reservoir basin morphomentry. Therefore, to assess potential storage-related effects to coldwater fish habitat availability in French Meadows, Hell Hole, Folsom, Shasta and San Luis reservoirs, end-of-month storage for each reservoir under the action alternatives was compared to end-of-month storage under the No Action Alternative for each month of the April to November period. Substantial reductions in reservoir storage were considered to result in substantial reductions in coldwater pool volume and, therefore, habitat availability for coldwater fish.

The criteria used to evaluate potential effects to the coldwater fisheries in Action Area reservoirs are as follows:

Decrease in reservoir storage, which also would reduce the coldwater pool, relative to the No Action Alternative, of sufficient magnitude or duration to adversely affect coldwater fish during the April to November period.

Warmwater Fisheries

Because warmwater fish species in reservoirs (including black bass, largemouth bass, smallmouth bass, spotted bass, green sunfish, crappie, and catfish) use the warm upper layer of the reservoirs and nearshore littoral habitats throughout most of the year, seasonal changes in reservoir storage, as it affects reservoir water surface elevation (feet msl), and the rates at which water surface elevation change during specific periods of the year, can directly affect the reservoir's warmwater fish resources. Reduced water surface elevations can potentially reduce the availability of nearshore littoral habitats used by warmwater fish for rearing, thereby potentially reducing rearing success and subsequent year-class strength. In addition, decreases in reservoir water surface elevation during the primary spawning period for warmwater fish nest building may result in reduced initial year-class strength through warmwater fish nest "dewatering."

Given the differences in geography and altitude among the reservoirs within the Action Area, warmwater fish spawning and rearing periods vary somewhat among reservoirs. Although black bass spawning may begin as early as February, or as late as May, in various California reservoirs, and may possibly extend to July in some waters, the majority of black bass and other centrarchid spawning in California occurs from March through May (Lee 1999; Moyle 2002). However, given the geographical and altitudinal variation among the Action Area reservoirs, in order to examine the potential of nest dewatering events to occur, the warmwater fish-spawning period is assumed to extend from March through June. Additionally, to encompass all reservoirs included in the Action Area, the period of April through November is appropriate for assessing effects on warmwater juvenile fish rearing.

Review of the available literature suggests that, on average, self-sustaining black bass populations in North America experience a nest success (i.e., the nest produces swim-up fry) rate of 60 percent (Friesen 1998; Goff 1986; Hunt and Annett 2002; Hurley 1975; Knotek and Orth 1998; Kramer and Smith 1962; Latta 1956; Lukas and Orth 1995; Neves 1975; Philipp et al. 1997; Raffetto et al. 1990; Ridgway and Shuter 1994; Steinhart 2004; Turner and MacCrimmon 1970). A study by CDFW, which examined the relationship between reservoir water surface elevation fluctuation rates and nesting success for black bass, suggests that a reduction rate of approximately six feet per month or greater would result in 60 percent nest success for largemouth bass and smallmouth bass (Lee 1999). Therefore, a decrease in reservoir water surface elevation of six feet or more per month is selected as the threshold beyond which spawning success of nest-building, warmwater fish could potentially result in population declines.

To evaluate potential effects on largemouth bass, smallmouth bass, and ultimately warmwater fish in general, the frequency of occurrence of month-to-month (March through June) reservoir reductions of six feet or more under the action alternatives relative to the No Action Alternative was examined.

The criteria used to evaluate potential effects on the warmwater fisheries in Action Area reservoirs are as follows:

Additional decreases in month-to-month reservoir water surface elevations of more than six feet per month, under the action alternatives relative to the No Action Alternative, of sufficient frequency to reduce warmwater fish spawning success over the March through June extended spawning period.

Additional decreases in water surface elevations of sufficient magnitude from April through November to appreciably reduce the availability of nearshore littoral habitats used by warmwater fish for rearing, thereby potentially reducing rearing success and subsequent year-class strength of warmwater juvenile fish rearing under the action alternatives relative to the No Action Alternative.

Rivers

Instream flow and water temperature are important parameters related to the production and condition of aquatic resources in riverine environments. Instream flow, and the magnitude and duration of flow fluctuation events, may affect fish populations, particularly salmonid populations, by determining the amount of available habitat or altering the timing of life history events (e.g., spawning). Rapid changes in flow have the potential to affect the survival of eggs and alevins by exposing redds, and rapidly receding flow conditions may strand juveniles in pools and side channels or on beach substrates where desiccation, rapidly increasing water temperature, and predation may affect overall survival. In addition, water temperatures influence metabolic, physiologic, and behavioral patterns, as well as fecundity and overall spawning success of fish populations (SWRI 2003).

The general criteria used to evaluate potential effects to fisheries and other aquatic resources in the Action Area rivers are as follows:

Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce the habitat

suitability of river fisheries and aquatic resources, or result in redd dewatering or juvenile stranding.

In the lower American and Sacramento rivers, evaluation of potential effects resulting from changes in river flows and water temperature under the action alternatives relative to the No Action Alternative focused on the species of primary management concern (e.g., anadromous salmonids and green sturgeon). Because anadromous salmonids (i.e., winter-run Chinook salmon, spring-run Chinook salmon, fall/late fall-run Chinook salmon, and steelhead) are known to use the lower American River and Sacramento Rivers during discrete time periods associated with specific lifestages, potential effects were evaluated using species-specific assessment parameters, where appropriate.

The effects analysis focused on determining potential effects to anadromous salmonids because their life history requirements are generally more restrictive than those of other fish species found in the rivers. Thus, if anadromous salmonids are not affected by the action alternatives relative to the No Action Alternative, it is unlikely that other, less sensitive fish species (e.g., splittail, American shad and striped bass) would be affected. The criteria used to evaluate potential effects on anadromous salmonids in the lower American and Sacramento rivers are as follows:

Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to notably reduce the suitability of habitat conditions during adult immigration.

Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce spawning habitat availability and incubation.

Decrease in flow and associated decrease in stage, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to notably increase redd dewatering or juvenile stranding.

Decrease in flow or increase in water temperature, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce the suitability of habitat conditions during juvenile rearing.

In the Sacramento River, similar considerations were included in the effects assessment for green sturgeon.

Sacramento-San Joaquin Delta

Hydrological evaluation provides the technical foundation for assessing effects of CVP operations on fish species and their habitat within the Delta. The assessment relies on a comparative analysis of changes in Delta parameters under action alternatives relative to the No Action Alternative, using Reclamation's forecasted operations for 2013. The potential for CVP operations associated with the action alternatives to affect Delta fisheries resources is examined by: (1) modifying habitat quality and availability for various fish species within the Delta; and (2) altering fish mortality resulting from CVP export pumping operations from the south Delta.

The hydrological evaluation provides monthly data that is used as part of a general evaluation of potential effects of project operations on habitat quality and availability for various fish and aquatic resources inhabiting the Bay-Delta estuary. The results also can be used to estimate potential fish salvage, based upon historical estimates of fish density at CVP salvage facilities, for use as part of this effect assessment. Evaluation parameters selected for part of this evaluation include:

- Location of the two-part per thousand salinity isohaline (X2);
- Delta outflow;
- E/I ratio; and
- Fish salvage at the Tracy and Skinner fish facilities

The USFWS, CDFW, NMFS, and others have established biological relationships based upon results of fisheries investigations conducted for use in evaluating the biological effects of changes in many of the habitat-related parameters that could be affected by implementation of the action alternatives relative to the No Action Alternative. However, biological relationships have not been established for some of the indices, such as the E/I ratio. Hence, findings of the effects assessment are based on a combination of established biological relationships, the best available scientific information on the life history periodicities and habitat requirements for various species, regulatory requirements, and the results of the hydrologic evaluation.

Sacramento-San Joaquin Delta X2 Location

The SWRCB D-1641 requires the X2 location to meet certain objectives from February through June. The location of X2 within Suisun Bay during the February through June period is thought to be directly or indirectly related to the reproductive success and survival of the early life stages for several estuarine species. Results of statistical regression analysis suggest that abundances of several estuarine species are greater during the spring when the location of X2 is within the western portion of Suisun Bay (e.g., Roe Island [River Kilometer (RKm) 64]), with lower abundances correlated with those years when the location of X2 location is farther to the east near the confluence (RKm 81) of the Sacramento and San Joaquin rivers (YCWA *et al.* 2003). A location of X2 near Chipps Island (RKm 74) could result in a distribution pattern where more estuarine species would be susceptible to entrainment and elevated mortality in the central and south Delta due to predation or relatively high water temperatures. The standards related to the location of X2 in the Bay-Delta Plan and SWRCB D-1641 also are intended to protect Delta resources by providing adequate transport flows to move Delta fisheries away from the influence of the CVP (and SWP) water diversion facilities into low-salinity rearing habitat in Suisun Bay and the lower Sacramento River (USFWS 2004).

Although the Bay-Delta Plan water quality objectives and SWRCB D-1641 requirements contain X2 objectives only for February through June, changes in monthly mean X2 locations are evaluated in this EA for all months of each year because the Delta provides year-round habitat for one or more life stages of various species.

The February through July period encompasses the peak delta smelt spawning period, and delta smelt larvae and juveniles are reported to be vulnerable to entrainment and elevated water temperatures from March through July. Upstream movements of X2 can cause delta smelt to become more susceptible to entrainment in the south Delta during March through July, and expose them to potentially lethal water temperatures during June through July (USFWS 2004).

Because many fish and aquatic resources inhabit the Delta estuary year-round, while other species inhabit the estuary on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing, the Delta analysis in this EA considers all months of the year. Although there are similarities in life stage timing and species specific estuarine habitat utilization reported in the literature, there are variations in run-specific outmigration patterns for species such as Chinook salmon. Winter-run Chinook salmon primarily migrate through the Delta from December through April (Reclamation 2004). The emigration period for spring-run Chinook salmon extends from November through early May (NMFS 2004a). Hallock (1961) found that juvenile steelhead in the Sacramento River Basin migrate downstream during most months of the year, but the peak emigration period occurs in the spring (NMFS 2004a).

Sacramento-San Joaquin Delta Outflow

The Bay-Delta Plan also established Delta outflow objectives for all months of the year. The Bay-Delta Plan states that… "Delta outflow objectives are included for the protection of estuarine habitat for anadromous fishes and other estuarine-dependent species." Seasonal flows influence the transport of eggs and young organisms through the Delta and into San Francisco Bay. Flows during the months of April, May, and June play an especially important role in determining the reproductive success and survival of many estuarine species including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983; Stevens et al. 1985; Herbold 1994; Meng and Moyle 1995 as cited in (DWR and Reclamation 1996b)). For the February through June period, Delta outflow objectives are met by compliance with the X2 objective. Potential effects on delta smelt associated with changes in Delta outflow under the Project, relative to the bases of comparison, are assessed utilizing the X2 analyses.

Changes in Delta outflow may affect the availability and quality of estuarine habitat, particularly during the late winter and spring months, which are thought to be important for survival and growth of a variety of fish and aquatic resources. In addition, the length of time juvenile Chinook salmon spend in the lower rivers and the Delta varies depending on the outflow, the times of year the salmon migrate, and the development stages of the fish (Kjelson et al. 1982 in Reclamation 2004). Residence time tends to be shorter during periods of high flow relative to periods of low flow. Analyses in this document include examination of monthly changes in Delta outflow under the action alternatives relative to the No Action Alternative, using Reclamation's operational forecast for 2008 and 2009.

Sacramento-San Joaquin Delta Export-to-Inflow Ratio

The ratio between CVP and SWP exports and freshwater inflow to the Delta from the Sacramento and San Joaquin river systems (the E/I ratio) has been used to assess potential operational effects on Bay-Delta habitat conditions. Relationships between E/I ratios and resulting changes in biological response, such as abundance or geographic distribution, or increases in vulnerability to CVP and SWP salvage, have not been established. However, the framework for environmental analyses has typically assumed that a higher export rate relative to freshwater inflow, on a seasonal basis, the higher the probability of adverse effects on geographic distribution or salvage losses as a result of export operations. E/I ratio limits

specified in the Bay-Delta Plan and SWRCB D-1641 are intended to protect Delta fishes by limiting their susceptibility to entrainment and elevated mortality in the Delta.

Analyses in this EA include examination of monthly changes in E/I ratios under the action alternatives relative to the No Action Alternative.

Salvage at the CVP and SWP Export Facilities in the Sacramento-San Joaquin Delta

The CVP (and SWP) export facilities that pump water from the Delta can directly affect fish mortality in the Delta through entrainment and associated stresses. Salvage operations at the CVP and SWP facilities (i.e., Tracy and Skinner fish collection facilities) are performed to reduce the number of fish adversely affected by entrainment. Salvage estimates are defined as the number of fish entering a salvage facility, and salvaged fish are subsequently returned to the Delta through a trucking and release operation. Because the survival of species that are sensitive to handling is believed to be low for many fish species, increased salvage is potentially considered an adverse effect and decreased salvage is considered a beneficial effect on Delta fisheries resources.

Fish salvage operations are conducted daily at the Tracy and Skinner fish salvage facilities for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, striped bass, and delta smelt, as well as numerous other species. An expanded (or total) daily salvage estimate for each species is determined at each fish salvage facility using a sub-sampling protocol which considers: (1) species-specific sub-sampling salvage count; (2) length of the sub-sampling period; and (3) length of the total daily pumping period.

Consistent with Reclamation's OCAP Biological Assessment (BA), it is assumed that changes in salvage are directly proportional to changes in the amount of water pumped (i.e., doubling the amount of water exported doubles the number of fish salvaged). Hence, the changes in fish salvaged at the export facilities as a result of the action alternatives are estimated by multiplying the species-specific monthly salvage rate by the percent change in the volume of water pumped during a particular time period under the action alternatives, relative to the No Action Alternative. The resulting values indicate the addition or reduction of fish expected to be salvaged at the export facilities with implementation of the action alternatives, relative to the No Action Alternative.

Middle Fork and North Fork American Rivers

Operations of the MFP under existing conditions currently result in highly variable flows on a daily and weekly basis. The overall general increased discharge under the action alternatives, relative to the No Action Alternative, would result in a temporal increase in exposure to higher average daily flows, thus decreasing the amount of time that fish and other aquatic organisms are exposed to daily base flow conditions. The increased flow could enhance instream habitat conditions for rainbow and brown trout, a primary component of the coldwater fishery in the Middle Fork American River. Also, changes in the flow regime associated with the action alternatives related to the No Action Alternative could increase the forage base of fish species in the Middle Fork American River.

Periodic dewatering of the stream margins during hydroelectric peaking operations has been shown to limit the ability of aquatic invertebrates to colonize these areas and achieve the densities that occur in areas that are constantly submerged (Gislason 1985). Differences in flow regime may provide a partial explanation for somewhat higher aquatic invertebrate diversity

(taxa richness) in the control reaches where flows are relatively stable during the summer and fall. Aquatic invertebrates such as stoneflies, which may contribute to the forage base for fish, are more likely to successfully colonize and reproduce in an environment with more stable flow conditions.

Flows under the action alternatives would not fluctuate beyond existing minimum and maximum ranges. Therefore, no effects to aquatic macroinvertebrate habitat availability are anticipated, relative to the No Action Alternative. The increased flow releases under the action alternatives would not increase the magnitude of flows in the Middle Fork American River and therefore, would not affect benthic macroinvertebrate assemblages, relative to the No Action Alternative. Also, the magnitude or velocity of flow releases under the action alternatives would not increase above current peaking levels; therefore, there is no additional risk of potentially disrupting or displacing benthic macroinvertebrates or suitable habitat, relative to the No Action Alternative.

It is anticipated that the released water temperatures from Oxbow Powerhouse would not notably change with the implementation of the action alternatives relative to the No Action Alternative. Also, during fall and winter months in the foothill region of the Sierra Nevada, ambient climatic conditions strongly influence downstream water temperatures. Therefore, it is expected that water temperatures in the Middle Fork American River below Oxbow Powerhouse would not noticeably change with the implementation of the action alternatives, relative to the No Action Alternative.

Similar, but less observable changes in flow and water temperature would be expected to occur in the North Fork American River due to flow attenuation. Therefore, changes in flow and water temperature associated with the action Alternatives relative to the No Action Alternative would not result in appreciably effects to fisheries and aquatic resources in Middle Fork and North Fork American rivers.

French Meadows and Hell Hole Reservoir

Under the Proposed Action Alternative, storage at French Meadows and Hell Hole Reservoir would be reduced during May of 2013, relative to the No Action Alternative. Storage would decrease by up to 20,000 AF by June 1, 2013 based on information provided by PCWA. Under the No Action Alternative, the 2013 carryover storage is expected to be approximately 150,000 AF, and 130,000 AF under the Proposed Action Alternative. Examination of storage at French Meadow and Hell Hole Reservoir obtained from PCWA demonstrates that since 2008, end of December storage has ranged from 138,969 to 250,892 AF, and end of May storage has ranged from 238,137 to 338,324 AF. Under the Proposed Action Alternative, storage in French Meadow and Hell Hole Reservoir would remain near historical ranges, and above FERC minimum specified storage levels.

Coldwater Fisheries

Hell Hole Reservoir supports coldwater recreational fisheries for resident rainbow and brown trout, and may also support lake trout and Kokanee salmon populations. The anticipated decreases in reservoir storage would not be expected to notably affect the reservoir's coldwater fisheries because: (1) coldwater habitat would remain available within the reservoir during all months of the April through November period; (2) physical habitat availability would not be

substantively reduced; and (3) anticipated seasonal reductions in storage would not be expected to notably affect the primary prey species utilized by coldwater fishes. Therefore, changes in end-of-month storage under the Proposed Action Alternative relative to the No Action Alternative would not result in effects to coldwater fish resources in Hell Hole Reservoir.

Warmwater Fisheries

Warmwater fisheries also are reported to exist in Hell Hole Reservoir, including smallmouth bass, catfish, and sunfish. Fish production in the reservoir is believed to be limited by relatively cold water temperatures and large seasonal fluctuations in water levels and low productivity compared to natural lakes (Jones and Stokes 2001).

Storage differences would result in a different boundary condition for water surface elevation at which warmwater fish nest building would occur, and reductions during the warmwater fish spawning period itself would not be expected to occur with implementation of the Proposed Action Alternative relative to the No Action Alternative. Similarly, anticipated reductions in water surface elevations associated with the Proposed Action Alternative relative to the No Action Alternative would not be expected to be of sufficient magnitude or duration to notably affect the April through November availability of nearshore littoral habitats used by warmwater fish for rearing. Consequently, potential reductions in water surface elevations under the Proposed Action Alternative relative to the No Action Alternative would not be expected to appreciably affect the warmwater fisheries in Hell Hole Reservoir.

Lower American River

The total transfer release under the Proposed Action Alternative would be approximately 100 cfs higher during summer of 2013, than flows expected under the No Action Alternative on the lower American River below Nimbus Dam. Following is a discussion of potential effects to various fish species/life stages associated with these changes in flow.

In addition to flow, water temperature is an important consideration for the lower American River, particularly for fall-run Chinook salmon and steelhead. Seasonal releases from Folsom Reservoir's coldwater pool influence thermal conditions for the lower American River.

Folsom Reservoir's coldwater pool oftentimes is not large enough to allow for coldwater releases during the warmest months (i.e., July through September) to provide maximum thermal benefits to steelhead, and coldwater releases during October and November for fall-run Chinook salmon immigration, spawning, and incubation. With the addition of the 20,000 AF by June 1, 2013, an increase of the coldwater pool will occur. This will allow additional thermal benefits for immigration, spawning and incubation.

Adult Fall-run Chinook Salmon/Steelhead Immigration

Adult upstream immigration of fall-run Chinook salmon generally occurs from August through December, whereas steelhead adult immigration generally occurs from December into March, which includes the period of changes in flow released from Nimbus Dam associated with the Proposed Action Alternative relative to the No Action Alternative. The increased flow rates associated with the Proposed Action Alternative relative to the No Action Alternative in the lower American River below Nimbus Dam would not be expected to reduce the attraction of adults immigrating into the lower American River, nor be of sufficient magnitude to encourage additional straying into the lower American River. Although physical passage impediments are

not believed to occur in the lower American River, increased flows (100 cfs) associated with the Proposed Action Alternative have the potential to facilitate the upstream migration of adult fall-run Chinook salmon and steelhead.

It is anticipated that the released water temperatures from Nimbus Dam would not appreciably change with the implementation of the Proposed Action Alternative relative to the No Action Alternative. Therefore, it is expected that water temperatures in the lower American River would not noticeably change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

During the adult fall-run Chinook salmon and steelhead adult immigration periods potentially affected by the Proposed Action Alternative relative to the No Action Alternative, changes in river flow or water temperature of sufficient magnitude or duration would not occur in the lower American River to affect adult immigration.

Adult Fall-run Chinook Salmon Spawning and Egg Incubation

Fall-run Chinook salmon spawning in the lower American river generally occurs from October to December, which encompasses the period when flow changes could be expected under the Proposed Action Alternative relative to the No Action Alternative. Examination of the spawning habitat- flow relationships developed through 2-D modeling (USFWS 2003) indicate that fall-run Chinook salmon spawning habitat would slightly increase associated with the 100 cfs increase in flow under the Proposed Action Alternative relative to the No Action Alternative.

Also, the increase in inflow to Folsom Reservoir by June 1, 2013, under the Proposed Action Alternative relative to the No Action Alternative, is expected to increase the coldwater pool availability in Folsom Reservoir. It is anticipated that the boundary condition release water temperatures from Nimbus Dam would not notably change with the implementation of the Proposed Action Alternative relative to the No Action Alternative. Ambient climatic conditions strongly influence downstream water temperatures in the lower American River. Therefore, it is expected that water temperatures in the lower American River would not notably change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

At the end of the Proposed Action Alternative, flows would be reduced by 100 cfs. Although it is recognized that stage-discharge relationships are site specific and can vary along the lower American River, an overall general relationship suggests that a stage change of about 1.5 inches could occur for every 100 cfs change. Reduction in flow at the cessation of the transfer period could result in a stage change in the lower American River of about 1.5 to 2 inches.

Examination of the cumulative redd depth distribution included in the IFIM study conducted by USFWS (2003) indicate that the shallowest fall-run Chinook salmon redds were located in about 0.4 feet (about 5 inches) deep water. Therefore, change in stage associated with cessation of the Proposed Action Alternative transfer period would not expected to dewater any fall-run Chinook salmon redds.

During the adult fall-run Chinook salmon adult spawning and egg incubation period potentially affected by the Proposed Action Alternative relative to the No Action Alternative, river flow fluctuations or water temperature increases of sufficient magnitude or duration would not occur

in the lower American River to appreciably affect adult fall-run Chinook salmon spawning and egg incubation.

Adult Steelhead Spawning and Egg Incubation

In the lower American River, steelhead spawning generally extends from late-December to April. Therefore, steelhead spawning and egg incubation does not have the potential to be affected under the Proposed Action Alternative relative to the No Action Alternative.

Juvenile Fall-run Chinook Salmon and Steelhead Rearing and Emigration

The juvenile fall-run Chinook salmon rearing and emigration period extends from late-December into June. Therefore, juvenile fall-run Chinook salmon rearing and emigration do not have the potential to be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

The primary period of steelhead smolt emigration occurs from March through June (Castleberry et al. 1991). It has been reported that steelhead move downstream as young-of-the-year (YOY) in the lower American River (Snider and Titus 2000b) from late-spring through summer. Nonetheless, some juvenile steelhead rearing is believed to occur year-round in the lower American River.

The increased flow rates associated with the Proposed Action Alternative relative to the No Action Alternative in the lower American River below Nimbus Dam would not be expected to increase the amount of habitat available for juvenile steelhead rearing. It is expected that water temperatures in the lower American River would not change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

At the end of the Proposed Action Alternative water transfer period, flows would be reduced by 100 cfs at the end of September which would correspond to a stage reduction of about 1.5 to 2 inches.

During the juvenile steelhead rearing period potentially affected by the Proposed Action Alternative relative to the No Action Alternative, river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to affect juvenile steelhead rearing.

American Shad

American shad immigration generally occurs from April through June, with corresponding spawning and egg incubation occurring from mid-May through June. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not appreciably change during this time period, American shad would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Striped Bass

Striped bass spawning, embryo incubation, and initial rearing period may begin in April, but generally peaks in May and early-June. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not notably change during this time period, striped bass spawning, embryo incubation, and initial rearing period would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative. In the lower American River, sub adult and adult striped bass have been observed opportunistically foraging

during other months of the year. However, because flows under the Proposed Action Alternative relative to the No Action Alternative would not appreciably change throughout the year, striped bass would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento Splittail

Sacramento splittail spawning, egg incubation, and initial rearing can occur between late February and early July, but peak spawning occurs in March and April. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not notably change during this time period, Sacramento splittail spawning, embryo incubation, and initial rearing would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

Other Fish Species

The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Proposed Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be appreciably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to appreciably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the lower American River also would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

Folsom Reservoir

Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 20,000 AF by June 1, 2013. June 2013 storage in Folsom Reservoir is expected to be 700,000 AF under the No Action Alternative, and 720,000 AF under the Proposed Action Alternative. The anticipated increase in reservoir storage would have beneficial effects on Folsom Reservoir's coldwater fisheries.

Sacramento River

Flows on the lower Sacramento River (below the confluence with the lower American River) would not change under the Proposed Action Alternative, relative to the No Action Alternative. Because there is no change in flow, fish and aquatic resources in the lower Sacramento River below the confluence with the lower American River would not be affected.

Winter-run Chinook Salmon

Adult winter-run Chinook salmon immigration and holding in the Sacramento River occurs from December through July, with a peak during the period extending from January through April. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon adult immigration and holding under the Proposed Action Alternative relative to the No Action Alternative.

Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243) between late-April and mid-August, with a peak generally in June. Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October. Therefore, winter-run Chinook salmon spawning and incubation would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Winter-run Chinook salmon fry rearing and emigration in the upper Sacramento River can extend from June through April. Emigration of winter-run Chinook salmon juveniles past Knights Landing, approximately 155.5 river miles downstream of the Red Bluff Diversion Dam, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon juvenile rearing and emigration. In addition, the slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding.

Spring-run Chinook Salmon

Adult spring-run Chinook salmon immigration and holding occurs from mid-February through September, and therefore would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Spawning has been reported to occur from September through December, with spawning peaking in mid-September. Embryo incubation generally occurs from September through March. This slight increase in flow in the lower Sacramento River would not result in an appreciable change in water temperature, and therefore would not affect spawning habitat suitability.

Once incubation is completed and fry emerge from the redds, some portion of an annual year-class may emigrate as post-emergent fry, and some rear in the upper Sacramento River and tributaries during the winter and spring and emigrate as juveniles. The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period extending from October through April. The slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of spring-run Chinook salmon juvenile rearing and emigration.

Under the Proposed Action Alternative, critical habitat for the spring-run Chinook salmon in the Sacramento River would not be affected relative to the No Action Alternative.

Fall-run Chinook Salmon

Adult fall-run Chinook salmon generally begin migrating upstream annually as early as June, with immigration continuing through December in most years. Adult fall-run Chinook salmon immigration generally peaks in November, and typically greater than 90 percent of the run has entered the river by the end of November. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to appreciably affect the physical

habitat availability or water temperature suitability of fall-run Chinook salmon adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Fall-run Chinook salmon spawning period generally extends from October through December. Embryo incubation generally occurs from October through March. Examination of the spawning habitat- flow relationships developed (USFWS 2003) for Chinook salmon in the Sacramento River indicate that this slight decrease in flow would not noticeably reduce spawning habitat availability under the Proposed Action Alternative relative to the No Action Alternative. Additionally, this slight increase in flow during this time period would not result in an appreciable change in water temperature, and therefore would not affect spawning habitat suitability. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect fall-run Chinook salmon embryo incubation.

Fall-run Chinook salmon fry emergence generally occurs from late-December through March, and juvenile rearing and emigration occurs from January through June and, therefore, would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Late Fall-Fun Chinook Salmon

Late fall-run Chinook salmon immigration in the Sacramento River occurs from October through April, with a peak during December. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of late fall-run Chinook salmon adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Late fall-run Chinook salmon spawn in the Sacramento River from early January to March, with embryonic incubation extending from January to June. Therefore, late fall-run Chinook salmon spawning and incubation would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the April through December period. Juvenile rearing can extend from seven to thirteen months in the Sacramento River subsequent to emergence. The slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of late fall-run Chinook salmon juvenile rearing and emigration.

Steelhead

Adult steelhead immigration generally can extend from August into March, with peak immigration during January and February. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of steelhead adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Spawning usually begins during late-December and may extend through March, but also can range from November through April. Embryo incubation can generally extend from November to May.

Examination of the spawning habitat- flow relationships developed (USFWS 2003) for steelhead in the Sacramento River indicate that the slight decrease in flow would not noticeably reduce spawning habitat availability or result in an appreciable change in water temperature and, therefore, would not affect spawning habitat suitability under the Proposed Action Alternative relative to the No Action Alternative. An appreciable change in stage at the end of the Proposed Action Alternative water transfer period would not occur, and therefore would not be expected to result in redd dewatering. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect steelhead embryo incubation.

Juvenile steelhead rearing can extend year-round in the Sacramento River, and the primary period of steelhead smolt emigration occurs from March through June. Thus, smolt emigration would not be expected to be affected by implementation of the Proposed Action Alternative relative to the No Action Alternative. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of steelhead juvenile rearing.

Under the Proposed Action Alternative, critical habitat for the Central Valley steelhead in the Sacramento River would not be affected relative to the No Action Alternative.

Green Sturgeon

Green sturgeon generally begin their inland migration in late-February, and enter the Sacramento River between February and late-July. Spawning activities occur from March through July, with peak activity believed to occur between April and June. The green sturgeon immigration and spawning periods do not include the period of the Proposed Action Alternative. Therefore, no changes to green sturgeon immigration and spawning are expected to occur in the Sacramento River under the Proposed Action Alternative relative to the No Action Alternative.

Juvenile green sturgeon reportedly rear in their natal streams year-round. It is expected that water temperatures in the Sacramento River would not change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of green sturgeon juvenile rearing.

American Shad

American shad immigration and spawning generally occurs from mid-May through June, which is outside the Proposed Action Alternative period. Therefore, American shad immigration and spawning are not expected to change under the Proposed Action Alternative relative to the No Action Alternative.

Striped Bass

Striped bass spawning, embryo incubation, and initial rearing in the Sacramento River would not be affected by the Proposed Action Alternative relative to the No Action Alternative, because flows during the period of these lifestages would not change under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento Splittail

Sacramento splittail spawning, egg incubation, and initial rearing can occur between late February and early July, with peak spawning occurs in March and April. Therefore, Sacramento splittail do not have the potential to be affected under the Proposed Action Alternative relative to the No Action Alternative.

Other Fish Species

The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Proposed Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be appreciably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the Sacramento River to notably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the Sacramento River also would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento-San Joaquin Delta

Evaluation parameters selected for part of this evaluation of the Proposed Action Alternative relative to the No Action Alternative includes examination of the habitat parameters of X2 location, Delta outflow, E/I ratio, and fish salvage at south Delta export facilities.

The implementation of the Proposed Action Alternative relative to the No Action Alternative is expected to result in de minimus (or non-observable) changes to X2 location, Delta outflow, E/I ratio, or fish salvage at south Delta export facilities. Hence, potential changes in the habitat parameters of X2 location, Delta outflow, and E/I ratio, and salvage (or loss) would not be of sufficient magnitude or duration to adversely affect anadromous salmonids, green sturgeon, delta smelt, or other fish species in the Delta.

San Luis Reservoir

Under the Proposed Action Alternative, San Luis Reservoir storage would not change significantly relative to the No Action Alternative. Therefore, the coldwater and warmwater fisheries of San Luis Reservoir would not be affected by implementation of the Proposed Action Alternative relative to the No Action Alternative.

Special Status Fish Species

Chinook Salmon

Four principal life history variants are recognized and are named for the timing of their spawning runs: fall-run, late fall-run, winter-run and spring-run (**Table A-3**). The Sacramento River supports all four runs of Chinook salmon. The larger tributaries to the Sacramento River (American, Yuba, and Feather rivers) and rivers in the San Joaquin Basin also provide habitat for one or more of these runs.

Table A-3. Generalized Life History Timing of Central Valley Chinook Salmon Runs

Run	Adult Migration Period	Peak Migration Period	Spawning Period [a]	Peak Spawning Period	Fry Emergence Period	Juvenile Stream Residency	Juvenile Emigration Period
Late fall	Oct – Apr	Dec	Early Jan - Mar	Feb - Mar	Apr - Jun	7-13 months	Apr - Dec
Winter	Dec - Jul	Jan - Mar	Late Apr - Oct	May - Jun	Jul - Oct	5-10 months	Jul - Apr
Spring	Mid-Feb -Jul	Apr - May	Late Aug - Dec	Mid-Sep	Nov - Mar	3-15 months	Oct - Mar
Fall	Jul - Dec	Sep - Oct	Late Sep - Mar	Oct - Nov	Dec - Mar	1-7 months	Dec - Jun

Sources: (Vogel and Marine 1991; CDFW 1998; Moyle 2002; NMFS 2004).

[a] The time periods identified for spawning include the time required for incubation and initial rearing, before emergence of fry from spawning gravels.

Winter-run Chinook Salmon

Winter-run Chinook salmon occur only in the Sacramento River. The Sacramento River winter-run Chinook salmon ESU is listed as "endangered" under both the Federal and State ESA. In 1993, critical habitat for winter-run Chinook salmon was designated to include the Sacramento River from Keswick Dam, (RM [river mile] 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta. Also included are waters west of the Carquinez Bridge, Suisun Bay, San Pablo Bay, and San Francisco Bay north of the San Francisco/Oakland Bay Bridge (NMFS 1993).

Adult winter-run Chinook salmon immigration and holding (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from December through July, with a peak during the period extending from January through April (USFWS 1995a). Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243). Winter-run Chinook salmon spawn between late-April and mid-August, with a peak generally in June. Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October (Vogel and Marine 1991).

Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam occurring from July through March (Reclamation 1992; Vogel and Marine 1991), although NMFS (NMFS 1993; NMFS 1997) report juvenile rearing and outmigration extending from June through April. Emigration (downstream migration) of winter-run Chinook salmon juveniles past Knights Landing, approximately 155.5 RMs downstream of the Red Bluff Diversion Dam, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years (Snider and Titus 2000a; Snider and Titus 2000b). The numbers of juvenile winter-run Chinook salmon caught in rotary screw traps at the Knights Landing sampling location were reportedly dependent on the magnitude of flows during the emigration period (Snider and Titus 2000a; Snider and Titus 2000b). Additional information on the life history and habitat requirements of winter-run Chinook salmon is contained in the NMFS BO for this run (NMFS 1993), which was developed to specifically evaluate impacts on winter-run Chinook salmon associated with CVP and SWP operations.

Spring-run Chinook Salmon

Historically, Central Valley spring-run Chinook salmon occurred in the headwaters of all major river systems in the Central Valley where natural barriers to migration were absent. Beginning in the 1880s, harvest, water development, construction of dams that prevented access to headwater areas and habitat degradation significantly reduced the number and range of spring-run Chinook salmon in the Central Valley. Today, Mill, Deer, and Butte creeks in the Sacramento River system support self-sustaining, persistent populations of spring-run Chinook salmon. The upper Sacramento, Yuba, and Feather rivers also are reported to support spring-run Chinook salmon. Due to the significantly reduced range and small size of remaining spring-run populations, the Central Valley spring-run Chinook salmon ESU is listed as a "threatened" species under both the State ESA and Federal ESA.

Sacramento River spring-run Chinook salmon are known to use the Sacramento River as a migratory corridor to spawning areas in upstream tributaries. Historically, spring-run Chinook salmon did not utilize the mainstem Sacramento River downstream of the Shasta Dam site except as a migratory corridor to and from headwater streams (CDFW 1998). Currently, the extent of spring-run Chinook salmon utilization of the upper Sacramento River (i.e., upstream of the Red Bluff Diversion Dam and downstream of Keswick Dam) for other than a migratory corridor is unclear.

All of the potential spring-run Chinook salmon holding and spawning habitat in the mainstem Sacramento River is located upstream from the Red Bluff Diversion Dam and downstream of Keswick Dam (CDFW 1998). The physical environment downstream from Keswick Dam is adequate for spring-run Chinook salmon; however, in some years high water temperatures would prevent egg and embryo survival (USFWS 1990 as reported *in* CDFW 1998). Water temperature downstream from Keswick Dam is a function of flow releases from Shasta Reservoir, the condition of reservoir storage, depth of water released from the reservoir, and climate. In years of low storage in Shasta Reservoir and under low flow releases, water temperatures exceed 56◦F downstream of Keswick Dam during critical months for spring-run Chinook salmon spawning and egg incubation.[4]

Adult spring-run Chinook salmon immigration and holding in California's Central Valley Basin occurs from mid-February through September (CDFW 1998; Lindley et al. 2004). Suitable water temperatures for adult upstream migration reportedly range between 57ºF and 67ºF (NMFS 1997). In addition to suitable water temperatures, adequate flows are required to provide migrating adults with olfactory and other cues needed to locate their spawning reaches (CDFW 1998).

The primary characteristic distinguishing spring-run Chinook salmon from the other runs of Chinook salmon is that adult spring-run Chinook salmon hold in areas downstream of spawning grounds during the summer months until their eggs fully develop and become ready for spawning. NMFS (1997) states, "Generally, the maximum temperature for adults holding, while eggs are maturing, is about 59- 60°F, but adults holding at 55-56°F have substantially better egg viability." Spring-run Chinook salmon reportedly spawn, to some extent, the mainstem

[4] A water temperature of 56°F represents the upper value of the water temperature range (i.e., 41.0°F to 56.0°F) suggested for maximum survival of eggs and yolk-sac larvae in the Central Valley of California (USFWS 1995c).

Sacramento River. Spawning and embryo incubation has been reported to primarily occur during September through mid-February, with spawning peaking in mid-September (DWR 2004c; DWR 2004d; Moyle 2002; Vogel and Marine 1991). Some portion of an annual year-class may emigrate as post-emergent fry (individuals less than 45 millimeters [mm] in length), and some rear in the upper Sacramento river and tributaries during the winter and spring and emigrate as juveniles (individuals greater than 45 mm in length, but not having undergone smoltification) or smolts (silvery colored fingerlings having undergone the smoltification process in preparation for ocean entry). The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period extending from October through April (Vogel and Marine 1991). On January 2, 2006, NMFS designated the lower American River as critical habitat for non-natal juvenile spring-run Chinook salmon rearing and smolt emigration.

Fall-run Chinook Salmon

In the Central Valley, fall-run Chinook salmon are the most numerous of the four salmon runs, and continue to support commercial and recreational fisheries of significant economic importance. Fall-run Chinook salmon is currently the largest run of Chinook salmon utilizing the Sacramento River system.

Adult fall-run Chinook salmon generally begin migrating upstream annually in July, with immigration continuing through December in most years (NMFS 2004; Vogel and Marine 1991). It has been reported that fall-run Chinook salmon in the Central Valley immigrate into natal rivers as early as June (Moyle 2002). Adult fall-run Chinook salmon immigration generally peaks in November, and typically greater than 90 percent of the run has entered the river by the end of November (CDFW 1992; CDFW 1995).

The timing of adult Chinook salmon spawning activity is strongly influenced by water temperatures. When daily average water temperatures decrease to approximately 60°F, female Chinook salmon begin to construct nests (redds) into which their eggs (simultaneously fertilized by males) are eventually released. Fertilized eggs are subsequently buried with streambed gravel. Due to the timing of adult arrivals and occurrence of appropriate spawning temperatures, spawning activity in recent years in the lower American River, for example, has peaked during mid- to late-November (CDFW 1992; CDFW 1995). In general, the fall-run Chinook salmon spawning and embryo incubation period extends from October through March (NMFS 2004; Vogel and Marine 1991). It should also be noted that if water temperature conditions are sufficiently low (i.e., $\leq$ 60°F), spawning activity may begin in September (Moyle 2002).

The intra-gravel residence times of incubating eggs and alevins (yolk-sac fry) are highly dependent upon water temperatures. The intra-gravel egg and fry incubation life stage for Chinook salmon generally extends from about mid-October through March.

Within the Action Area, fall-run Chinook salmon fry emergence generally occurs from late-December through March (Moyle 2002). In the Sacramento River Basin, fall-run Chinook salmon juvenile emigration occurs from January through June (Moyle 2002; Vogel and Marine 1991). Emigration surveys conducted by CDFW have shown no evidence that peak emigration of Chinook salmon is related to the onset of peak spring flows in the lower American River (Snider et al. 1997). Temperatures required during emigration are believed to be about the same as those required for successful rearing, as discussed below.

Water temperatures reported to be optimal for rearing of Chinook salmon fry and juveniles are reported to be between 45 and 65°F (NMFS 2002a; Rich 1987; Seymour 1956). Raleigh et al. (1986) reviewed the available literature on Chinook salmon thermal requirements and suggested a suitable rearing temperature range of approximately 53.6 to 64.4°F, and an upper limit of 75°F. Zedonis and Newcomb (1997) report that the smoltification process may become compromised at water temperatures above 62.6°F.

Late Fall-Run Chinook Salmon

Most late fall-run Chinook salmon spawn in the Sacramento River, rather than its tributaries (USFWS 1995d). Adult immigration and holding of late fall-run Chinook salmon in the Sacramento River generally begins in October, peaks in December, and ends in April (Moyle 2002). Late fall-run Chinook salmon spawn during periods of high flows, when flow fluctuations can be damaging to redds constructed in high terraces, which can be exposed as water recedes (USFWS 1995d). Spawning in the mainstem Sacramento River occurs primarily from Keswick Dam (RM 302) to Red Bluff Diversion Dam (RM 258), and generally occurs from January through April (Moyle 2002; NMFS 2004; Vogel and Marine 1991). Late fall-run Chinook salmon embryo incubation can extend through June (Vogel and Marine 1991). Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the April through December period (Vogel and Marine 1991).

Central Valley Steelhead

The Central Valley steelhead DPS is listed as a "threatened" species under the Federal ESA, and has no State listing status. Within the Action Area, Central Valley steelhead occurs in the Sacramento and American rivers.

Most wild, indigenous populations of steelhead occur in upper Sacramento River tributaries below the Red Bluff Diversion Dam, including Antelope, Deer, and Mill creeks, and the Yuba River. Remnant populations may also exist in Big Chico and Butte creeks (McEwan and Jackson 1996). Naturally spawning populations also occur in the American and Feather rivers, and possibly the upper Sacramento and Mokelumne rivers, but these populations have had substantial hatchery influence and their ancestry is not clearly known (Busby et al. 1996). Steelhead runs in the Feather and American rivers are sustained largely by Feather River and Nimbus (American River) hatcheries (McEwan and Jackson 1996).

Estimates of steelhead run sizes have been sporadic and limited to only a few locations over the last 50 years. The average annual run size in the Sacramento River above the mouth of the Feather River during 1953 through 1958 was estimated at 20,540 fish (Hallock 1989). Although an accurate estimate is not available, the recent annual run size for the entire Sacramento River Basin, based on Red Bluff Diversion Dam counts, hatchery counts, and available natural spawning escapement estimates, is probably fewer than 10,000 fish (McEwan and Jackson 1996). The most reliable indicators of recent declines in hatchery and wild stocks are trends reflected in Red Bluff Diversion Dam and hatchery counts. Annual counts at the Red Bluff Diversion Dam declined from an average of 11,187 adult fish in the late 1960s and 1970s to 2,202 adult fish in the 1990s. Recent counts at Coleman, Feather River, and Nimbus hatcheries also are well below the historical averages. Frank Fisher (CDFW) estimated that 10 percent to 30

percent of adults returning to spawn in the Sacramento River system are of hatchery origin (McEwan and Jackson 1996).

Central Valley steelhead is known to use the Sacramento River as a migratory corridor to spawning areas in upstream tributaries. Historically, steelhead likely did not utilize the mainstem Sacramento River downstream from the Shasta Dam site except as a migratory corridor to and from headwater streams. The number of steelhead that spawn in the Sacramento River is unknown, but it is probably low (DWR 2003b).

Adult steelhead immigration into Central Valley streams typically begins in August and continues into March (McEwan 2001; NMFS 2004). Steelhead immigration generally peaks during January and February (Moyle 2002). Optimal immigration and holding temperatures have been reported to range from 46°F to 52°F (CDFW 1991b). Spawning usually begins during late-December and may extend through March, but also can range from November through April (CDFW 1986). Optimal spawning temperatures have been reported to range from 39°F to 52°F (CDFW 1991b). Unlike Chinook salmon, many steelhead do not die after spawning. Those that survive return to the ocean, and may spawn again in future years.

Optimal egg incubation temperatures have been reported to range from 48°F to 52°F (CDFW 1991b). Preferred water temperatures for fry and juvenile steelhead rearing are reported to range from 45°F to 65°F (NMFS 2002a). Each degree increase between 65°F and the upper lethal limit of 75°F reportedly becomes increasingly less suitable and thermally more stressful for the fish (Bovee 1978). Although the reported preferred water temperatures for fry and juvenile steelhead rearing range from 45°F to 65°F, most of the literature on steelhead smoltification suggest water temperatures of 52°F (Adams et al. 1975; Rich 1987;Myrick and Cech 2001), or less than 55°F (Wedemeyer et al. 1980; McCullough et al. 2001; USEPA 2003; Zaugg and Wagner 1973) are required for successful smoltification to occur. The primary period of steelhead smolt emigration occurs from March through June (Castleberry et al. 1991). It has been reported that steelhead move downstream as young-of-the-year (YOY) in the lower American River (Snider and Titus 2000b) from late-spring through summer.

Green Sturgeon

Green sturgeon migrates from the ocean to freshwater to spawn. Adults of this anadromous fish species tend to be more marine-oriented than the more common white sturgeon. Spawning populations have been identified in the Sacramento River, and most spawning is believed to occur in the upper reaches of the Sacramento River as far north as Red Bluff (Moyle et al. 1995).

Adults begin their inland migration in late-February (Moyle et al. 1995), and enter the Sacramento River between February and late-July (CDFW 2001). Spawning activities occur from March through July, with peak activity believed to occur between April and June (Moyle et al. 1995). Green sturgeon reportedly tolerate spawning water temperatures ranging from 50°F to 70°F (CDFW 2001). Water temperatures above 68°F (20°C) are reportedly lethal to green sturgeon embryos (Beamesderfer and Webb 2002).

Small numbers of juvenile green sturgeon have been captured and identified each year from 1986 through 2001 in the Sacramento River at the Hamilton City Pumping Plant (RM 206) and at Red Bluff Diversion Dam from 1995 through 2001 (NMFS 2002b). Juvenile green sturgeon reportedly rear in their natal streams year-round (Environmental Protection Information Center et al. 2001; Moyle 2002). Growth of juvenile green sturgeon is reportedly optimal at 59°F (15°C)

and reduced at both 51.8°F (11°C) and 66.2°F (19°C) (Cech et al. 2000). Proposed critical habitat designation for the southern Distinct Population Segment (DPS) of North American Green Sturgeon was noticed in the Federal Register on September 8, 2008 (73 FR 52084). The southern DPS consists of populations originating from coastal watersheds south of the Eel River ("Southern DPS"). The only known spawning population for the Southern DPS is in the Sacramento River.

American Shad

American shad occur in the Sacramento River, its major tributaries, the San Joaquin River and the Delta. Because of its importance as a sport fish, American shad have been the subject of investigations by CDFW. American shad are native to the Atlantic coast and were planted in the Sacramento River in 1871 and 1881 (Moyle 2002).

Adult American shad typically enter Central Valley rivers from April through early July (CDFW 1986), with the majority of immigration and spawning occurring from mid-May through June (Urquhart 1987). Water temperature is an important factor influencing the timing of spawning. American shad are reported to spawn at water temperatures ranging from approximately 46°F to 79°F (USFWS 1967), although optimal spawning temperatures are reported to range from about 60ºF to 70°F (Bell 1986; CDFW 1980; Leggett and Whitney 1972; Painter et al. 1979; Rich 1987). Spawning takes place mostly in the main channels of rivers, and generally about 70 percent of the spawning run is made up of first time spawners (Moyle 2002).

Shad have remarkable abilities to navigate and to detect minor changes in their environment (Leggett 1973). Although homing is generally assumed in the Sacramento River and its tributaries, there is some evidence that numbers of first-time spawning (i.e., "virgin") fish are proportional to flows of each river at the time the shad arrive. When suitable spawning conditions are found, American shad school and broadcast their eggs throughout the water column. The optimal temperature for egg development is reported to occur at 62°F. At this temperature, eggs hatch in six to eight days; at temperatures near 75°F, eggs would hatch in three days (MacKenzie et al. 1985). Egg incubation and hatching, therefore, are coincident with the spawning period.

Striped Bass

Striped bass occur in the Sacramento River, its major tributaries, and the Delta. Substantial striped bass spawning and rearing occurs in the Sacramento River and Delta, although striped bass can typically be found upstream as far as barrier dams (Moyle 2002). Striped bass are native to the Atlantic coast. They were first introduced to the Pacific coast in 1879, when they were planted in the San Francisco Estuary (Moyle 2002).

Adult striped bass are present in Central Valley rivers throughout the year, with peak abundance occurring during the spring months (CDFW 1971; DeHaven 1979; DeHaven 1977). Striped bass spawn in water temperatures ranging from 59°F to 68°F (Moyle 2002). Therefore, spawning may begin in April, but peaks in May and early-June (Moyle 2002). In the Sacramento River, most striped bass spawning is believed to occur between Colusa and the mouth of the Feather River. In years of higher flow, spawning typically occurs further upstream than usual because striped

bass continue migrating upstream while waiting for temperatures to rise (Moyle 2002). Sacramento River currents carry striped bass embryos and larvae to rearing habitats in the Delta.

The number of striped bass entering Central Valley streams during the summer is believed to vary with flow levels and food production (CDFW 1986). Sacramento River tributaries seem to be nursery areas for young striped bass (CDFW 1971; CDFW 1986). Optimal water temperatures for juvenile striped bass rearing have been reported to range from approximately 61°F to 73°F (USFWS 1988).

Delta Smelt

In addition to the Delta, delta smelt have been found in the Sacramento River as far upstream as the confluence with the American River (Moyle 2002; USFWS 1994).

Delta smelt are a euryhaline fish, native to the Sacramento-San Joaquin estuary. As a euryhaline species, delta smelt tolerate wide-ranging salinities, but rarely occur in waters with salinities greater than 10 ppt to 14 ppt (Baxter et al. 1999). Similarly, delta smelt tolerate a wide-range of water temperatures, as they have been found at water temperatures ranging from 42.8°F to 82.4°F (Moyle 2002). Delta smelt are typically found within Suisun Bay and the lower reaches of the Sacramento and San Joaquin rivers, although they are occasionally collected within the Carquinez Strait and San Pablo Bay. The delta smelt is a small slender bodied fish, with a typical adult size of 2 to 3 inches, although some individuals may reach lengths of 5 inches.

During the late winter and spring, delta smelt migrate upstream into freshwater areas to spawn. Shortly before spawning, adults migrate upstream from the brackish-water estuarine areas into river channels and tidally influenced backwater sloughs. In the Sacramento-San Joaquin river system, delta smelt spawning reportedly occurs from February through May, with embryo incubation extending through June (Wang 1986). Delta smelt are thought to spawn in shallow fresh or slightly brackish waters in tidally influenced backwater sloughs and channel edgewaters (Wang 1986). While most delta smelt spawning seems to take place at 44.6°F to 59°F, gravid delta smelt and recently hatched larvae have been collected at 59°F to 71.6°F. Thus, it is likely that spawning can take place over the entire range of 44.6°F to 71.6°F (Moyle 2002). Females generally produce between 1,000 and 2,600 eggs (Bennett 2005), which adhere to vegetation and other hard substrates. Larvae hatch in between 10 and 14 days (Wang 1986) and are planktonic (float with water currents) as they are transported and dispersed downstream into the low-salinity areas within the western delta and Suisun Bay (Moyle 2002). Delta smelt grow rapidly, with the majority of smelt living only one year. Most adult smelt die after spawning in the early spring; although they may be capable of spawning twice during a season, (Bennett 2005; Brown and Kimmerer 2001; Moyle 2002). Delta smelt feed entirely on zooplankton. For the majority of their one-year life span, delta smelt inhabit areas within the western Delta and Suisun Bay characterized by salinities of approximately 2 ppt. Historically, they have been abundant in low (around 2 ppt) salinity habitats. Delta smelt occur in open surface waters and shoal areas (USFWS 1994).

Because delta smelt typically have a one-year life span, their abundance and distribution have been observed to fluctuate substantially within and among years. Delta smelt abundance appears to be reduced during years characterized by either unusually dry years with exceptionally low outflows (e.g. 1987 through 1991) and unusually wet years with exceptionally high outflows (e.g. 1982 and 1986). Other factors thought to affect the abundance and distribution of delta smelt within the Bay-Delta estuary include entrainment in water diversions, changes in the

zooplankton community resulting from introductions of non-native species, and potential effects of toxins.

Sacramento Splittail

USFWS removed Sacramento splittail from the list of threatened species on September 22, 2003, and did not identify it as a candidate for listing under the ESA. Sacramento splittail are however, identified as a California species of special concern and, informally, as a Federal species of concern. Splittail occur in the Sacramento River, its major tributaries, the San Joaquin River and the Delta.

Sacramento splittail spawning can occur anytime between late February and early July but peak spawning occurs in March and April (Moyle 2002). DWR (2004a) reported that Sacramento splittail spawning, egg incubation and initial rearing in the Feather River primarily occurs during February through May. Attraction flows are necessary to initiate travel onto floodplains where spawning occurs (Moyle et al. 2004). Spawning generally occurs in water with depths of three to six feet over submerged vegetation where eggs adhere to vegetation or debris until hatching (Moyle 2002; Wang 1986). Eggs normally incubate for three to seven days depending on water temperature (Moyle 2002). After hatching, splittail larvae remain in shallow weedy areas until water recedes, and they migrate downstream (Meng and Moyle 1995).

Juvenile Sacramento splittail prefer shallow-water habitat with emergent vegetation during rearing (Meng and Moyle 1995). Sommer et al. (Sommer et al. 2002) reports juvenile splittail are more abundant in the Yolo Bypass floodplain in the shallowest areas of the wetland with emergent vegetation. Downstream movement of juvenile splittail appears to coincide with drainage from the floodplains between May and July (Caywood 1974; Meng and Moyle 1995; Sommer et al. 1997).

Sommer et al. (1997) discuss the resiliency of splittail populations and suggest that because of their relatively long life span, high reproductive capacity and broad environmental tolerances, splittail populations have the ability to recover rapidly even after several years of drought conditions. This suggests that frequent floodplain inundations are not necessary to support a healthy population. Moyle et al. (2004) report that the ability of at least a few splittail to reproduce even under the worst flow conditions insures that the population will persist indefinitely, despite downward trends in total population size during periods of drought.

Hardhead

Hardhead are a large (occasionally exceeding 600 mm standard length [SL]), native cyprinid species that generally occur in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 2002). The species is widely distributed throughout the Sacramento-San Joaquin River system, though it is absent from the valley reaches of the San Joaquin River. Hardhead mature following their second year. Spawning migrations, which occur in the spring into smaller tributary streams, are common. The spawning season may extend into August in the foothill streams of the Sacramento and San Joaquin River basins. Spawning behavior has not been documented, but hardhead are believed to elicit mass spawning in gravel riffles (Moyle 2002). Little is known about life stage specific temperature requirements of hardhead; however,

temperatures ranging from approximately 65°F to 75°F are believed to be suitable (Cech et al. 1990).

Longfin Smelt

Longfin smelt is a euryhaline species. They are most abundant in San Pablo and Suisun bays (Moyle 2002). They tend to inhabit the middle to lower portion of the water column. The longfin smelt spends the early summer in San Pablo and San Francisco bays, generally moving into Suisun Bay in August. Most spawning is from February to April at water temperatures of 44.6°F to 58.1°F (Moyle 2002). The majority of adults perish following spawning. Longfin smelt eggs have adhesive properties and are probably deposited on rocks or aquatic plants upon fertilization. Newly hatched longfin smelt are swept downstream into more brackish parts of the estuary. Strong Delta outflow is thought to correspond with longfin smelt survival, as higher flows transport longfin smelt young to more suitable rearing habitat in Suisun and San Pablo bays (Moyle 2002). Longfin smelt are rarely observed upstream of Rio Vista in the Delta (Moyle et al. 1995).

River Lamprey

The anadromous river lamprey is found in coastal streams from San Francisco Bay to Alaska (Moyle 2002). Adults migrate back into freshwater in the fall and spawn from April to June in small tributary streams (Wang 1986). River lamprey are reported to spawn at water temperatures ranging from 55.4°F to 56.3°F (Wang 1986). Adults die after spawning. Presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocoetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and water temperatures do not exceed 77°F. Ammocoetes begin their transformation into adults when they are about 12 cm TL, during the summer. The process of metamorphosis may take 9 to 10 months, the longest known for any lamprey species. Lampreys in the final stages of metamorphosis congregate immediately upriver from saltwater and enter the ocean in late spring. Adults apparently only spend three to four months in saltwater, where they grow rapidly, reaching 25 cm to 31 cm TL (Moyle 2002).

Sacramento Perch

Sacramento perch are deep-bodied, laterally compressed centrarchids. Historically, Sacramento perch were found throughout the Central Valley, the Pajaro and Salinas rivers, and Clear Lake. The only populations today that represent continuous habitation within their native range are those in Clear Lake and Alameda Creek. Within their native range, Sacramento perch exist primarily in farm ponds, reservoirs, and lakes into which they have been introduced (Moyle 2002). Sacramento perch are often associated with beds of rooted, submerged, and emergent vegetation and other submerged objects. Sacramento perch are able to tolerate a wide range of physicochemical water conditions. This tolerance is thought to be an adaptation to fluctuating environmental conditions resulting from floods and droughts. Thus, Sacramento perch do well in highly alkaline water (McCarraher and Gregory 1970; Moyle 1976). Most populations today are established in warm, turbid, moderately alkaline reservoirs or farm ponds. Spawning occurs during spring and early summer and usually begins by the end of March, continuing through the first week of August (Mathews 1965; Moyle 2002). Introductions of non-native species, not necessarily habitat alterations, are foremost in the cause of Sacramento perch declines (Moyle 2002).

California Roach

The California roach, a native freshwater minnow, is found throughout the Sacramento-San Joaquin Basin (Moyle 2002). California roach are generally found in small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al. 1982; Moyle 2002). They are most abundant in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams (Moyle 2002). Roach are tolerant of relatively high temperatures (86°F to 95°F) and low oxygen levels (1 to 2 parts per million [ppm]) (Taylor et al. 1982). Roach reach sexual maturity by about the second year (approximately 45 mm SL). Reproduction generally occurs from March to June, usually when temperatures exceed 60.8°F, but may be extended through late July (Moyle 2002).

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Appendix B: Indian Trust Assets Compliance Memo

KLEINSMITH, DOUGLAS <dkleinsmith@usbr.gov>

Re: ITA request for PCWA WWD Warren Act

RIVERA, PATRICIA <privera@usbr.gov> Thu, Apr 25, 2013 at 6:25 AM
To: "KLEINSMITH, DOUGLAS" <dkleinsmith@usbr.gov>
Cc: Kristi Seabrook <kseabrook@usbr.gov>, Mary Williams <marywilliams@usbr.gov>

Doug,

I reviewed the proposed action to approve the Placer County Water Agency (PCWA) proposes to release 20,000 acre-feet of its Middle Fork Project water rights supply into the United States Bureau of Reclamation's (Reclamation) Folsom Reservoir by June 1, 2013 for purpose of transfer to Westlands Water District (District) and for the benefit of Folsom Reservoir's "coldwater pool" that provides habitat for coldwater fish species.

In order to provide flexibility and utilize available capacity, either the Federal pumping plant at C.W. Bill Jones or the State pumping plant at Harvey O. Banks will be used to convey the transfer water directly to the District for irrigation use during the summer of 2013, or to possibly convey the water to O'Neill Forebay for storage in the federal share of San Luis Reservoir for eventual re-release and delivery through federal facilities to the District for irrigation use at a later time.

The water which PCWA proposes to release for this transfer will be in addition to water which it planned to release prior to reaching a transfer agreement. PCWA will seek approval for the transfer from the State Water Resources Control Board and will enter into a refill agreement with Reclamation so that refill of the upsteam reservoirs will not negatively impact Folsom storage. Without this transfer, the operation plan for PCWA Middle Fork Project reservoirs, French Meadows and Hell Hole, identified a combined carryover storage of 150,000 acre-feet. With the proposed transfer, the combined planned carryover storage will be 1390,000 acre-feet.

The proposed action does not have a potential to affect Indian Trust Assets.

Patricia River

Native American Affairs Program Manager

US Bureau of Reclamation
Mid-Pacific Region
2800 Sacramento, California 95825
(916) 978-5194

----------kristi this is admin----------

Appendix C: Cultural Resources Compliance Memo

United States Department of the Interior

BUREAU OF RECLAMATION
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825-1898

IN REPLY
REFER TO:
MP-153
ENV-3.00

VIA ELECTRONIC MAIL ONLY

April 26, 2013
MEMORANDUM

To: Doug Kleinsmith
Natural Resource Specialist – Division of Environmental Affairs

From William Soule
Archaeologist – Division of Environmental Affairs

Subject: 13-MPRO-157 Warren Act Contract to Westlands Water District (WWD) for a Non-CVP Water Transfer from Placer County Water Agency (PCWA) 2013

This proposed undertaking by Reclamation is to enter into a Warren Act contract to transfer 20,000 acre-feet of water from the PCWA to the WWD in 2013. This is the type of undertaking that does not have the potential to cause effects to historic properties, should such properties be present, pursuant to the National Historic Preservation Act Section 106 regulations codified at 36 CFR § 800.3(a)(1). Reclamation has no further obligations under NHPA Section 106, pursuant to 36 CFR § 800.3(a)(1).

Under the proposed one-year Warren Act contract, the PCWA is proposing a transfer of 20,000 AF from 2013 water supplies currently storied in Middle Fork Project (MFP) reservoirs on the Rubicon River and American River to WWD for irrigation use in the WWD service areas. Federal facilities that will potentially be involved in this transfer are the Jones Pumping Plant, the Delta-Mendota Canal, and San Luis Reservoir. If the Jones Pumping Plant does not have the available capacity, the State Pumping Plant at Banks and the California Aqueduct would be used to convey the transferred water to the O'Neill Forebay. Approval of this action will not result in any construction or changes in land use

After reviewing the April, 2013 Draft Environmental Assessment (EA) for this undertaking, I concur with the statement in section 3.1.1.2 of the EA that this action has no potential to affect historic properties pursuant to the NHPA Section 106 regulations at 36 CFR Part 800.3(a)(1). This memorandum is intended to convey the completion of the Section 106 process for this undertaking. Please retain a copy in the administrative record for this action. Should changes be made to this project, additional NHPA Section 106 review, possibly including consultation with the State Historic Preservation Officer, may be necessary. Thank you for providing the opportunity to comment.

Bill
William E. Soule, M.A., Archaeologist
U.S. Bureau of Reclamation, Mid-Pacific Region, MP-153
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