Chapter 4 Proposed Action

Reclamation and DWR propose to continue the coordinated long-term operation of the CVP and SWP to maximize water supply delivery and optimize power generation consistent with applicable laws, contractual obligations, and agreements; and to increase operational flexibility by focusing on non-operational measures to avoid significant adverse effects. based on the conditions estimated to occur through 2030. Reclamation and DWR propose to store, divert, and convey water in accordance with existing water contracts and agreements, including water service and repayment contracts, settlement contracts, exchange contracts, and refuge deliveries, consistent with water rights and applicable laws and regulations. The "Current Operation" shows the applicable criteria for operation of the CVP and SWP today. Although not part of the effects of operating the project into the future, the Current Operation provides a reference for the changes under the proposed action to assist in understanding the proposed action. Table 4-1 below identifies specific changes from current operations that are part of this proposed action. The proposed action includes habitat restoration that would not occur under the without action scenario and provides specific commitments for habitat restoration.

In preparing this Proposed Action, Reclamation and DWR considered conditions estimated to occur through 2030. If conditions past 2030 are similar to the analysis period, this BA can remain in effect. If, in accordance with the ESA, new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered or if the amount or extent of taking specified in the incidental take statement is exceeded, formal consultation will be reinitiated.

Table 4-1. Comparison of Select Components Across Without Action, Current Operation, and Proposed Action

Without Action	Current Operation	Proposed Action
Sacramento		
No temperature management	NMFS RPA I.2.1-I.2.4: Shasta Temperature Management, WRO 90-5 downstream temperature targets	Temperature management based on use of Shasta cold water pool for Winter-Run survival, including WRO 90-5.
No spring pulses	No spring pulses	Spring pulses if projected May 1 storage > 4 MAF
No fall base flows	3,250 cfs minimum flow	Measures to reduce Fall-Run redd dewatering and rebuild cold water pool, e.g., when end-of-September storage is: ≤ 2.2 MAF, flow is 3,250 cfs; ≤ 2.8 MAF, flow is 4,000 cfs; ≤ 3.2 MAF, flow is 4,500 cfs; > 3.2 MAF, flow is 5,000 cfs.
No Winter-Run Conservation Hatchery	Livingston-Stone National Fish Hatchery	Increased use of Livingston-Stone National Fish Hatchery during droughts
Trinity		
No flow control	Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows

~~No fish flows in Grass Valley Creek~~	~~No fish flows in Grass Valley Creek~~	~~Pulse flows between March 1 and April 15 to mobilize gravel, and October and November releases for Coho spawning, to the extent feasible~~
Clear Creek		
No base flows	Base flow of 50–100 cfs based on 1960 CDFG MOA	Base flow of 200 cfs October to May, 150 cfs from June to September in all except critical years. In critical years, base flows may be reduced below 150 cfs based on the available water from Trinity Reservoir.
No channel maintenance flows	Channel maintenance flows when flood operations occur	10 TAF for channel maintenance, unless flood control operations provide similar releases, using the river release outlets, in all but dry and critical years
No pulse flows	Two pulse flows in Clear Creek in May and June of at least 600 cfs for at least 3 days for each pulse per year	10 TAF for pulse flows, using the river release, in all but critical years
No temperature management	Daily water temperature of: (1) 60º F at the Igo gage from June 1 through September 15; and (2) 56ºF at the Igo gage from September 15 to October 31.	Daily water temperature in below normal and wetter years of: (1) 60ºF at the Igo gage from June 1 through September 15; and (2) 56ºF or less at the Igo gage from September 15 to October 31; operate as close as possible to these targets in dry and critical years.
Feather		
No minimum flow	FERC License flows	FERC License flows
American River		
No minimum flows	2006 Flow Management Standard	2017 Flow Management Standard: Flows range from 500 to 2,000 cfs based on time of year and annual hydrology, and "planning minimum"
No temperature management	Daily average water temperature of 65°F or lower at Watt Avenue Bridge from May 15 through October 31. 56°F temperature target November 1 through December 31.	May 15 through October 31 daily average water temperature of 65°F (or target temperature determined by temperature model) or lower at Watt Avenue Bridge. When the target temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at Watt Avenue may be increased incrementally (i.e., no more than 1°F every 12 hours) to as high as 68°F. November 1 through ~~DeceecemberDecember~~ 31 daily average water temperature of 56°F target if cold water pool allows. A temperature higher than 56°F may be targeted based on temperature modeling results.
Delta		
No exports	D-1641 requirements; and OMR requirements based on USFWS RPA Actions 1-3 and NMFS RPA Action IV.2.3	D-1641 requirements; and ~~Risk~~risk-based OMR management incorporating real-time monitoring and models ~~where possible~~

DCC closed	DCC operations based on NMFS RPA that requires consultation to avoid exceeding water quality standards	DCC operations based on D-1641, closures for fish protections, and operations that avoid exceeding water quality standards
No Delta Outflow requirement	D-1641 requirements; and maintain average X2 for September and October no greater (more eastward) than 74 km in the fall following wet years and 81 km in the fall following above normal years	Delta outflow to meet D-1641 requirements; ~~and~~ Suisun Marsh Salinity Control Gate ~~Operation~~operation for up to 60 days ~~between June~~in the summer and/or fall depending on year type; increased Delta outflow in wet and ~~September of~~ above normal ~~and below normal~~ year types in certain conditions.
No management of reverse flows	Old and Middle River Reverse Flows based on calendar date and workgroups per USFWS RPA Actions 1-3 and NMFS RPA Action 1V.2.3.	Old and Middle River Reverse flows based on species distribution, modeling, and risk analysis with provisions for capturing storm flows
No Head of Old River Barrier (HORB)	HORB installed between September 15 and November 30 of most years when flows at Vernalis is <5,000 cfs; occasionally also between April 15 and May 30 if Delta Smelt entrainment is not a concern	No HORB installed ~~(WaterFix proposed action continues)~~
No Delta Smelt conservation hatchery	U.C. Davis Fish Culture Center Refugial Population	Increased use of the U.C. Davis Fish Culture Center and a Delta Fish Species Conservation Hatchery ~~and~~for the introduction of cultured fish into the wild
No COA	1986 COA with 2018 Addendum	1986 COA with 2018 Addendum
Stanislaus		
No base flows	Appendix 2-E flows from NMFS RPA III.1.3	Stepped ~~release plan~~Release Plan
San Joaquin		
No base flows	San Joaquin River Restoration Program flows	San Joaquin River Restoration Program flows

4.1 Decreasing Operational Discretion

In the 1920s, farmers and municipalities relied upon intermittent surface flows and groundwater for water supply. Over time, as land in California was reclaimed and demand for water increased, over-pumping caused groundwater-level declines in the Sacramento and San Joaquin Valleys and associated aquifer-system compaction and land subsidence. The concept of a statewide water development project was first raised in 1919 by Lieutenant Robert B. Marshall of the U.S. Geological Survey, in large part to meet the demands of California's economy and prevent ongoing impacts resulting from water shortages, including land subsidence. He proposed transporting water from the Sacramento River system to the San Joaquin Valley then moving some of it over the Tehachapi Mountains into Southern California. His proposal led to the first plan for a state-operated water project.

In 1931, State Engineer Edward Hyatt introduced a report identifying the facilities required and the economic means to accomplish the north-to-south water transfer. Called the "State Water Plan," the

report took 9 years and $1 million to prepare. To implement the plan, the Legislature passed the Central Valley Act of 1933, which authorized the project. A $170 million bond act was subsequently approved by the voters of the State of California in a special election on December 19, 1933. In the midst of the Great Depression, revenue bonds were unmarketable, so the State was unable to secure funding to begin construction of the CVP. The State then sought the assistance of the federal government. Following the issuance of a feasibility report, President Franklin Roosevelt's administration agreed to take over the CVP as a public works project.

In the Rivers and Harbors Act of 1935, Congress originally authorized the CVP and provided initial funding. The Rivers and Harbors Act of 1937 reauthorized the CVP for the purposes of "improving navigation, regulating the flow of the San Joaquin River and the Sacramento River, controlling floods, providing for storage and for the delivery of the stored waters thereof, for construction under the provisions of the Federal Reclamation Laws of such distribution systems as the Secretary of the Interior (Secretary) deems necessary in connection with lands for which said stored waters are to be delivered, for the reclamation of arid and semiarid lands and lands of Indian reservations, and other beneficial uses, and for the generation and sale of electric energy as a means of financially aiding and assisting such undertakings and in order to permit the full utilization of the works constructed." Congress gave Reclamation broad authority to operate the dams and reservoirs of the CVP "first, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses; and, third, for power." Reclamation had substantial flexibility in determining how to balance the three original project purposes.

Reclamation and DWR's operation of the CVP and SWP changed significantly in 1978 with the issuance of the WQCP under the SWRCB Water Right Decision 1485 (D-1485). D-1485 imposed on the water rights for the CVP and SWP new terms and conditions that required Reclamation and DWR to meet certain standards for water quality protection for agricultural, M&I, and fish and wildlife purposes; incorporated a variety of Delta flow actions; and set salinity standards in the Delta while allowing the diversion of flows into the Delta during the winter/spring. Generally, during the time D-1485 was in effect, natural flows met water supply needs in normal and wetter years and reservoir releases generally served to meet export needs in drier years.

The D-1485 requirements applied jointly to both the CVP and SWP, requiring a joint understanding between the projects of how to share this new responsibility. To ensure operations of the CVP and SWP were coordinated, the COA was negotiated and approved by Congress in 1986, establishing terms and conditions by which Reclamation and DWR would coordinate operations of the CVP and SWP, respectively. The 1986 COA envisioned Delta salinity requirements but did not address export restrictions during excess conditions.

In 1992, the CVPIA amended previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses, and fish and wildlife enhancement as having an equal priority with power generation. The CVPIA included a number of other provisions that represented additional Congressional direction for operation of the CVP, and overlaid a more complex statutory framework. These overlapping and sometimes competing requirements create challenges in how to address and balance the myriad of obligations Reclamation has in operating the CVP, and how to coordinate with the SWP.

In 1995, the SWRCB issued an update to the WQCP for the Bay-Delta. In 1999 (revised in 2000) the SWRCB issued D-1641 to implement those elements of the 1995 WQCP that were to be implemented through water rights. The 1995 WQCP and D-1641 included a new export to total Delta

inflow (E/I) ratio of 35 percent from February through June. The 35 percent E/I from February to June was a significant change from D-1485. The 1995 WQCP and D-1641 also imposed Spring X2, pumping limitations based on San Joaquin River flow, which in combination with the E/I ratio, reduced the availability of "unstored" flow for the CVP and SWP. February to June became an unreliable season for conveying water across the Delta. The effect of D-1641 was a shift in the export season, in part, to the summer, and the CVP and SWP entered the fall with lower reservoir levels and less need for flood releases in the fall and winter.

In addition, D-1641 imposed a flow requirement for the San Joaquin Basin at Vernalis which included both base flows and a large spring pulse flow. However, it did not address how the requirement would be shared between the three major San Joaquin tributaries. In lieu of the SWRCB assigning responsibility, a number of interested parties entered into the San Joaquin River Agreement, which included flow commitments from all three tributaries, funding commitments, transfers, and voluntary demand reductions. The agreement was initially set to expire in 2009 but was extended to 2012, when it expired and was not replaced.

In 2000, Reclamation signed the Trinity ROD. This defined a minimum flow regime of 369,000 acre-feet in critical dry years ranging to 816,000 acre-feet in wet years in the Trinity River. The ROD decreased the amount of water Reclamation could bring from the Trinity River over to the Sacramento River, reducing water supplies for Delta outflow and salinity and reducing the Shasta Reservoir cold water pool flexibility. This was intended to benefit Trinity River listed fish species, but it complicated Reclamation's ability to meet requirements imposed for the protection of Sacramento River listed fish.

4.2 Operational Tradeoffs

Operation of the CVP and SWP involves a balancing of various laws, regulations, contracts, and agreements. The overlapping and often conflicting requirements necessitate tradeoffs among watersheds, among fish species, among authorized purposes, and among water users. The tradeoffs occur within a season, between seasons, and across water years. Summarized below are examples of these conflicts and resulting tradeoffs that inform this proposed action.

To help protect against drought, Reclamation traditionally operated the CVP to achieve higher end-of-water-year storage that provided for increased carryover into the next year. Over time, the CVP has come under increasing pressure to provide water for environmental purposes which has resulted in decreased water supply reliability (see Figure 4-1 below). To meet state permit conditions, contractual demands, and environmental obligations, more demand has been placed on storage, resulting in lower end-of-water-year storage than was typical in the past. Significant tradeoffs in operational decision making now arise due to overlapping and conflicting regulations that make it difficult to meet congressionally authorized CVP purposes, including those for fish and wildlife.

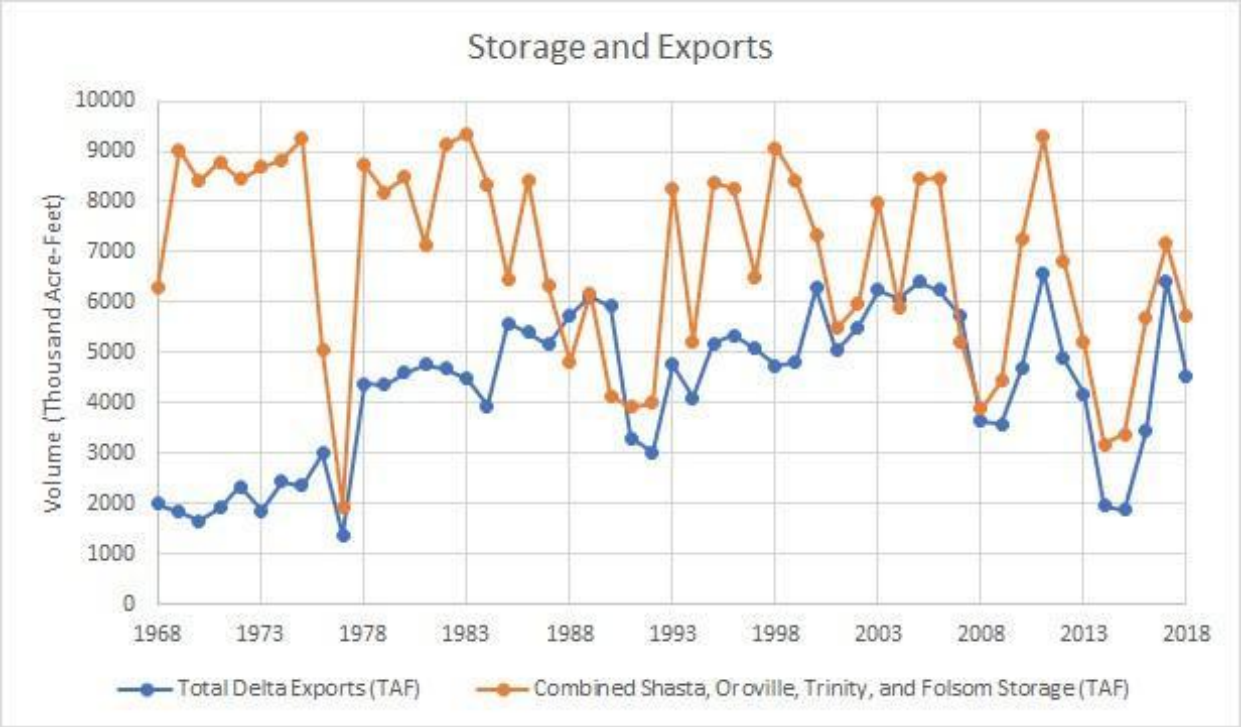

Figure 4-1. Delta Exports and Reservoir End-of-September Storage, 1968–2018

If releases are reduced during some timeframes to maintain higher storage levels in reservoirs, that has a corresponding effect of reducing inflows to the Delta, which then reduces Delta outflows. The benefit of increased reservoir storage has to be weighed against the potential negative downstream impacts on fisheries. In addition, maintaining a higher carryover storage increases the risk of having to make flood control releases early in the season to draw down to the required maximum flood conservation space. Making flood control releases in October and November to draw down to the required maximum storage conflicts with needs to reduce flows rapidly during the fall to encourage development of the cold water pool for the following year.

At Shasta Reservoir, Reclamation seeks to build cold water pool for providing suitable temperatures for Winter-Run Chinook Salmon spawning and incubation in the summer. Releases earlier in the year may reduce this cold water pool. To avoid Winter-Run Chinook Salmon and Fall-Run Chinook Salmon redd dewatering, releases higher than what is needed for instream requirements or Delta requirements may occur. Releases may also occur to facilitate spring pulses for juvenile outmigration, or increased releases to meet Delta outflow or salinity requirements per D-1641. Water temperature management strategies that deplete cold water pool early in the year come at the expense of later season temperatures.

The Trinity ROD and lower Klamath fall augmentation flows limit Reclamation's transbasin diversions and impact Reclamation's temperature operations and CVP deliveries on the Sacramento River. Increases in Trinity River releases in the late summer and fall result in lower storage in Trinity Reservoir at the end of the water year. The decreases in storage accumulate from water year to water year when the reservoir does not refill. Hydrologic conditions that do not refill the reservoir result in lower end-of-summer storages, negative impacts on cold water pool, and potentially warmer stream temperatures for Fall-Run Chinook Salmon spawning in the Trinity River.

Reclamation and DWR coordinate regarding downstream requirements (Delta outflow, Delta salinity, etc.). The amount of water from each reservoir depends upon reservoir storage, channel capacity, fishery concerns, projected inflows, and projected end-of-September storage. With its several upstream reservoirs, Reclamation balances releases so that no one reservoir bears the full burden of meeting its share of the downstream requirements.

On the American River, temperature targets during the summer are intended to benefit Steelhead. Meeting this requirement typically uses nearly the full volume of cold water pool. As a result, there is typically a limited cold water pool remaining in the fall to provide suitable spawning and incubation temperatures for Fall-Run Chinook Salmon. There is rarely enough cold water to provide optimal conditions for both species. Water transfers through Folsom from upstream senior water right holders that occur after Folsom Reservoir has stratified (typically early June) also may have small negative impacts on the cold water pool.

Demands for higher outflow directly conflict with fishery agency requests to maintain substantial cold water pool storage in the reservoirs through the summer for temperature operations in the summer and fall. There are also tradeoffs between species; for example, spring pulse flows on the Sacramento River to benefit Spring-Run Chinook Salmon could negatively impact temperature operations for Winter-Run Chinook Salmon.

San Luis Reservoir is an off-stream storage facility primarily fed by water pumped from the Delta. This supply is used annually to meet south of Delta contractor demands. In the past (prior to major seasonal restrictions of Delta pumping), Delta exports were utilized heavily during the rainy season to capture excess flows in the Delta and store that additional water supply in San Luis Reservoir. The developed water supply (i.e., stored water) was then used during the summer months to provide water to the south of Delta contractors. Now, however, because of significant export restrictions during the precipitation season imposed by the 1995/2006 WQCP and the 2008/2009 biological opinions, the bulk of the joint CVP/SWP Delta export capability is timed during the summer months, resulting in a higher percentage of south of Delta deliveries relying on upstream storage. Ideally, San Luis Reservoir would be as full as possible by April 1 of each water year, then operated to meet south of Delta needs throughout the summer. San Luis Reservoir low point generally occurs the end of August of each water year. If San Luis low point is too low, there can be algae problems for users of water through the San Felipe Project, particularly Santa Clara Valley Water District. Those users have expressed a need to have a plan to prevent San Luis Reservoir from becoming so low that water supplies are negatively impacted by algal growth.

With respect to hydropower generation, the use of direct river release outlets to access colder water below the power penstock intakes for fishery purposes causes the releases to bypasses hydropower production. This impacts ~~the preferential~~ power customers and represents a loss of revenue to Reclamation. In addition, increased requirements and regulations over the years have impacted the ability to deliver CVP water, resulting in lower allocations. The lower allocations result in lower revenues for the restoration fund and increase power customer costs to make up the difference.

4.3 Coordinated Operation Agreement

Reclamation and DWR propose to operate their respective facilities in accordance with the COA. The COA defines the project facilities and their water supplies, sets forth procedures for coordinating operations, and identifies formulas for sharing joint responsibilities for meeting Delta standards and other legal uses of water. It further identifies how unstored flow will be shared, sets up a framework

for exchange of water and services between the projects, and provides for periodic review of the agreement.

Through the COA, Reclamation and DWR share the obligation for meeting in-basin uses. In-basin uses are defined in the COA as legal uses of water in the Sacramento Basin, including the water required under the provisions of Exhibit A of the COA [SWRCB Delta standards]. Each project is obligated to ensure water is available for these uses. The respective degree of obligation is dependent on several factors, as described below.

Balanced water conditions are defined in the COA as periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flows approximately equal the water supply needed to meet Sacramento Valley in-basin uses plus exports. Excess water conditions are periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses plus exports. Reclamation's Central Valley Operations Office (CVO) and DWR's SWP Operations Control Office jointly decide when balanced or excess water conditions exist. During balanced water conditions, the projects share the responsibility in meeting in-basin uses.

During excess water conditions, sufficient water is available to meet all beneficial needs, and the CVP and SWP are not required to supplement the supply with water from reservoir storage. Under Article 6(g) of the COA, Reclamation and DWR have the responsibility (during excess water conditions) to store and export as much water as possible, within physical, legal, and contractual limits.

Implementation of the COA principles has continuously evolved since 1986 as changes have occurred to CVP and SWP facilities, to operating criteria, and to the overall physical and regulatory environment. For example, updated water quality and flow standards adopted by the SWRCB, CVPIA, and ESA responsibilities have affected both CVP and SWP operations. The 1986 COA incorporated D-1485 provisions regarding Delta salinity, outflow, and export restrictions. It also envisioned and provided a methodology to incorporate future regulatory changes, like Delta salinity requirements, but did not explicitly envision (or explicitly address) sharing of export restrictions. Both D-1641 and the 2008 and 2009 biological opinions included various export restrictions that were not explicitly addressed in the 1986 COA; however, the available export capacity as a result of these export restrictions was shared between the projects in the absence of a formal update.

In 2018, Reclamation and DWR modified four key elements of the COA to address changes since COA was originally signed: (1) in-basin uses; (2) export restrictions; (3) CVP use of Banks Pumping Plant up to 195,000 acre-feet per year; and (4) the periodic review. COA sharing percentages for meeting Sacramento Valley in-basin uses now vary from 80 percent responsibility of the United States and 20 percent responsibility of the State of California in wet year types to 60 percent responsibility of the United States and 40 percent responsibility of the State of California in critical year types. In a dry or critical year following two dry or critical years, the United States and State will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin use. When exports are constrained, and the Delta is in balanced conditions, Reclamation may pump up to 65 percent of the allowable total exports with DWR pumping the remaining capacity. In excess conditions, these percentages change to 60/40.

4.4 CVP Water Contracts

Based on the provisions of federal reclamation law, the CVP delivers water pursuant to water service and water repayment contracts, as well as settlement, exchange, and refuge contracts. Reclamation also delivers water pursuant to temporary, not to exceed 1 year, "Section 215 Contracts," when there are surplus flood flows. Pursuant to the Warren Act, Reclamation provides for the conveyance of non-CVP (which includes SWP water) when there is excess capacity available in CVP facilities. This consultation covers the operation of the CVP and SWP to deliver water under the terms of all existing contracts up to full contract amounts, which includes the impacts of maximum water deliveries and diversions under the terms of existing contracts and agreements, including timing and allocation. Reclamation is not proposing to execute any new contracts or amend any existing contracts as part of this consultation.

Reclamation proposes to operate the CVP to meet its obligations to deliver water to senior water right holders who received water prior to construction of the CVP, to wildlife refuge areas identified in the CVPIA, and to water service contractors.

Many senior water right holders executed contracts with Reclamation, such as the Sacramento River Settlement Contractors and San Joaquin River Exchange Contractors. The terms of those contracts differ significantly from water service contracts. The pattern of diversion of water under a water service contract depends on the use of the water, with irrigation water typically diverted and used during the irrigation season (March through October), and M&I water diverted and used year-round. All water service contracts contain a shortage provision allowing Reclamation to reduce the amount of water made available for a variety of reasons, such as droughts. Table 4-2 summarizes the number of CVP water service and repayment contracts and the amount of water under contract.

Table 4-2. CVP Water Service and Repayment Contracts

[1]Contract quantities do not reflect actual deliveries due to system conditions.

CVP Division	Number of Contracts	Contract Quantity[1] (Acre-Feet)
Tehama-Colusa Canal, Corning Canal, Redding Area, and Trinity River Division	36	468,890
American ~~River[2]~~River	9	~~313,765~~328,750
New Melones/Eastside Contracts	2	155,000
South of Delta	44	2,112,898
Friant Division	27	2,249,475
Contra Costa Water District	1	195,000

~~[1]Contract quantities do not reflect actual deliveries due to system conditions.~~

~~[2] Includes foreseeable long-term water service contract actions currently under review through separate consultation processes (i.e., pending contract pursuant to Fazio legislation for the El Dorado County Water Agency and contract renewals for the City of Roseville, Sacramento Municipal Utility District, Sacramento County Water Agency, and Placer County Water Agency).~~

This consultation covers Reclamation's operational actions to meet the terms of its existing CVP water supply contracts (i.e., water service contracts, and settlement, exchange, and refuge contract).

CVP Water service and repayment contracts include shortage provisions as follows: Article 12, Constraints on the Availability of Water, provides for a Condition of Shortage, which is defined in Article 1(c) as "...a condition respecting the Project during any Year such that the Contracting Officer is unable to deliver sufficient water to meet the Contract Total." Article 12(c) provides "In any Year in which there may occur a shortage for any of the reasons specified in subdivision 12(b) above, the Contracting Officer shall apportion Project Water among the Contractor and others entitled, under existing contracts and future contracts (to the extent such future contracts are permitted under subsections (a) and (b) of Section 3404 of the CVPIA) and renewals thereof, to receive Irrigation Water consistent with the contractual obligations of the United States." Article 12(d) states, "Project Water furnished under this Contract will be allocated in accordance with the then-existing Project M&I Water Shortage Policy. Such policy shall be amended, modified, or superseded only through a public notice and comment procedure."

The largest contracts belong to the Sacramento River Settlement Contractors (approximately 2.1 MAF) and the San Joaquin River Exchange contractors (approximately 840 TAF). In very dry years, Reclamation and DWR are often limited to operating the CVP and SWP solely to meet these, and other senior water right requirements, along with refuge water supply requirements and minimum instream and Delta flows, M&I deliveries pursuant to the CVP M&I Shortage Policy, and SWP exports for health and safety. In recent drought years, limited water supplies, dry hydrology, and regulatory restrictions made it difficult for Reclamation to make water available to satisfy contracts already reduced by 25 percent in those years. Reclamation delivers Level 2 refuge water primarily from the CVP and acquires Incremental Level 4 water from voluntary measures which include water conservation, conjunctive use, purchase, lease, donations, or similar activities, or a combination of such activities which do not require involuntary reallocations of project yield. This proposed action covers the operation to deliver up to full contract amounts, including full Level 4 refuge contract amounts. Table 4-3 summarizes senior CVP water rights holders and the amount of water under contract.

Table 4-3. CVP Settlement Agreements

Contractor	Number of Contracts	Contract Quantity (Acre-Feet)
Sacramento River Settlement (SRS)	132	2,112,194 (1,775,313 Base + 336,881 Project)
San Joaquin River Exchange	4	840,000
Oakdale/S. San Joaquin ID Agreement and Stipulation	1	≤ 600,000
American River Contracts	13	578,441
Friant Division Riparian Holding Contracts	n/a	5 cfs past each diversion
South of Delta Settlement Contractors	9	35,623
North of Delta Refuges—Level 2 CVP	2	179,000
South of Delta Refuges—Level 2 CVP	3	376,515

Note: Contract quantities do not reflect actual deliveries due to system conditions.

The contracts referenced above usually include articles such as Article 5, Constraints on the Availability of Water, which states that "in a Critical Year, the Contractor's Base Supply and Project Water agreed to be diverted during the period April through October of the Year in which the

principal portion of the Critical Year occurs and, each monthly quantity of said period shall be reduced by 25 percent."

4.5 SWP Water Contracts

The SWP has signed long-term contracts with 29 water agencies statewide to deliver water supplies developed from the SWP system. These contracts are with both M&I water users and agricultural water users. The contracts specify the charges that will be made to the water agency for both: (1) Conservation of Water, and (2) Conveyance of Water. The foundational allocation of water to each contractor is based on their respective "Table A" entitlement, which is the maximum amount of water delivered to them by the SWP, on an annual basis. Typically, annual water deliveries to individual agencies are less than their maximum Table A amount, due to a wide variety of reasons.

DWR proposes to operate the SWP in accordance with contracts with senior water right holders in the Feather River Service Area (approximately 983 TAF). Further, under State Water Contracts, DWR allocates Table A water as an annual supply made available for scheduled delivery throughout the year. Table A contracts total 4,173 TAF, with over 3 MAF for San Joaquin Valley and Southern California water users.

Article 21 of the long-term SWP water supply contracts provides an interruptible water supply made available only when certain conditions exist: (1) the SWP share of San Luis Reservoir is physically full, or projected to be physically full; (2) other SWP reservoirs south of the Delta are at their storage targets or the conveyance capacity to fill these reservoirs is maximized; (3) the Delta is in excess condition; (4) current Table A demand is being fully met; and (5) Banks has export capacity beyond that which is needed to meet current Table A and other SWP operational demands.

4.5.1 SWP Settlement Agreements

DWR has water rights settlement agreements to provide water supplies with entities north of Oroville, along the Feather River, Bear River, and in the Delta. These agreements provide users with water supplies that they were entitled to prior to the construction of the SWP's Oroville Complex. Collectively, these agreements provide over 1 MAF of water each year. DWR also has agreements with several (more than 60) riparian diverters along the Feather, Yuba, and Bear Rivers to provide water for diversion. Table 4-4 summarizes the volumes under the water rights settlement agreements.

Table 4-4. SWP Settlement Agreements

Location	Entity	Amount (Acre-Feet)
North of Oroville	Andrew Valberde	135
North of Oroville	Jane Ramelli	800
North of Oroville	Last Chance Creek WD	12,000
Feather River	Garden Highway Mutual Water	18,000
Feather River	Joint Water Districts Board	620,000
Feather River	South Feather Water & Power	17,555
Feather River	Oswald WD	3,000
Feather River	Plumas Mutual Water	14,000
Feather River	Thermalito Irrigation District	8,200

Location	Entity	Amount (Acre-Feet)
Feather River	Tudor Mutual Water	5,000
Feather River	Western Canal/PG&E	295,000
Bear River	South Sutter/Camp Far West	4,400
Delta	Byron-Bethany ID	50,000
Delta	East Contra Costa ID	50,000
Delta	Solano Co./Fairfield, Vacaville and Benicia	31,620

4.5.2 SWP Contracting Agencies

The SWP has signed contracts with 29 parties to provide water supplies developed by the SWP. Table 4-5 shows the maximum contracted annual water supply per DWR's most recent water supply reliability report.

Table 4-5. SWP Water Service Contracts

Contracting Agency	Maximum Supply (Acre-Feet)
Butte County	27,500
Plumas County	2,700
Yuba City	9,600
Napa County Flood Control and Water Conservation District	29,025
Solano County	47,756
Alameda County—Zone 7	80,619
Alameda County Water District	42,000
Santa Clara Valley Water District	100,000
Oak Flat Water District	5,700
Kings County	9,305
Dudley Ridge Water District	45,350
Empire West Side Irrigation District	3,000
Kern County Water Agency	982,730
Tulare Lake Water Storage District	87,471
San Luis Obispo County	25,000
Santa Barbara County	45,486
Antelope Valley-East Kern Water Agency	144,844
Santa Clarita Valley Water Agency	95,200
Coachella Valley Water District	138,350
Crestline-Lake Arrowhead Water Agency	5,800
Desert Water Agency	55,750
Littlerock Creek Irrigation District	2,300
Metropolitan Water District of Southern California	1,911,500
Mojave Water Agency	85,800
Palmdale Water District	21,300
San Bernardino Valley Municipal Water District	102,600
San Gabriel Valley Municipal Water District	28,800

Contracting Agency	Maximum Supply (Acre-Feet)
San Gorgonio Pass Water Agency	17,300
Ventura County Watershed Protection District	20,000

4.6 D-1641

Reclamation and DWR propose to operate in accordance with obligations under D-1641, which provides protection for fish and wildlife, M&I water quality, agricultural water quality, and Suisun Marsh salinity. D-1641 granted Reclamation and DWR the ability to use or exchange each project's diversion capacity capabilities to maximize the beneficial uses of the CVP and SWP. The SWRCB conditioned the use of Joint Point of Diversion capabilities based on staged implementation and conditional requirements for each stage of implementation.

4.7 CVPIA

Reclamation proposes to operate in accordance with its obligations under the CVPIA, including but not limited to CVPIA 3406 (b)(2). DOI accounts for the following actions in meeting the 3406 (b)(2) requirement:

1. Primary Purposes: Any fish action (export reduction or upstream release) that predominantly contributes to one of the enumerated 3406(b) programs identified by the courts, including 3406(b)(1), (4), (5), (8), (9), (12), (18) and (19), must be counted against the up to 800 TAF of (b)(2) water. Thus, any upstream release or export reduction that predominantly contributes to one of those purposes will be deducted from the 3406(b)(2) account.
2. Secondary Purposes: Water operations in accordance with ESA and fish and wildlife objectives of D-1641 water quality actions may also be included in (b)(2) accounting. Upstream releases mandated by ESA Biological Opinions may also count towards 3406 (b)(2). Export reductions in ESA Biological Opinions or specified under D-1641 for fish and wildlife objectives may also count towards 3406 (b)(2). Releases for other water quality actions (i.e., net delta outflow) under D-1641 may also count towards 3406 (b)(2).

Pursuant to section 3406(b)(2)(C) the Secretary of the Interior may temporarily reduce deliveries of the quantity of water dedicated under this paragraph up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water. The Secretary may also make water available for other purposes if the Secretary determines that the 800,000 acre-feet identified in section 3406(b)(2) is not needed to fulfill the purposes of section 3406.

~~4.7~~4.8 Allocation and Forecasts

Reclamation proposes to allocate CVP water on an annual basis in accordance with contracts. Reclamation bases north of Delta allocations primarily on available water supply within the north of Delta system along with expected controlling regulations throughout the year. For south of Delta allocations, Reclamation relies on upstream water supply, previously stored water south of the Delta (in San Luis Reservoir) and conveyance capability through the Delta. Flows on the San Joaquin River often limit conveyance, as these flows are a driver of the flow direction within the Delta and through

their influence on Old and Middle net reverse flow, can affect entrainment levels at the State and federal pumps.

The water allocation process for the CVP begins in the fall when Reclamation makes preliminary assessments of the next year's water supply possibilities, given current storage conditions combined with a range of hydrologic conditions. Reclamation may refine these preliminary assessments as the water year progresses. Beginning February 1, Reclamation prepares forecasts of water year runoff using precipitation to date, snow water content accumulation, and runoff to date. All of the CVP's Sacramento River Settlement water rights contracts and San Joaquin River Exchange contracts require that contractors be informed no later than February 15 of any possible deficiency in their supplies. Reclamation targets February 20 as the date for the first announcement of all CVP contractors' forecasted water allocations for the upcoming contract year. Reclamation updates forecasts of runoff and operations plans at least monthly between February and May.

Reclamation performs operations forecasting on a 12-month ahead cycle each month to determine how the available water resources can best be used to meet project objectives and requirements. Reclamation bases forecasts on the 12-month projected runoff volumes that would occur naturally and considers potential upstream operations where relevant. For October and November, projected runoff is based entirely on historical hydrology as no snowpack data are available yet. In December and January, inflow forecasts may include snow pillow information and precipitation as well as historical hydrology. For the February through May period, the runoff volume estimates are based on the observed inflow to date and current snowpack measurements made at the end of each preceding month, projections through September, and historical hydrology for the next water year. These forecasts represent the uncertainty inherent in making runoff predictions. This uncertainty may include sources such as unknown future weather conditions, the various prediction methodologies, and the spatial coverage of the data network in a given basin.

In most years, the combination of carryover storage and runoff into CVP reservoirs and the Central Valley is not enough to provide sufficient water to meet all CVP contractors' contractual demands. Multiple legislative, contractual, and settlement obligations have created an increased tension in Reclamation's ability to make contractual deliveries of water to water users and to meet other legal obligations. As provided in Section 9 of the Reclamation Projects Act of 1939, Section 215 of the Reclamation Reform Act of 1982, and Section 3404(b) of CVPIA, Reclamation is authorized to enter into temporary contracts, not to exceed 1 year, for delivery of surplus flood flows.

~~4.7.1~~4.8.1 SWP Allocation and Forecasting

At the beginning of each new water year, there is significant uncertainty as to the hydrologic conditions that will exist in the future several months, and hence, the water supplies that will be allocated by the SWP to its water contractors. In recognition of this, DWR utilizes a forecasting-water supply allocation process that is updated monthly, incorporates known conditions in the Central Valley watershed to-date, and forecasts future hydrologic conditions in a conservative manner to provide an accurate estimate of SWP water supplies that can be delivered to SWP contractors as the water year progresses.

There are many factors considered in the forecast-supply process. Some of these factors are the following:

- Water storage in Lake Oroville (both updated and end-of-water-year (September 30))
- Water storage in San Luis Reservoir (both updated and end-of-calendar-year)

- Flood operations constraints at Lake Oroville
- Snowpack surveys (updated monthly from February through May)
- Forecasted runoff in the Central Valley (reflects both snowpack and precipitation)
- Feather River settlement agreement obligations
- Feather River fishery flows and temperature obligations
- Anticipated depletions in the Sacramento and Delta basins
- Anticipated Delta standards and conditions
- Anticipated CVP operations for joint responsibilities
- Contractor supply requests and delivery patterns

Staff from both the Operations Control Office (OCO) and the State Water Projects Analysis Office (SWPAO) coordinate their efforts to determine the current water supply allocations. OCO primarily focuses on runoff/operations models to determine allocations. SWPAO requests updated information from the contractors on supply requests and delivery patterns to determine allocations. Both OCO and SWPAO staff meet at least once a month with the DWR Director to make final decisions on staff's proposed allocations.

The Initial Allocation for SWP Deliveries is made by December 1 of each year with a conservative assumption of future precipitation to avoid over-allocating water before the hydrologic conditions are well defined for the year. As the water year unfolds, Central Valley hydrology and water supply delivery estimates are updated using measured/known information and conservative forecasts of future hydrology. Monthly briefings are held with the DWR Director to determine formal approvals of delivery commitments announced by DWR.

Another water supply consideration is the contractual ability of SWP contractors to "carry over" allocated (but undelivered) Table A from 1 year to the next if space is available in San Luis Reservoir. The carryover storage is often used to supplement an individual contractor's current year Table A allocations if conditions are dry. Carryover supplies left in San Luis Reservoir by SWP contractors can result in higher storage levels in San Luis Reservoir. As project pumping fills San Luis Reservoir, the contractors are notified to take, or lose, their carryover supplies. Carryover water not taken, after notice is given to remove it, then becomes project water available for reallocation to all contractors in a given year.

Article 21 (surplus to Table A) water which is delivered early in the calendar year may be reclassified as Table A later in the year depending on final allocations, hydrology, and contractor requests.

Reclassification does not affect the amount of water carried over in San Luis Reservoir, nor does it alter pumping volumes or schedules.

~~4.7.2~~4.8.2 Daily Operations

After the allocations and forecasting process, Reclamation and DWR coordinate their operations on a daily basis. Some factors which Reclamation and DWR consider when coordinating their joint operations include required in-Delta flows, Delta outflow, water quality, schedules for the joint use facilities, pumping/wheeling arrangements, and any facility limitations. Both projects must meet the

flood obligations of individual reservoirs. CVP operations must also consider navigational flows at Wilkins Slough (see Upper Sacramento River for additional details).

During balanced water conditions, Reclamation and DWR maintain a daily water accounting of CVP and SWP obligations. This accounting allows for flexible operations and avoids the need to change reservoir releases made several days in advance (due to travel time from the Delta). Therefore, adjustments can be made "after the fact," using actual observed data rather than by prediction for the variables of reservoir inflow, storage withdrawals, and in-basin uses. This iterative process of observation and adjustment results in a continuous truing up of the running COA account. The project that is "owed" water (i.e., the project that provided more or exported less than its COA-defined share) may request the other project adjust its operations to reduce or eliminate the accumulated account within a reasonable time.

The COA provides the mechanism for determining each project's responsibility for meeting in-basin use, but real-time conditions dictate real-time actions. Conditions in the Delta can change rapidly. For example, weather conditions combined with tidal action can quickly affect Delta salinity conditions and, therefore, the Delta outflow required to maintain joint salinity standards under D-1641.

Increasing or decreasing project exports can achieve changes to Delta outflow immediately. Imbalances in meeting each project's initial shared obligations are captured by the COA accounting and balanced out later.

When more reaction time is available, reservoir release changes are used to adjust to changing in-basin conditions. If Reclamation decides the reasonable course of action is to increase upstream reservoir releases, then the response may be to increase Folsom Reservoir releases first because the released water will reach the Delta before flows released from other CVP and SWP reservoirs. DWR's Lake Oroville water releases require about 3 days to reach the Delta, while water released from Reclamation's Shasta Reservoir requires 5 days to travel from Keswick Reservoir to the Delta. As water from another reservoir arrives in the Delta, Reclamation can adjust Folsom Reservoir releases downward. Alternatively, if sufficient time exists for water to reach the Delta, Reclamation may choose to make initial releases from Shasta Reservoir. Each occurrence is evaluated on an individual basis, and appropriate action is taken based on multiple factors. Again, the COA accounting captures imbalances in meeting each project's initial shared obligation.

One of the principal considerations when determining which reservoir to make releases from is the reservoir refill potential, i.e., the probability that a reservoir will, over the course of a year's inflow and releases, return to a desirable carryover storage. The refill potential is approximated by the average annual runoff divided by the total reservoir storage. Reservoirs that are large compared to the average runoff of their watershed, such as New Melones, have a small refill potential (0.5). Reservoirs that are small compared to the average runoff of their watershed, such as Folsom, have a large refill potential (2.5).

Folsom Reservoir generally has the best refill potential of the CVP reservoirs. Refill potential also is a consideration when evaluating how much water to move from Trinity Reservoir (0.5) to the Sacramento River side. Shasta Reservoir currently has an average annual runoff of approximately 8,476 TAF, with 4,500 TAF of storage, meaning an approximate refill potential of 2, so releases from Shasta Reservoir are more likely to be replaced with new inflow and bring storage back up than releases from Trinity Reservoir.

The duration of balanced water conditions varies from year to year. Balanced conditions never occur in some very wet years, while very dry years may have long continuous periods of balanced conditions, and still other years may have had several periods of balanced conditions interspersed with excess water conditions. Account balances continue from one balanced water condition through the excess water condition and into the next balanced water condition. When the project that is owed water enters into flood control operations, which could be Shasta Reservoir for the CVP or Lake Oroville for the SWP, the accounting is zeroed out for that project.

Reclamation and DWR staff meet daily to discuss and coordinate CVP and SWP system operations. A number of items are discussed at this daily meeting, including:

- Current reservoir conditions
- Pumping status and current outages (for both the CVP and the SWP and how they are affecting project operations)
- Upcoming planned outages (CVP and SWP) and what that means for future operations
- Current reservoir releases and what changes may be planned
- Current regulatory requirements and compliance status
- Delta conditions to determine if CVP and SWP pumping make use of all available water

Reclamation and DWR also coordinate with Hydrosystem Controllers and Area Offices to ensure that, if necessary, personnel are available to make the desired changes. Once Reclamation and DWR each decide on a plan for that day and complete all coordination, each issue change orders to effectuate the decisions, if necessary.

Reclamation and DWR are co-located in the Joint Operations Center. Additionally, the California Data Exchange Center, California-Nevada River Forecast Center and the DWR Flood Management Group are also co-located in the Joint Operations Center. This enables efficient and timely communication, particularly during flood events.

4.84.9 New Science

Reclamation reinitiated consultation on the coordinated long-term operation of the CVP and SWP, in part because of new information. A substantial amount of new information and science has occurred since the 2008 and 2009 biological opinions. The following selected studies particularly inform the proposed action described in this biological assessment, but do not form a comprehensive list:

- Martin, 2017: A phenomenological assessment of temperature-related Chinook Salmon egg mortality modeling, calibrated to fry survival to Red Bluff, Martin et al. concluded the ideal incubation temperature for eggs in the river was 12C or 53.6°F. Below 53.6°F, there is no mortality due to temperature according to Martin. Biophysical models of oxygen transfer across the egg membrane corroborated the difference between temperature-dependent egg mortality predicted in the laboratory versus fry survival to Red Bluff. The 2017 LOBO review (Gore 2018), stated that the Martin approach represents a powerful predictive model for salmon vulnerability to temperature exposure but that the predictions of the oxygen diffusion model should be tested under field conditions because of the model's apparent sensitivity to extremely small changes in flow velocity, and it may be problematic to apply a density dependent model that lacks any mechanistic basis or site-specific information. Additionally, new laboratory studies from UC

Davis (Del Rio et al. In Press) affirm earlier findings (USFWS 1999) that embryo survival is not appreciably impaired at daily mean water temperatures at or near 56°F.

- Anderson 2018: Anderson reviewed Martin 2017 and found that for Chinook Salmon egg incubation shifting the focus of management from meeting a compliance temperature of 53.6°F on the Sacramento River all season long to releasing cold water for just the life stage specific requirements of eggs yields efficiencies for when cold water from Shasta Reservoir is needed and when water from Shasta Reservoir can be saved.
- Grimaldo 2017: Models of Delta Smelt and salmonids at both CVP and SWP showed salvage of adult Delta Smelt increased at OMR more negative than -5,000 cfs, when all other variables were held at their averages. While OMR flow was an important predictor of CVP salvage, more important than even CVP exports, the OMR threshold of -5,000 cfs was most notable in SWP salvage.
- Perry 2018: Statistical modeling revealed that survival was positively related to inflow only in reaches that transitioned from bidirectional tidal flows to unidirectional flow with increasing inflows. Bidirectional to unidirectional transitions occurred in Sutter, Steamboat, and Georgiana Sloughs, and in the Sacramento River from the DCC to Rio Vista, and in the Mokelumne Rivers between the DCC and the San Joaquin River.
- SST 2017: Neither Coded Wire Tag (CWT) nor acoustic tag (AT) data for juvenile Fall-Run Chinook Salmon show a strong and consistent relationship between survival of fish from the San Joaquin River and exports at Jones and Banks Pumping Plants. The evidence of relationship between exports and through-Delta survival is inconclusive, however, the authors stated that their basis of knowledge is low. "It is unknown whether equivocal findings regarding the existence and nature of a relationship between exports and through-Delta survival is due to the lack of a relationship, the concurrent and confounding influence of other variables, or the effect of low overall survival in recent years."
- Six-Year Acoustic Telemetry Study: The Six-Year Steelhead Acoustic Telemetry Study monitored yearling Steelhead migrating through the San Joaquin River and Old River during 2011 to 2016. Estimated survival was no different between the two routes in 2011, 2012, and 2014, but was greater for Steelhead that migrated through the San Joaquin River route in 2015 (average for all release groups was 0.30 [range, 0.19–0.46]), and 2016 (average was 0.45 for all release groups [range, 0.23–0.61]) (statistically significant for 2015 and 2016 survival estimates at alpha = 0.05; Reclamation 2018a,b,c; Buchanan 2018a,b,c).
- Buchanan 2018. Buchanan et al. summarized results of the Fall-Run Chinook acoustic tag studies in the San Joaquin River from 2010 through 2015. The results were survival of Fall-Run Chinook Salmon has been low since 2002, ranging between 0 and 0.05. Even in the high flow year of 201, survival was only 0.02, suggesting increased flows alone are not sufficient to resolve low survival. Over half of the Fall-Run Chinook Salmon that made it through the San Joaquin part of the Delta to Chipps Island were salvaged at the CVP and transported to Chipps.
- Hammock 2017 and Kimmerer and Rose 2018: These studies have used field research and modeling respectively to improve the scientific understanding of food limitation in Delta Smelt. Hammock et al. (2015, 2017) showed that feeding success is variable in space and time. Kimmerer and Rose (2018) used an individual-based life cycle model to show that if it were possible to achieve, a return to pre-overbite clam historical prey densities might increase the Delta Smelt's population growth rate by 14 percent to 81 percent.
- MAST / FLaSH Reports: "According to the FLaSH conceptual model, conditions are supposed to be favorable for Delta Smelt when fall X2 is approximately 74 km or less, unfavorable when X2

is approximately 85 km or greater, and intermediate in between (Reclamation 2011, 2012). The data generally supported the idea that lower X2 and greater area of the LSZ would support more subadult Delta Smelt. The greatest LSZ area and lowest X2 occurred in September and October 2011 and were associated with a high FMWT index which was followed by the highest SKT index on record, although survival from subadults to adults was actually lower in 2011 than in 2010 and 2006. There was little separation between the other years on the basis of X2, LSZ area, or FMWT index. The position and area of the LSZ is a key factor determining the quantity and quality of low salinity rearing habitat available to Delta Smelt and other estuarine species…" Any perceived benefit to the Delta Smelt population of having X2 in the 'favorable area' throughout most of 2017 due to high outflows remains unclear, with the Delta Smelt Fall Midwater Trawl index showing a decrease from that in 2016 and remaining near all-time lows.

- Bush 2017: Using isotopic analysis of otoliths from over a thousand Delta Smelt, Bush (2017) found the species exhibits partial migration through three different life history phenotypes, which include a freshwater resident fish, a brackish water resident fish, and a migratory phenotype, hatching in fresh water then occurring in brackish water during the juvenile and sub-adult stage. The relative abundance of each life history phenotype varied inter-annually with the latter most abundant, but not always dominant, in all years studied. The yearly contributions from each phenotype were found to vary with freshwater flows and temperature.
- CAMT Delta Smelt Entrainment Studies:- New research shows that when Delta Smelt salvage is analyzed independently for SWP and CVP fish facility data, OMR flow has smaller explanatory influence on salvage than some other variables (Grimaldo et al. 2017). Population abundance, as indexed by the CDFW FMWT program, and turbidity have high explanatory power for adult Delta Smelt salvage at the SWP and CVP, particularly during the era of OMR management per the 2008 USFWS Biological Opinion. The basis for OMR flow management partially stems for earlier work showing that adult Delta Smelt salvage (Grimaldo et al. 2009) and proportional losses (Kimmerer 2008) increased as net OMR flow increased southward towards the Projects. New statistical techniques ~~suggests~~suggest a number of factors to minimize salvage or entrainment risk. However, given the correlation of OMR and SWP and CVP models, salvage and entrainment risk could be achieved through management of either indexes of the hydrodynamic influence from Project exports. It is worth noting that the ultimate objective for managing Delta Smelt entrainment should not focus on observed salvage. Rather, the management objective should be to target entrainment losses, in a traditional fisheries sense, to sustainable levels that do not compromise population growth rates (Maunder and Deriso 2011; Rose et al. 2013). New research ~~preformed~~performed under CAMT, can help scientists and resource managers identify circumstances when those large entrainment losses are likely to occur, which can ultimately be used to develop population risk assessment models (Grimaldo et al. 2017; Gross et al. 2018; Korman et al. 2018; Smith et al. 2018). -The question about whether the Delta Smelt population can rebound from record-low abundances, even with improved entrainment management during the winter, remains outstanding given the importance of other factors at play (i.e., poor food supply, growth, water temperatures; see Maunder and Deriso 2011; Rose et al. 2013).

~~4.9~~4.10 Proposed Action by Basin

Table 4-6 shows each of the components of the proposed action for this consultation, including ~~both~~ operational changes ~~and~~, non-flow habitat, and facility improvements. The table also shows whether each action is covered at a site-specific or a programmatic level in this biological assessment and ~~whether the action is part of the Core Water Operations of the CVP and SWP, subject to periodic~~

~~review after implementation, or whether it is an action to be coordinated prior to implementation (i.e., adaptively managed). The actions identified as a conservation measure represent firm commitments believed necessary to address adverse effects of the ongoing operation of the CVP and SWP and are indicated by an asterisk in the table below. Conservation measures may include habitat restoration, facility improvements, or intervention measures—hands on measures to affect fish directly, rather than affecting their habitat.~~ the proposed implementation approach. The three proposed implementation approaches are generally described as follows (further details are provided in section 4.12 and Appendix C):

- "Core" – the action is part of the Core Water Operations of the CVP and SWP.
- "Scheduling" – agencies and water users provide recommendations to Reclamation on scheduling and shaping specific flow actions.
- "Collaborative Planning" – agencies and water users work collaboratively to define, plan, and implement an action.

Completed consultations with existing biological opinions that address the effects of long-term operations, and do not trigger reinitiation under this consultation are identified by "NCO" (Not Consulted On).

Table 4-6. Components of the Proposed Action

Title	Site Specific or Programmatic~~?~~	~~Core Operation or Adaptive Management?~~Implementation Approach
CVP/SWP Wide		
Divert and store water consistent with obligations under water rights and decisions by the State Water Resources Control Board	Site-specific	Core
Shasta Critical Determinations and Allocations to Water Service and Water Repayment Contractors	Site-specific	Core
~~2018 Revised Coordinated Operations Agreement~~	~~NCO~~	~~NCO~~
Upper Sacramento		
Seasonal Operations	Site-specific	Core
Spring Pulse Flows	Site-specific	~~AM~~Scheduling
Shasta Cold Water Pool Management	Site-specific	Core
Fall and Winter Refill and Redd Maintenance	Site-specific	Core
Operation of a Shasta Dam Raise	Site-specific	Core
Rice Decomposition Smoothing~~*~~	Site-specific	Core
Spring Management of Spawning Locations~~*~~	Site-specific	~~AM~~Collaborative Planning
Cold Water Management Tools (e.g., Battle Creek Restoration, Intake Lowering near Wilkins Slough, Shasta TCD Improvements~~)*~~)	Programmatic	~~AM~~Collaborative Planning
Spawning and Rearing Habitat Restoration~~*~~	Programmatic	~~AM~~Collaborative Planning
Small Screen Program~~*~~	Programmatic	~~AM~~Collaborative Planning

Winter-Run Conservation Hatchery Production*	Programmatic	AMCollaborative Planning
Adult Rescue*	Programmatic	AMCollaborative Planning
Juvenile Trap and Haul*	Programmatic	AMCollaborative Planning
Trinity		
Seasonal Operations	Site-specific	Core
Trinity River Record of Decision	NCO	NCO
Long-Term Plan to Protect Adult Salmon in the Lower Klamath River	NCO	NCO
Grass Valley Creek Flows from Buckhorn Dam	Site-specific	Core
Whiskeytown Reservoir Operations	Site-specific	Core
Clear Creek Minimum Flows	Site-specific	Core
Clear Creek Geomorphic and Spring Attraction Pulse Flows	Site-specific	Scheduling
Spring Creek Debris Dam	Site-specific	Core
Clear Creek Restoration Program*	NCO	NCO
Feather River		
FERC Project #2100-134	NCO	NCO
American River		
Seasonal Operations	Site-specific	Core
2017 Flow Management Standard Releases and "Planning Minimum"	Site-specific	Core
American River Pulse Flows	Site-specific	Scheduling
Spawning and Rearing Habitat Restoration*	Programmatic	AMCollaborative Planning
Drought Temperature Facility Improvements*	Programmatic	AMCollaborative Planning
Stanislaus		
Seasonal Operations	Site-specific	Core
Stanislaus River Stepped Release Plan	Site-specific	Core
Stanislaus River Pulse Flows	Site-specific	Scheduling
Alteration of Stanislaus DO Requirement	Site-specific	Core
Spawning and Rearing Habitat Restoration*	Programmatic	AMCollaborative Planning
Temperature Management Study*	Programmatic	AMCollaborative Planning
San Joaquin		
San Joaquin River Restoration Program	NCO	NCO
Lower SJRSan Joaquin River Habitat*	Programmatic	AMCollaborative Planning
Bay-Delta		
Seasonal Operations	Site-specific	Core
Minimum Export Rate	Site-specific	Core

Delta Cross Channel Operations	Site-specific	Core
Agricultural Barriers	Site-specific	Core
Contra Costa Water District Rock Slough Operations	Site-specific	Core
North Bay Aqueduct	Site-specific	Core
Water Transfers	Site-specific	Core
Clifton Court Aquatic Weed Removal	Site-specific	Core
Suisun Marsh Preservation Agreement	NCO	NCO
OMR Management	Site-specific	Core
Tracy Fish Collection Facility* Operations	Site-specific	Core
Skinner Fish Facility* Operations	Site-specific	Core
~~Operations~~		
~~Suisun Marsh Salinity Control Gates Operation*~~	~~Site-specific~~	~~Core~~
~~Fall~~ Delta Smelt Habitat*	Site-specific	~~AM~~Collaborative Planning
Clifton Court Predator Management*	Site-specific	Core
San Joaquin Basin Steelhead Telemetry Study*	Site-specific	~~AM~~Collaborative Planning
Sacramento Deepwater Ship Channel Food Study*	Programmatic	~~AM~~Collaborative Planning
North Delta Food Subsidies/Colusa Basin Drain Study*	Programmatic	~~AM~~Collaborative Planning
Suisun Marsh Roaring River Distribution System Food Subsidies Study*	Programmatic	~~AM~~Collaborative Planning
~~Habitat Restoration~~		
Tidal Habitat Restoration (Complete 8,000 acres from 2008 ~~BiOp)*~~biological opinion)	Programmatic	~~AM~~Collaborative Planning
Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project*	NCO	NCO
Predator Hot Spot Removal*	Programmatic	~~AM~~Collaborative Planning
~~Facility Improvements~~		
Delta Cross Channel Gate Improvements*	Programmatic	~~AM~~Collaborative Planning
Tracy Fish Facility Improvements*	Programmatic	~~AM~~Collaborative Planning
Skinner Fish Facility Improvements*	Programmatic	~~AM~~Collaborative Planning
Small Screen Program*	Programmatic	~~AM~~Collaborative Planning

~~Fish Intervention~~		
Reintroduction efforts from Fish Conservation and Culture Laboratory~~*~~	Site-specific	~~AM~~Collaborative Planning
Delta Fish Species Conservation Hatchery~~*~~	Programmatic	~~AM~~Collaborative Planning

~~*Denotes a Conservation Measure~~

The proposed action for each basin is described in more detail below. These sections give some background for context along with a description of the proposed seasonal operations and proposed action.

~~4.9.1~~4.10.1 Upper Sacramento River (Shasta and Sacramento Divisions)

Reclamation operates the CVP Shasta Division for flood control, navigation, agricultural water supplies, M&I water supplies, fish and wildlife, hydroelectric power generation, Delta water quality, and water quality in the upper Sacramento River. Water rights, contracts, and agreements specific to the Upper Sacramento include SWRCB Decisions 990, 90-5, 91-1, and 1641, Settlement Contracts, Exchange Contract, and Water Service Contracts. Facilities include the Shasta Dam, Lake (4.552 MAF capacity), and Power Plant; Keswick Dam, Reservoir, and Power Plant, and the Shasta TCD. The Sacramento Division includes the Red Bluff Pumping Plant, the Corning Pumping Plant, and the Corning and Tehama-Colusa Canals, for the irrigation of over 150,000 acres of land in Tehama, Glenn Colusa, and Yolo Counties.

Flood control limits releases to less than 79,000 cfs at the tailwater of Keswick Dam and a stage of 39.2 feet in the Sacramento River at Bend Bridge gauging station (~100,000 cfs) to avoid inundating populated areas downstream. Flood control operations are based on regulating criteria developed by the USACE pursuant to the provisions of the Flood Control Act of 1944. Flood control may reserve up to 1.3 MAF of storage behind Shasta, leaving 3.2 MAF for storage management.

Historical commerce on the Sacramento River resulted in a CVP authorization to maintain minimum flows of 5,000 cfs at Chico Landing to support navigation in accordance with the River and Harbors Acts of 1935 and 1937. Although no commercial traffic persists, long-time water users diverting from the river have set their pump intakes based on minimum navigation flows; therefore, the CVP operates to approximately 5,000 cfs at the Wilkins Slough gage during periods when the intakes are being operated. This flow is often a challenge to meet under critical water supply conditions due to both water supply and cold water pool limitations, in which cases Reclamation has operated to approximately 4,000 cfs although impacts on senior diverters occur.

The intake for the Tehama-Colusa Canal and the Corning Canal is located on the Sacramento River approximately 2 miles southeast of Red Bluff. Water is diverted from the Sacramento River through a 2,000 cfs pumping plant (with ability to expand to 2,500 cfs) into a settling basin for continued conveyance in the Tehama-Colusa Canal and the Corning Canal.

The ACID holds senior water rights and has a settlement contract with Reclamation. Water is diverted to its main canal (on the right bank of the river) from a diversion dam located in Redding about 5 miles downstream from Keswick Dam. Reclamation will coordinate with ACID to ensure safe operation of the diversion dam during the irrigation season, from April through October.

In 1990 and 1991, SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. The orders stated that Reclamation shall operate Keswick and Shasta Dams and the Spring Creek Power Plant to meet a daily average water temperature of 56°F as far downstream in the Sacramento River as practicable during periods when higher temperature would be harmful to Winter-Run Chinook Salmon. Under the orders, the water temperature compliance point may be modified to an upstream location when the objective cannot be met at Red Bluff Pumping Plant. In addition, Order 90-05 modified the minimum flow requirements initially established in the 1960 MOA for the Sacramento River below Keswick Dam. The water right orders also recommended the construction of a Shasta TCD to improve the management of the limited cold water resources, and monitoring and coordination.

As a result, Shasta Dam is equipped with a TCD that allows temperature operations without impacting power generation. The TCD allows Reclamation to control the temperature of the water released from Shasta Dam. The TCD has four levels of gates from which water can be drawn, upper gates, middle gates, PRG gates (e.g., lower gates) and the Side Gates (coldest configuration). The last tool to reduce temperatures is to operate the TCD in the full side gate position, drawing the lowest (and coldest) possible water from the reservoir. Reclamation must balance the objectives of pulse flows or water supply releases early in the season which can conflict with the goal of maintaining a cold water pool sufficient to meet species' needs toward end of spawning and incubation season in the fall.

To operate the Shasta TCD, a defined amount of reservoir elevation above each set of gates is required to ensure safe operation. This requirement is reflected in Table 4-7 as 35 feet of submergence above the top of the gates.

Table 4-7. Shasta Temperature Control Device Gates with Elevation and Storage

TCD Gates	Shasta Elevation with 35 feet of Submergence of the TCD Gates (feet)	Shasta Storage (MAF)
Upper Gates	1,035	~3.66
Middle Gates	935	~1.64
Pressure Relief Gates	840	~0.59
Side Gates	720[1]	~0.08

[1]Low level intake bottom

~~4.9.1.1~~4.10.1.1 *Seasonal Operations*

Reclamation operates in the winter for flood control, including both the channel capacity within the Sacramento River and Shasta Reservoir flood conservation space. The USACE is responsible for developing and maintaining the Water Control Manual (WCM) for Shasta Reservoir. The WCM provides that the top of conservation pool (TOC) will set the storage amount that Reclamation is not to exceed on a given date. Releases for flood control will vary dependent upon the current storage, the forecasted inflow, and the flow in the mainstem Sacramento River at Bend Bridge. Reclamation operates Shasta Dam releases to keep flows at Bend Bridge below 100,000 cfs, and therefore reservoir elevations may temporarily exceed the TOC storage to protect downstream populated areas. During the winter period, there can be significant flow fluctuations from Keswick Dam due to the flood control operations. When not operating for flood control, Shasta Dam is operated primarily to conserve storage while meeting minimum flows both down the Sacramento River and in the Delta. These minimum flows are held until irrigation demands require increased releases.

During the winter to spring period there are accretions (flows from unregulated creeks) into the Sacramento River below Shasta Dam. These local accretions help to meet both instream demands and outflow requirements, minimizing the need for additional releases from Shasta and Folsom Reservoirs. In wetter year types, Reclamation may be able to operate mostly for flood control and minimum instream requirements because of the large volumes of accretions to the Sacramento River. In drier years, these accretions may be lower and, therefore, require Reclamation to release a higher level of releases from the upstream reservoirs to meet state permit requirements as well as project exports in the Delta.

In the spring, releases are fairly steady (unless Shasta Reservoir is in flood control operations) until flows are needed to support instream demands on the mainstem Sacramento River and Delta Outflow requirements. Releases for Delta Outflow requirements are balanced between Shasta Reservoir and Folsom Reservoir. Both reservoirs have substantial temperature control requirements, and both need to substantially fill to be able to fully meet their temperature control requirements. Therefore, releases must be carefully balanced to allow each reservoir to fill without negatively impacting the other. An overarching goal for Reclamation when operating the CVP is to fill the reservoirs as much as possible by the end of the flood control season (end of May), while still meeting all other authorized project purposes.

Currently, the seasonal operation of the TCD is generally as follows: during mid-winter and early spring the highest possible elevation gates are utilized to draw from the upper portions of the lake to conserve deeper colder resources. During late spring and summer, the operators begin the seasonal progression of opening deeper gates as Shasta Reservoir elevation decreases and cold water resources are utilized. In late summer and fall, the TCD side gates are opened to utilize the remaining cold water resource.

During the summer, operational considerations are mainly flows required for Delta outflows, instream demands, and temperature control. In river temperatures below Shasta Dam can be controlled via two methods. First is changing release volume or shifting releases between Trinity and Sacramento reservoirs, and the second is selective withdrawal through the TCD. Determination of which method to use is made on a daily basis as operators balance releases from multiple reservoirs to meet ~~downsteam~~downstream needs.

Fall operations are dominated by temperature control and provision of fish spawning habitat. By late fall, the remaining cold water pool in Shasta Reservoir is usually limited. This can be a delicate balancing act in that if the early fall flows are too high then the fish may make their redds higher up on the edge of the river, and they become subject to the possibility of dewatering when the flows are reduced later in the fall. Sacramento River releases cannot be too low early in the fall as there are still significant instream diversion demands on the mainstem of the Sacramento River between Keswick Dam and Wilkins Slough, and depending on conditions, SWRCB Delta requirements may require upstream reservoir releases. This necessitates maintaining higher releases to support the instream demands until they fall off later in the season. At that time, Reclamation's objective is to drop Keswick releases to a lower level to conserve storage.

~~4.9.1.2~~4.10.1.2 *Spring Pulse Flows*

Under the Core Water Operation, Reclamation would ~~not~~ release spring pulse flows ~~unless~~when the projected total May 1 Shasta Reservoir storage ~~is greater than 4 MAF.~~indicates a likelihood of sufficient cold water to support summer cold water pool management. Total storage provides a surrogate for the likely cold water pool and would inform the decision in addition to monthly winter

reservoir temperature measurements and climate forecasts. Reclamation would evaluate the projected May 1 Shasta Reservoir storage at the time of the February forecast to determine whether a spring pulse would be allowed in March, and would evaluate the projected May 1 Shasta Reservoir storage at the time of the March forecast to determine whether a spring pulse would be allowed in April. If Shasta Reservoir total storage on May 1 is projected to be sufficient for cold water pool management (e.g., greater than 4 MAF~~,~~), Reclamation ~~would~~could make a ~~Spring~~spring pulse release ~~as long as the~~ of up to 150 TAF in coordination with the Upper Sacramento scheduling team. Reclamation would not make a spring pulse release if the release would ~~not~~ cause Reclamation to drop into a ~~lower~~ Tier ~~of the~~4 Shasta summer cold water pool management (i.e., the additional flow releases would decrease cold water pool such that summer Shasta temperature management drops in Tier 4) or interfere with the ability to meet other anticipated demands on the reservoir. Appendix C provides for an interagency and stakeholder group to determine the timing, duration, and frequency of the spring pulse within the 150 TAF volume.

~~4.9.1.3~~4.10.1.3 *Cold Water Pool Management*

The closer Shasta Reservoir is to full by the end of May, the greater the likelihood of being able to meet the Winter Run Chinook Salmon temperature control criteria throughout the entire temperature control season. If Shasta Reservoir storage is high enough to use the Shasta TCD upper shutters by the end of May, Reclamation can maximize the cold water pool potential. Storage of 3.66 MAF allows water to pass through the upper gates of the Shasta TCD, but historical relationships suggest that a storage of 4 MAF on May 1st generally provides enough storage to continue operating through the upper gates and develop a sufficient cold water pool to meet 53.5°F on the Sacramento River above Clear Creek (at the CCR gaging station) for Winter-Run Chinook Salmon spawning and egg incubation. Figure 4-2 provides an approximate rule of thumb for the relationship between temperature compliance, total storage in Shasta Reservoir, and cold water pool in Shasta Reservoir.

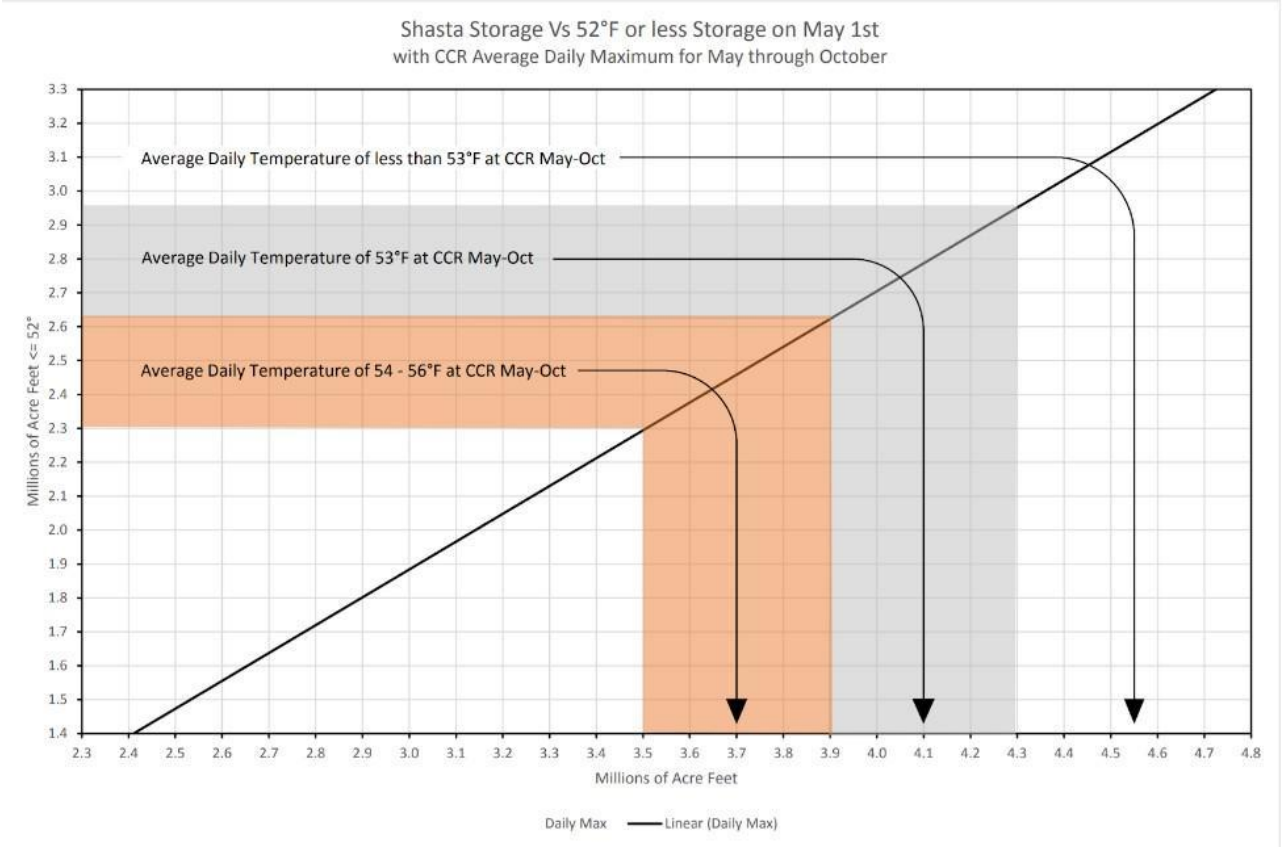

Figure 4-2. Relationship between Temperature Compliance, Total Storage in Shasta Reservoir, and Cold Water Pool in Shasta Reservoir

~~4.9.1.3.1~~4.10.1.3.1 Summer Cold Water Pool Management

Reclamation proposes to operate the TCD at Shasta Dam to continue providing temperature management in accordance with CVPIA 3406(b)(6) while minimizing impacts on power generation. Cold water pool is defined as the volume of water in Shasta Reservoir that is less than 52°F, which Reclamation would determine based on monthly (or more frequent) reservoir temperature profiles. The Sacramento River above Clear Creek (CCR) gage is a surrogate for the downstream extent of most Winter-Run Chinook Salmon redds. Temperature management would start after May 15, or when the monitoring working group determines, based on real-time information, that Winter-Run Chinook Salmon have spawned, whichever is later. Temperature management would end October 31, or when the monitoring working group determines based on real-time monitoring that 95 percent of Winter-Run Chinook Salmon eggs have hatched, and aelvin have emerged, whichever is earlier.

Reclamation proposes to address cold water management utilizing a tiered strategy that allows for strategically selected temperature objectives, based on projected total storage and cold water pool, meteorology, Delta conditions, and habitat suitability for incoming fish population size and location. The tiered strategy recognizes that cold water is a scarce resource that can be managed to achieve desired water temperatures for fisheries objectives. Figure 4-3 below shows examples of water temperatures at CCR under the four tiers. The proposed tiers are described below, along with storage levels that are likely to provide for cold water management within the tier. Actual operations will depend upon the available cold water and modeling. In any given year, cold water pool and storage

could result in Reclamation switching between tiers within the year if needed to optimally use the cold water pool.

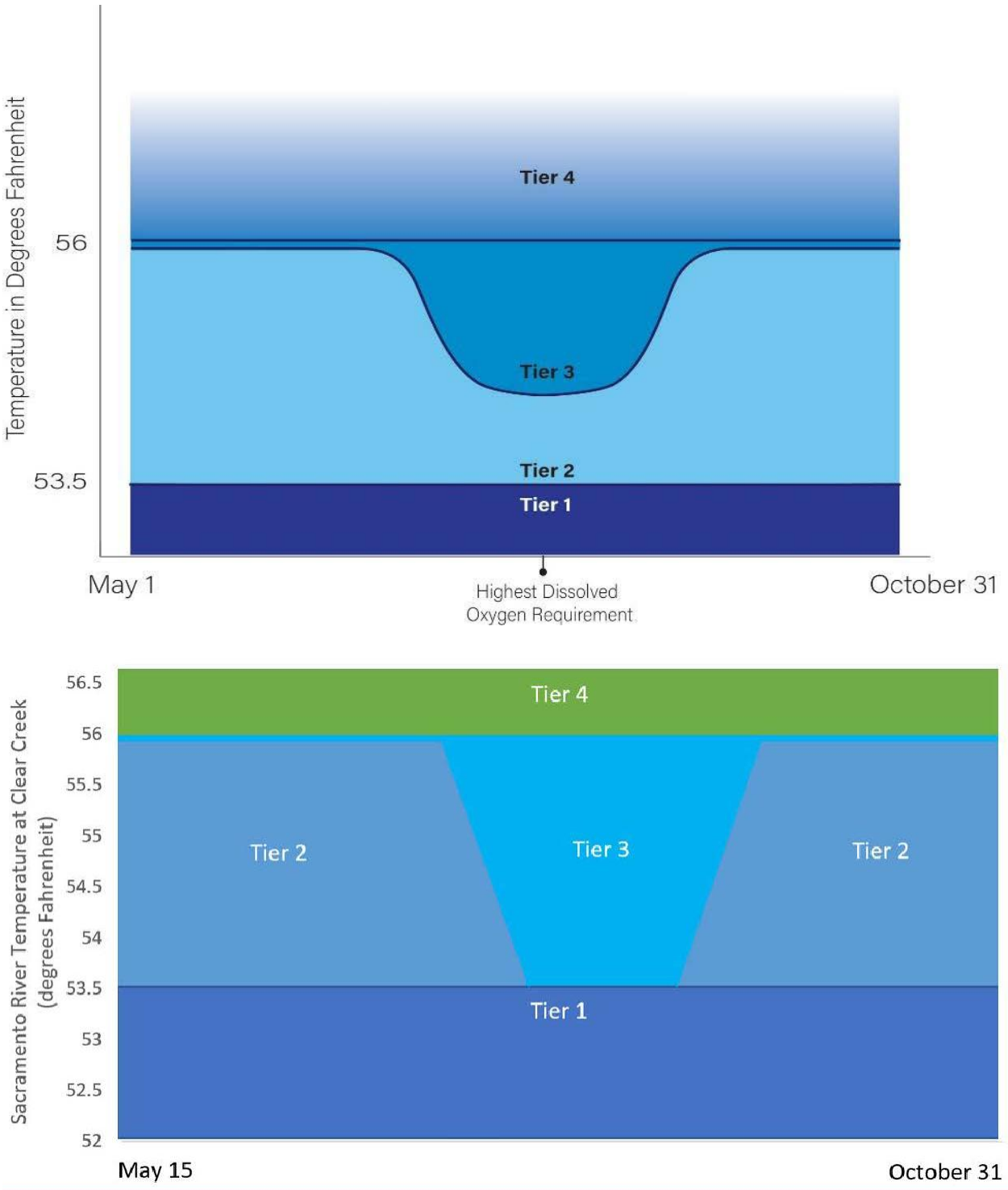

Figure 4-3. Tiered Temperature Management Strategy

- Tier 1. In years when Reclamation determines that cold water pool is sufficient (e.g., more than 2.8 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that a daily average temperature of 53.5°F at CCR can be maintained from May 15 to October 31), Reclamation proposes to operate to a daily average temperature of 53.5°F at the CCR gaging station to minimize temperature dependent mortality.
- Tier 2. In years when cold water pool is insufficient to allow Tier 1 (e.g., less than 2.8 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that the 53.5°F at CCR cannot be maintained from May 15 to October 31), Reclamation would optimize use of cold water for Winter-Run Chinook Salmon eggs based on life-stage-specific requirements, reducing the duration of time of operating to 53.5°F target temperatures. Water temperatures at CCR would vary based on real-time monitoring of redd timing and lifestage-specific temperature dependent mortality models, for example, Anderson (2017). The time period of 53.5°F at CCR would be centered ~~around~~on the projected time period when the Winter-Run eggs have the highest dissolved oxygen requirement (37–67 days post fertilization). At 2.79 MAF of cold water pool, Reclamation would operate to 53.5°F from 37 days after the first observed redd to 67 days after the last observed redd, as long as this is earlier than October 31. The duration of the 53.5°F protection will decrease in proportion to the available cold water pool on May 1. Reclamation will determine this time period by running different temperature scenarios through the latest egg mortality model(s) and real-time monitoring of redds. Reclamation would operate to daily average temperatures at CCR during the temperature management season outside of the stage-specific critical window no warmer than 56°F.
- Tier 3. When Reclamation determines that life-stage-specific temperature targets cannot be met per (2) above (e.g., less than 2.3 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that maintaining 53.5°F at CCR would have higher mortality than a warmer temperature), Reclamation proposes to use cold water pool releases to maximize Winter-Run Chinook Salmon redd survival by increasing the coldest water temperature target (see Figure 4-4 below). At the highest storage levels in Tier 3, the targeted temperature at CCR will be daily average 53.5°F and as storage decreases would warm in the life-stage-specific critical period up to 56°F. Reclamation would increase the temperature while minimizing adverse effects to the greatest extent possible, as determined by the latest egg mortality models, real-time monitoring, and expected and current water availability. This tier would be in effect until Reclamation could no longer meet 56°F at CCR at which point Reclamation would shift to tier 4.
- Tier 4. If there is less than 2.5 MAF of total storage (note the use of "total" storage as opposed to the "cold water pool" used in the previous criteria) in Shasta Reservoir at the beginning of May, or if Reclamation cannot meet 56°F at CCR, Reclamation will attempt to operate to a less than optimal temperature target and period that is determined in real-time with technical assistance from NMFS and USFWS. Reclamation will explore improved coordination of downstream diversions, and the potential for demand shifting. In addition, Reclamation proposes to implement intervention measures (e.g., increasing hatchery intake and trap and haul, as described below).

At the March forecast (mid-March), if the forecasted Shasta Reservoir total storage is projected to be below 2.5 MAF at the end of May, Reclamation would initiate discussions with USFWS and NMFS on potential intervention measures should this low storage condition continue into April and May, as described in Tier 4. Reclamation proposes to perform the first temperature model run in April after the DWR Bulletin 120 has been received and the operations forecast completed. This is the first month that a temperature model run is feasible based on temperature profiles. Prior to April, there is insufficient stratification in Shasta Reservoir to allow a temperature model to provide meaningful results. The April temperature model scenario is used to develop an initial temperature plan for

submittal to the SWRCB. This temperature plan may be updated as Reclamation has improved data on reservoir storage and cold water pool via the reservoir profiles at the end of May, and throughout the temperature control season. Figure 4-4 provides a decision tree explaining the decision points for Shasta Reservoir temperature management.

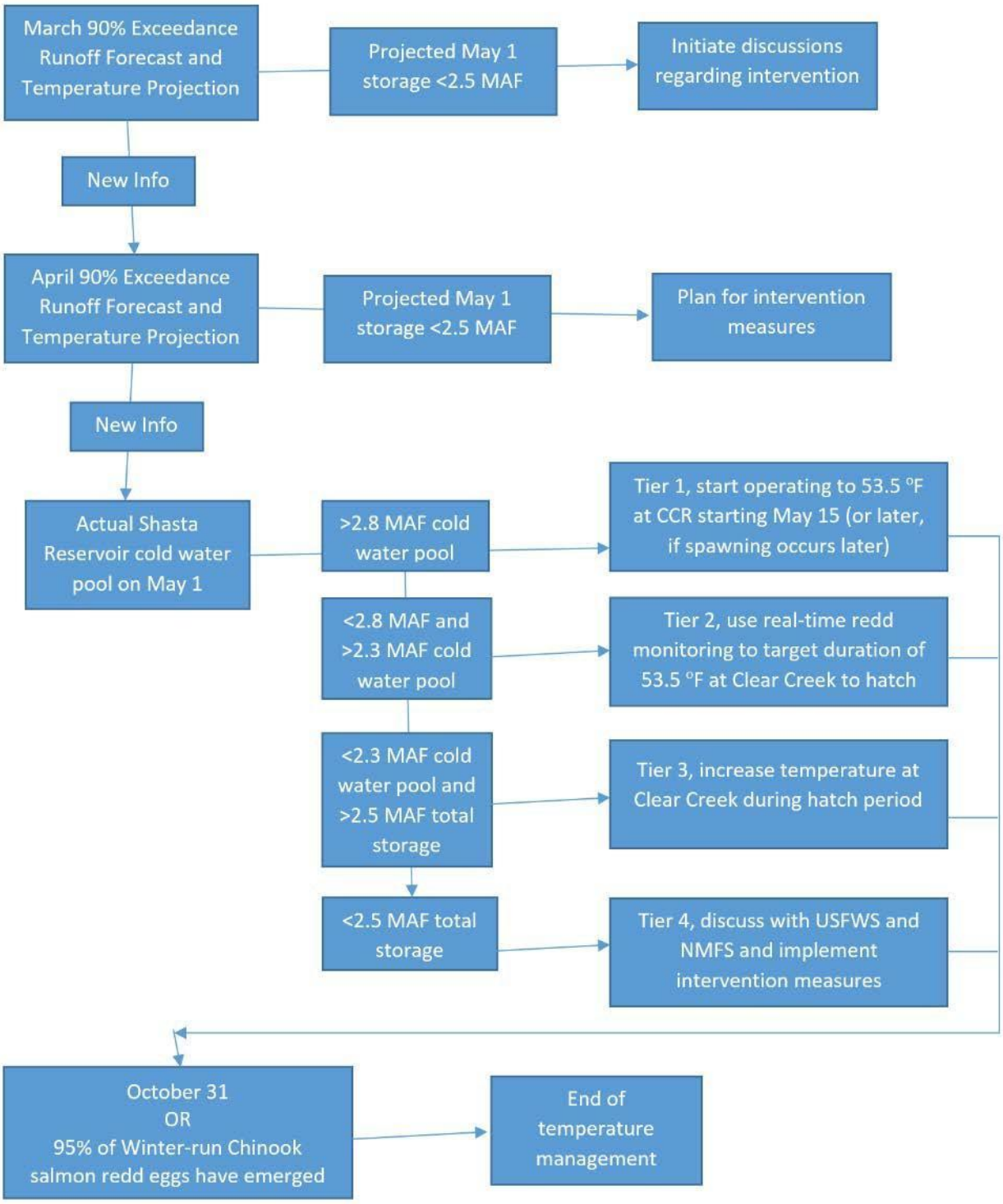

Figure 4-4. Decision Tree for Shasta Reservoir Temperature Management

Reclamation intends to provide temperature profile measurements for Shasta, Whiskeytown, and Trinity Reservoirs as shown in Table 4-8.

Table 4-8. Temperature Profile Measurements for Shasta, Whiskeytown, and Trinity Reservoirs

Reservoir	Every Month	Every 2 Weeks	Every Week	Comment
Shasta	01/01–03/01 12/1–12/31	03/01–05/01 11/15–12/01	05/01–11/15	25 ft intervals for "Every Month," otherwise 5 ft intervals
Whiskeytown	01/01–12/31			25 ft intervals
Trinity	01/01–12/31			25 ft intervals

Reclamation proposes to provide a draft temperature management plan to the SRTTG in April for its review and comment, consistent with WRO 90-5. Reclamation's proposed April temperature management plan will describe which of the four tiers Reclamation forecasts for that year's summer temperature management season, along with a temperature modeling scenario and the operations forecast. The SWRCB has overall authority to determine if the plan is sufficient to meet water right permit requirements.

~~4.9.1.4~~4.10.1.4 *Fall and Winter Refill and Redd Maintenance*

Reclamation proposes to rebuild storage and cold water pool for the subsequent year. Maintaining releases to keep late spawning Winter-Run Chinook Salmon redds underwater may drawdown storage necessary for temperature management in a subsequent year. Reclamation will minimize effects with a risk analysis of the remaining Winter-Run Chinook Salmon redds, the probability of sufficient cold water in a subsequent year, and a conservative distribution and timing of subsequent Winter-Run Chinook Salmon redds. ~~If maintaining flows puts~~If the ~~subsequent~~combined productivity of the remaining redds plus a conservative scenario for the following year ~~class at a 10 percent or~~is less ~~risk~~than the productivity of maintaining, Reclamation will reduce releases to rebuild storage.

~~Demands by the National Wildlife Refuges, upstream CVP contractors, and the Sacramento River Settlement Contractors in October result in Keswick Dam releases that are generally not maintained throughout the winter due to needs to store water for beneficial uses the following year. These releases result in some early fall Chinook redds being dewatered at winter base flows. Targets~~The conservative scenario for the following year would include a 75% (dry) hydrology; 75% (warm) climate; a median distribution for the timing of redds, and the ability to remain within Tier 3 or higher (colder) tiers.

If, based on the above analysis, Reclamation determines reduced releases are needed to rebuild storage, targets for winter base flows (December 1 through the end of February) from Keswick would be set in October ~~and would be~~ based on ~~the previous months'~~ Shasta Reservoir end-of-September storage. These targets would be set based on end-of-September storage and the current hydrology~~.~~, after accounting for winter-run red stranding. Base flows would be set based on historic performance to accomplish improved refill capabilities for Shasta Reservoir to build cold water pool for the following year. Table 4-9 shows examples of possible Keswick Releases based on Shasta Reservoir storage condition; these would be refined through future modeling efforts as part of the seasonal operations planning.

Table 4-9. Keswick Dam Release Schedule for End-of-September Storage

Keswick Release (cfs)	Shasta End-of-September Storage
3,250	≤ 2.2 MAF
4,000	≤ 2.8 MAF
4,500	≤ 3.2
5,000	> 3.2 MAF

~~4.9.1.4.1~~4.10.1.4.1 Operation of Shasta Dam Raise

Reclamation proposes to enlarge Shasta Dam and Reservoir by raising the dam crest 18.5 feet under a separate ESA consultation for construction. The additional storage created by the 18.5-foot dam raise would be used to improve the ability to meet water temperature objectives and habitat requirements for salmonids during drought years and increase water supply reliability. Reclamation would operate a raised Shasta Dam consistent with the downstream requirements and operations described in this proposed action.

~~Reclamation would operate a raised Shasta Dam consistent with scenario CP4A in the 2015 Shasta Lake Water Resources Investigation Feasibility Report, for CVP operation only. CP4A focuses on increasing anadromous fish survival, while also increasing water supply reliability. An 18.5-foot raise would increase storage by approximately 634 TAF. Operation under scenario CP4A would include a dedicated cold water storage of 191 TAF. Operations for the remaining portion of increased storage (approximately 443 TAF) would be 120 TAF reserved in dry years and 60 TAF reserved in critical years to focus on CVP deliveries. Reclamation conducted modeling for CP4A that looked at CVP only, as shown in Table 4-10 below.~~

~~**Table 4-10. Increases in Deliveries (average all years)**~~

	~~CP4A (acre-feet) CVP and SWP~~	~~CP4A CVP Only (acre-feet) (approximate)~~
~~Agriculture~~	~~31,700~~	~~65,500~~
~~M&I~~	~~19,900~~	~~4,700~~

~~4.9.1.4.2~~4.10.1.4.2 Conservation Measures

Conservation measures are included to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment. These conservation measures include actions that benefit listed species without impacting water supply or other beneficial uses.

- ~~Water Operations~~
- ~~Rice Decomposition Smoothing: Demands by the National Wildlife Refuges, upstream CVP contractors, and the Sacramento River Settlement Contractors in October result in Keswick Dam releases that are generally not maintained throughout the winter due to needs to store water for beneficial uses the following year. These releases result in some early Fall-Run Chinook Salmon~~

~~redds being dewatered at winter base flows.~~Rice Decomposition Smoothing: Following the emergence of Winter-Run Chinook Salmon and prior to the majority of Fall-Run Chinook Salmon spawning, upstream Sacramento Valley CVP contractors and the Sacramento River Settlement Contractors propose to work to synchronize their diversions to lower peak rice decomposition demand. With lower late October and early November flows, Fall-Run Chinook Salmon are less likely to spawn in shallow areas that would be subject to dewatering during winter base flows. Early reductions (late October–early November) would balance the potential for dewatering late spawning Winter-Run Chinook Salmon redds and early Fall-Run Chinook Salmon dewatering.

- Spring Management of Spawning Locations: Reclamation will coordinate with NMFS ~~as part of adaptive management~~ to establish experiments to refine the state of the science and determine if keeping water colder earlier induces earlier spawning, or if keeping April/May Sacramento River temperatures warmer induces later spawning~~, to refine the state of the science~~.
- Cold Water Management Tools: Reclamation will explore additional opportunities ~~as part of adaptive management~~ to extend the cold water pool, options include:
    - *Battle Creek Restoration:* Reclamation would accelerate implementation of the Battle Creek Salmon and Steelhead Restoration Project, which is intended reestablish approximately 42 miles of prime salmon and Steelhead habitat on Battle Creek, and an additional 6 miles on its tributaries. Winter-Run Chinook Salmon are currently limited to a single population that spawns in a 5-mile stretch of the Sacramento River, but they are being reintroduced to Battle Creek (around 200,000 juveniles were released in Battle Creek in 2018), and this new population would benefit from the restoration efforts. ~~An additional population of Winter-Run Chinook Salmon on Battle Creek would provide temperature compliance flexibility.~~
    - *Lower Intakes near Wilkins Slough:* Due to temperature requirements, Sacramento River flows at or near Wilkins Slough can drop below the 5,000 cfs minimum navigational flow set by Congress. As many of the fish screens at diversions in this region were designed to meet the 5,000 cfs minimum, they may not function properly at the lower flows and as a result, not meet state and federal fish screening requirements during the lower flows (NCWA 2014). This could result in take of state and federally protected species that use this section of the river. This action would provide grants to water users within this area to install new diversions and screens that would operate at lower flows, which would allow Reclamation to have greater flexibility in managing Sacramento River flows and temperatures for both water users and wildlife, including listed salmonids (NCWA 2014). The authority for this action is 3406(b)(21). One example project under this program is screening of Meridian Farms.
    - *Shasta Temperature Control Device Improvements:* ~~Depending upon~~Reclamation proposes to study the ~~type~~feasibility of ~~dam raise proposed, the~~ infrastructure improvements to enhance TCD ~~would be either modified or replaced by Reclamation, informed by updated modeling. For relatively small raises of Shasta Dam, the existing TCD structure would be retrofitted to account for additional dam height, and to reduce~~ performance, including reducing the leakage of warm water into the structure~~, but no new structure would be needed. However, modifications to, or replacement of, the existing structure are more likely to be necessary for increasingly higher dam raises. The authority for this action is 3406(b)(6).~~.

~~• Habitat Restoration~~

- Spawning Habitat: Reclamation proposes to create additional spawning habitat by injecting ~~40–55~~approximately 15,000 – 40,000 tons of gravel annually into the Sacramento River ~~by~~to 2030, using the following sites: ~~Salt Creek Gravel Injection Site,~~ Keswick Dam Gravel Injection Site,

~~South Shea Levee, Shea Levee, and~~ Market Street Injection Site, Redding Riffle, Turtle Bay, Tobiasson Island ~~Side Channel~~, Shea Levee sites, and Kapusta.

- Rearing Habitat: Reclamation ~~and~~ , in coordination with the Sacramento River Settlement Contractors ~~propose~~proposes to create 40–60 acres of side channel and floodplain habitat at approximately 10 sites in ~~Shasta and Tehama County~~ the Sacramento River by 2030~~, including Cypress Avenue, Shea~~. The potential sites include Salt Creek, Turtle Bay Island, ~~Anderson River Park; South Sand Slough; Rancheria Island;~~Kutras Lake Rearing Structures, Painter's Riffle maintenance, North Cypress maintenance, Cypress South, North Tobiasson Rearing Structures maintenance, Tobiasson Side Channel, Shea Side Channel~~; and Turtle Bay~~, Kapusta Side Channel, Kapusta 1-A Side Channel maintenance, Kapusta 1-B Side Channel, Anderson River Park Side Channels, Cow Creek Side Channel, I-5 Side Channel, China Gardens, Rancheria Island Side Channel, Rancho Breisgau, Lake California Side Channel maintenance, Rio Vista Side Channel, East Sand Slough Side Channel, La Barranca Side Channel, Woodson Bridge Bank Rearing Improvement, Jellys Ferry, Dog Island, Altube Island, Blackberry Island, Oklahoma Avenue, Mooney Island, McClure Creek, Blethen Island, Wilsons Landing, McIntosh Island, Shaw, Larkins, Reilly Island, Hanson Island, and Broderick.
- Small Screen Program: ~~As part of adaptive management,~~ Reclamation and DWR propose to continue to work within existing authorities (e.g., Anadromous Fish Screen Program) to screen small diversions throughout Central Valley CVP/SWP streams and the Bay-Delta.
- ~~Intervention~~
- Winter-Run Chinook Salmon Conservation Hatchery Production: In a Tier 4 year, Reclamation proposes to increase production of Winter-Run Chinook Salmon. Increased production during drought could help populations continue over multiple years. Increased production would aim to offset temperature dependent mortality on the Sacramento River. Reclamation would consider New Zealand or Great Lake Winter-Run Chinook Salmon stock for augmenting conservation hatchery stock to improve heterozygosity.
- Adult Rescue: Reclamation proposes to trap and haul adult salmonids and sturgeon from Yolo and Sutter bypasses during droughts and after periods of bypass flooding, when flows from the bypasses are most likely to attract upstream migrating adults~~,~~ and move them up the Sacramento River to spawning grounds. This trap and haul is in addition to weir fish passage projects that are part of the proposed action elsewhere. This would improve survival of the adults, leading to increased juvenile production in the following year and more flexibility with salvage.
- Trap and Haul: If Reclamation projects a Tier 4 year (less than 2.5 MAF of storage at the beginning of May), Reclamation proposes implementation of a downstream trap and haul strategy for the capture and transport of juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation proposes to place temporary juvenile salmon collection traps (e.g., rotary screw traps, fyke nets, floating juvenile collectors, weirs, trawls, seines), at key feasible locations, downstream of spawning areas in the Sacramento River. Reclamation would transport collected fish to a safe release location or locations in the Delta upstream of Chipps Island. or in the bay. Juvenile trap and haul activities would occur from December 1 through May 31, consistent with the migration period for juvenile Chinook Salmon and Steelhead (NMFS 2014) depending on hydrologic conditions. In the event of high river flows or potential flooding, ~~the fish weirs~~trapping operations would cease and traps would be removed, as appropriate.

~~4.9.2~~4.10.2 Trinity River Division

Congress authorized the Trinity River Division in 1955 as an integrated component of the CVP in order to increase water supplies for irrigation and other beneficial uses in the Central Valley, recognizing that water "surplus" to the present and future needs of the Trinity and Klamath Basins could be diverted to the Central Valley "without detrimental effect to the [Klamath-Trinity Basin's] fishery resources." Accordingly, Reclamation operates the Trinity River Division both to export water to the Sacramento River system and to ensure necessary flow releases into the Trinity-Klamath Basin, such as through implementation of the Department of the Interior's Trinity River Mainstem Fishery Restoration ROD (2000 ROD). Trans-basin exports transfer water from the Trinity River to the Sacramento River system through Lewiston Reservoir, Carr Tunnel, Whiskeytown Reservoir, and Spring Creek tunnel.

~~4.9.2.1~~4.10.2.1 *Seasonal Operations*

Diversion of Trinity Basin water to the Sacramento Basin (transbasin diversion) provides water supply and major hydroelectric power generation for the CVP and plays a key role in water temperature control in the Trinity River and upper Sacramento River. Transbasin diversions are managed to support water supply and temperature objectives within the Sacramento system and are regulated by the ROD and Trinity Reservoir supply. The 2000 Trinity ROD strictly limits Reclamation's transbasin diversions to 55 percent of annual inflow on a 10-year average basis to legal and trust mandates for the restoration and protection of the Trinity fishery which restrict the amount of water authorized for exportation to the Central Valley. Reducing transbasin diversions was intended to improve the cold water pool in Trinity Reservoir to improve conditions for fall spawning down the Trinity River. This limitation on transbasin diversions significantly impacts Reclamation's temperature operations on the Sacramento River and Reclamation's ability to satisfy senior water right holder and/or Settlement contractor commitments within the CVP system.

Trinity River exports are first conveyed through Carr Power Plant which flows directly into Whiskeytown Lake, a heavily used recreation facility. From Whiskeytown Lake, the exported water continues to flow into Spring Creek Power Plant and ultimately outflows into the Sacramento River below Keswick, or water is released from Whiskeytown to Clear Creek. Although Whiskeytown Lake is primarily used as conveyance system for transbasin transfers, operations at both Carr and Spring Power plants are done in a manner to maintain specified elevations for supporting recreation (based on season).

The amounts and timing of Trinity River basin exports into the Sacramento River basin are determined by subtracting Trinity River scheduled flow and targeted carryover storage from the forecasted Trinity water supply. Reclamation maintains at least 600 TAF in Trinity Reservoir, except during the 10–15 percent of water years when Shasta Reservoir is also drawn down. Reclamation proposes to address end-of-water-year carryover on a case-by-case basis in dry and critically dry water year types described in the Water Operations Governance process below.

The seasonal timing of Trinity River exports is a result of determining how to make best use of a limited volume of Trinity River export (in concert with releases from Shasta Reservoir) to help conserve cold water pools and meet water temperature objectives on the upper Sacramento and Trinity Rivers, as well as power production economics.

These exports support better Trinity River temperatures by maintaining cold water and reducing residence time within Lewiston Reservoir. Transbasin diversions also typically help meet Sacramento

River temperatures by providing additional cold water resources to the Sacramento River. As a result, Trinity River export operations are completely integrated with Shasta Dam operations.

~~4.9.2.2~~4.10.2.2 *Trinity River Record of Decision*

The 2000 ROD prescribed increase flows to meet federal statutory and other responsibilities to protect and restore the basin's fishery resources, to be released from Lewiston Dam down the Trinity River. Specifically, it entails: (1) variable annual instream flows for the Trinity River from the Trinity River Division based on forecasted hydrology for the Trinity River Basin; (2) mechanical habitat rehabilitation projects along with sediment management and watershed restoration efforts; and (3) an adaptive management program. The 2000 ROD flow release schedules vary among water-year classes and were designed to address the environmental requirements of anadromous fish and fluvial geomorphic function. The following five water year classes and associated annual water volumes for release to the Trinity River are identified as: Critically Dry (369 TAF); Dry (453 TAF); Normal (636 TAF); Wet (701 TAF); and Extremely Wet (815 TAF).

Total river release can reach up to 11,000 cfs below Lewiston Dam (flood criteria) due to local high water concerns in the floodplain and local bridge flow capacities. Flood criteria provides seasonal storage targets and recommended releases November 1 to March 31.

~~4.9.2.2.1~~4.10.2.2.1 **Long-Term Plan to Protect Adult Salmon in the Lower Klamath River**

In addition, in various years since 2003, and particularly since 2013, certain fishery agencies, together with the Tribal Governments, have ~~been requesting~~requested additional late-season flows in the Trinity River above the 2000 ROD baseline flows (primarily in August and September) to prevent fish illness from instream crowding and warm waters in the lower Klamath River in drier years. In some cases, these releases were made in successive dry years and therefore had cumulative effects year to year, leading to lower storage in Trinity Reservoir and water supply and temperature impacts in the Sacramento and Trinity Rivers and Clear Creek.

Reclamation released a Record of Decision for the Long Term Plan to Protect Adult Salmon in the Lower Klamath River in 2017 (2017 ROD), which identified an adaptive management approach, a process, and criteria for Reclamation to determine if and when to provide supplemental flows from mid-August to late September from Lewiston Dam to prevent an episodic disease outbreak in the lower Klamath River in years when the criteria for such flows are met. These flows include a Preventative Base Flow component of a supplemental release of up to 40 TAF from Lewiston Dam over the course of approximately 30 days, beginning on or about August 23, with the intent of meeting and/or maintaining a target of up to 2,800 cfs in the lower Klamath River; a Preventative Pulse Flow component of up to 10 TAF release over 4 days to achieve a peak of 5,000 cfs in the lower Klamath River; and an Emergency Flow component which would be up to 34 TAF from Lewiston Dam over no more than 8 days, beginning on or about September 20 to meet a target of 5,000 cfs in the lower Klamath River. The 2017 ROD cited proviso 1 of Section 2 of the 1955 Act as authority for the releases. ~~Another proviso of Section 2 states that "not less than 50,000 acre-feet shall be released annually from the Trinity Reservoir and made available to Humboldt County and downstream water users."~~

~~4.9.2.3 *Grass Valley Creek Flows from Buckhorn Dam*~~

~~Reclamation proposes to release water from Buckhorn Dam to Grass Valley Creek in accordance with requirements published in the Buckhorn dam and reservoir standard operating procedures~~

~~manual for water rights permit 18879 issued to DWR, which establishes the timing and magnitude of minimum flows and flushing flows from the dam.~~

~~In addition, Reclamation proposes to increase flow from the dam outlet works for maintenance of the outlet channel and to cue juvenile salmonids in the reach to begin their downstream migration to the Trinity River. Reclamation proposes to release pulse flows when the reservoir water elevation exceeds 2,803.13 ft above sea level between March 1 and April 15 to the extent feasible.~~

~~Reclamation also proposes to increase flow in the outlet channel when necessary in October and November to provide adult Coho sufficient flow for upstream migration and spawning, to the extent feasible.~~

~~4.9.2.4~~4.10.2.3 *Whiskeytown Reservoir Operations*

Reclamation proposes to operate Whiskeytown Reservoir to: (1) regulate inflows for power generation and recreation; (2) support upper Sacramento River temperature objectives; and (3) provide for releases to Clear Creek, as proposed below. Two temperature curtains in Whiskeytown Reservoir were installed to pass cold water through the bottom layer of the reservoir and limit warming from Carr power plant to Clear Creek or Spring Creek Power Plant.

Whiskeytown Lake is annually drawn down by approximately 35 TAF of storage space during November through April to regulate flows for winter and spring flood management. Heavy rainfall events occasionally result in spillway discharges to Clear Creek. Operations at Whiskeytown Lake during flood conditions are complicated by its operational relationship with the Trinity River, Sacramento River, and Clear Creek. On occasion, imports of Trinity River water to Whiskeytown Reservoir may be suspended to avoid aggravating high flow conditions in the Sacramento Basin. Joint temperature control objectives also similarly interact among the Trinity River, Clear Creek, and Sacramento River.

~~4.9.2.5~~4.10.2.4 *Clear Creek Flows*

Reclamation proposes to release Clear Creek flows in accordance with the 1960 MOA with CDFW, and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Reclamation proposes a minimum base flow in Clear Creek of 200 cfs from October through May and 150 cfs ~~year-round~~from June to September in all year types except Critical year types. In Critical years, Clear Creek base flows may be reduced below 150 cfs based on available water from Trinity Reservoir. Additional flow may be required for temperature management during the fall.

In addition, Reclamation proposes to create pulse flows for both channel maintenance and spring attraction flows. For spring attraction flows, Reclamation would release 10 TAF (measured at the release), with daily release up to the safe release capacity (approximately 900 cfs, depending on reservoir elevation and downstream capacity), in all year-types except for Critical year-types to be shaped by the Clear Creek Implementation Team in coordination with CVO. For channel maintenance flows, Reclamation would release 10 TAF from Whiskeytown, with a daily release up to the safe release capacity, in all year-types except for Dry and Critical year-types (based on the Sacramento Valley index) to be shaped by the Clear Creek Implementation Team in coordination with CVO. Pulses would be scheduled with CVO. No channel maintenance flows would be scheduled before January 1. For each storm event that results in a Whiskeytown Gloryhole spill of at least 3,000 cfs for 3 days, Reclamation will reduce the channel maintenance flow volume for this

year or the following year by 5,000 acre-feet. If two Gloryhole spills occur that meet this criterion in a year, additional channel maintenance flows would not be released in that year. In Critical years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days and would not release any channel maintenance flows. Reclamation could instead, or in addition, use mechanical methods to mobilize gravel or shape the channel if needed to meet biological objectives ~~as part of adaptive management~~.

The outlet from Whiskeytown Reservoir to Clear Creek is equipped with outlets at two different elevations. Releases can be made from either or both outlets to manage downstream temperature releases. Reclamation proposes to manage Whiskeytown releases to meet a daily average water temperature of: (1) 60°F at the IGO gage from June 1 through September 15; and (2) 56°F or less at the IGO gage from September 15 to October 31. Reclamation may not be able to meet these temperatures in Critical or Dry water year types. In these years, Reclamation will operate to as close to these temperatures to the extent possible.

~~4.9.2.6~~4.10.2.5 *Spring Creek Debris Dam*

The Spring Creek Debris Dam (SCDD) was constructed to regulate runoff containing debris and acid mine drainage from Spring Creek, a tributary to the Sacramento River that enters Keswick Reservoir. The SCDD can store approximately 5,800 acre-feet of water. Operation of SCDD and Shasta Dam has allowed some control of the toxic wastes with dilution criteria. In January 1980, Reclamation, CDFW, and SWRCB executed an MOU to implement actions that protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. In the operational situation when heavy rainfall events will fill SCDD and Shasta Reservoir will not reach flood control conditions, increased releases from CVP storage may be required to maintain desired dilution ratios for metal concentrations. Since water released for dilution of toxic spills is likely to be in excess of other CVP requirements, such releases increase the risk of a loss of water for other beneficial purposes.

~~4.9.2.7~~4.10.2.6 *Clear Creek Restoration Program*

Reclamation and DWR propose to continue channel maintenance under the Clear Creek Restoration Program.

~~4.9.3~~4.10.3 Feather River

DWR will operate Oroville Dam consistent with the NMFS, USFWS, and CDFW environmental requirements applicable for the current FERC License for the Oroville Complex (FERC Project #2100-134). The downstream boundary of FERC's Oroville Project area is the Feather River above the city of Gridley. During the summer, DWR typically releases water from Lake Oroville to meet the requirements of instream flows and D-1641. Additional releases are made for local deliveries and exports at Banks Pumping Plant. DWR balances the cumulative storage between Lake Oroville and San Luis Reservoirs so as to meet its flood control requirements, Sacramento–San Joaquin Delta requirements, and deliver water supplies to its contracted water agencies consistent with all environmental constraints. Lake Oroville may be operated to convey water through the Delta to San Luis Reservoir via Banks under different schedules depending on Delta conditions, reservoir storage volumes, storage targets and regulatory requirements.

Decisions as to when to move water from Lake Oroville to San Luis Reservoir are based on many real-time factors.

~~4.9.4~~4.10.4 American River Division

Reclamation operates the CVP American River Division for flood control, M&I and agricultural water supplies, hydroelectric power generation, fish and wildlife protection, recreation, and Delta water quality. Facilities include the Folsom Dam, reservoir (977 TAF capacity), power plant, urban water supply temperature control device, and the Joint Federal Project auxiliary spillway as well as the Nimbus Dam, Lake Natoma, Nimbus Power Plant, and Folsom South Canal.

Folsom Reservoir is the main storage and flood control reservoir on the American River. Numerous other smaller reservoirs in the upper basin provide hydroelectric generation and water supply without specific flood control responsibilities. The total upstream reservoir storage above Folsom Reservoir is approximately 820 TAF and these reservoirs are operated primarily for hydropower production. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows (136 TAF); Hell Hole (208 TAF); Loon Lake (76 TAF); Union Valley (271 TAF); and Ice House (46 TAF). Reclamation coordinates with the operators of these reservoirs to aid in planning for Folsom Reservoir operations.

Releases from Folsom Dam are re-regulated approximately 7 miles downstream by Nimbus Dam. Nimbus Dam creates Lake Natoma, which serves as a forebay for diversions to the Folsom South Canal. Releases from Nimbus Dam to the American River pass through the Nimbus Power Plant, or the spillway gates at flows in excess of 5,000 cfs. Because Folsom Reservoir is the closest reservoir to the Delta, releases from Folsom can more quickly address Delta water quality requirements under D-1641.

Reclamation proposes to meet water rights, contracts and agreements that are both specific to the American River Division as well as those that apply to the entire CVP, including the Delta Division. For lower American River flows (below Nimbus Dam), Reclamation proposes to adopt the minimum flow schedule and approach proposed by the Water Forum in 2017. in the document titled "Lower American River – Standards for Minimum Flows" dated December 2018. Flows range from 500 to 2000 cfs based on time of year and annual hydrology. The flow schedule is intended to improve cold water pool and habitat conditions for Steelhead and Fall-Run Chinook Salmon. Specific flows are determined using an index intended to define the current and recent hydrology. Although Reclamation has assumed the index proposed by the Water Forum in 2017 for the purposes of modeling and analysis within this biological assessment, Reclamation intends to continue discussions with the Water Forum to ensure the index used for implementation is appropriate to meet the intended objectives under continuously changing hydrology.

Reclamation proposes to work together with the American River ~~Stakeholders~~water agencies to define an appropriate amount of storage in Folsom Reservoir that represents the lower bound for typical forecasting processes at the end of calendar year (the "planning minimum"). ~~The objective of the planning minimum is to preserve storage to protect against future drought conditions and to facilitate the development of the cold water pool when possible.~~The planning minimum brings Reclamation's forecasting process together with potential local actions that either increase Folsom storage or reduce demand out of Folsom Reservoir. The implementation of a planning minimum allows Reclamation to work with the American River Group to identify conditions when local water actions may be necessary to ensure storage is adequate for diversion from the municipal water intake at Folsom Dam and/or the extreme hydrology presents a risk that needs to be properly communicated to the public and surrounding communities. This planning minimum will be a single value (or potentially a series of values for different hydrologic year types) to be used for each year's forecasting process into the future. The objective of incorporating the planning minimum into the

forecasting process is to provide releases of salmonid-suitable temperatures to the lower American River and reliable deliveries (using the existing water supply intakes and conveyance systems) to American River water agencies that are dependent on deliveries or releases from Folsom Reservoir. This planning minimum is expected to be initially defined in 2019; however, it will be continuously evaluated between Reclamation and the Water Forum throughout implementation.

Reclamation expects infrequent scenarios where the forecasted storage may fall below the "planning minimum" due to a variety of circumstances and causes. In those instances, Reclamation and the American River ~~stakeholders~~water agencies will develop a list of potential off-ramp actions that may be taken to either improve forecasted storage or decrease demand on Folsom Reservoir. In its forecasting process for guiding seasonal operations, Reclamation will plan to maintain or exceed the planning minimum at the end of the calendar year. Reclamation has no legal liability should it fall below the planning minimum. When Reclamation estimates, using the forecasting process, that it would not be able to maintain Folsom Reservoir storage at or above the ~~end-of-December "~~planning minimum" for that year type (such as in extreme hydrologic conditions) or unexpected events cause the storage level to be at risk, American River ~~Division contractors~~water agencies would coordinate with Reclamation to identify and implement appropriate actions to improve forecasted storage conditions, and the American River ~~stakeholders~~water agencies would work together to educate the public on the actions that have been agreed upon and implemented and the reasons and basis for them. If potential changes to Folsom Dam operations would have impacts on other aspects of the CVP and SWP or the entire integrated system, Reclamation will meet and discuss these potential changes and impacts with water contractors.

Reclamation would ramp down to the revised minimum flows from Folsom Reservoir as soon as possible in the fall and maintain these flows, where possible.

~~4.9.4.1~~4.10.4.1 *Seasonal Operations*

In the winter and spring, flood control releases typically dominate the flow regime in the American River Division. Flood control operations occur to safely pass large storm events without exceeding the identified downstream levee capacity. This includes making dry-weather releases to ensure that the maximum storage adheres to the flood control elevation identified in the applicable Water Control Manual. Reclamation proposes to not reduce flows more than 500 cfs/day and not more than 100 cfs per hour except if necessary for flood control operations. Reclamation will minimize releases above 4,000 cfs during sensitive life stages (e.g., eggs, incubation, rearing) of salmonids and Steelhead to the extent feasible.

As part of implementing the 2017 Flow Management Standard, Reclamation proposes redd dewatering protective adjustments to limit potential redd dewatering due to reductions in the minimum release during the January through May period. Redd dewatering protective adjustments should limit the amount of dewatering due to a reduction of the minimum release, not the actual river release, and, as such, would not always minimize dewatering impacts to the same extent. In January and February, there is a Chinook Salmon redd dewatering protective adjustment, and in February through May there is a Steelhead redd dewatering protective adjustment.

During non-flood control operations within the fall and winter months, Reclamation proposes to operate to build storage by making minimum releases and capturing inflows, although drier conditions may also require releases for Delta requirements. To the extent possible, releases will be held relatively consistent to minimize potential redd dewatering.

Spring releases will be controlled by flood control requirements or, in drier hydrology, Delta requirements and water supply. Reclamation proposes to operate Folsom Dam in a manner designed to maximize capture of the spring runoff to fill as close to full as possible. To the extent practicable, Reclamation proposes to accommodate requests for spring pulse flows by re-shaping previously planned releases; however, these requests will not be accommodated in times when they may compromise temperature operations later in the year. Reclamation proposes to follow the 2017 Flow Management Standard, which includes a pulse flow event at some time during the period extending from March 15 to April 15 by supplementing normal operational releases from Folsom Dam under certain conditions when no such flow event has occurred between the preceding February 1 and March 1 timeframe. This spring pulse flow provides a juvenile salmonid emigration cue before relatively low flow conditions and associated unsuitable thermal conditions later in the spring, and downstream in the lower Sacramento River.

Reclamation proposes to continue to make summer releases for instream temperature control, Delta outflow, and exports, typically above the planning minimum flows. By late October, it is typical for Folsom Reservoir to have depleted the cold water pool. The primary way to provide additional instream cooling is to release water from the lower outlet works. This operation bypasses the power penstocks and has a significant impact on power generation. In order to optimize power generation, Reclamation proposes to limit power bypass operations solely to respond to emergency or unexpected events or during extreme drought years when a drought emergency has been declared by the Governor of California.

~~4.9.4.2~~4.10.4.2 *Temperature Management*

Reclamation proposes to prepare a draft Temperature Management Plan by May 15 for the summer through fall temperature management season using the best available (as determined by Reclamation) decision support tools. The information provided by the Operations Forecast will be used in the development of the Temperature Plan. The draft plan will contain: (1) forecasts of hydrology and storage; and (2) a modeling run or runs, using these forecasts, demonstrating what temperature compliance schedule can be attained. Reclamation will use an iterative approach, varying shutter configurations, with the objective to attain the best possible temperature schedule for the compliance point at Watt Avenue Bridge. The draft plan will be shared with the American River Group ~~(ARG)~~ before finalization~~,~~ and may be updated monthly based on system conditions.

Reclamation proposes to manage the Folsom/Nimbus Dam complex and the water temperature control shutters at Folsom Dam to maintain a daily average water temperature of 65°F (or other temperature as determined by the temperature modeling) or lower at Watt Avenue Bridge from May 15 through October 31, to provide suitable conditions for juvenile Steelhead rearing in the lower American River. If the temperature is exceeded for 3 consecutive days, Reclamation will notify NMFS and outline steps being taken to bring the water temperature back into compliance. During the May 15 to October 31 period, if the Temperature Plan defined temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at Watt Avenue may be increased incrementally (i.e., no more than 1°F every 12 hours) to as high as 68°F. The priority for use of the lowest water temperature control shutters at Folsom Dam shall be to achieve the water temperature requirement for listed species (i.e., Steelhead), and thereafter may also be used to provide cold water for Fall-Run Chinook Salmon spawning.

~~4.9.4.3~~4.10.4.3 *Conservation Measures*

Conservation measures are included to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses.

- Spawning and Rearing Habitat Named Projects: Project activities include primarily side channel and floodplain creation, expansion, and grading, spawning gravel and large cobble additions, and woody material additions. Pursuant to CVPIA 3406(b)(13), Reclamation proposes to implement the ~~Cordova Creek Phase II and Carmichael Creek Restoration~~ following projects~~, and increase woody material in the American River. Reclamation also proposes to conduct gravel augmentation and floodplain work at~~: Paradise Beach, Howe ~~Ave, Howe~~ Avenue to Watt Avenue rearing habitat, William Pond Outlet, Upper River Bend, Ancil Hoffman, ~~Sacramento Bar – North,~~ El Manto, Sacramento Bar~~—~~ North, Sacramento Bar South, Lower Sunrise, Sunrise, Upper Sunrise, Lower Sailor Bar, Upper Sailor Bar, Nimbus main channel and side channel, Discovery Park, Cordova Creek Phase II, Carmichael Creek Restoration and Sunrise Stranding Reduction.
- Reclamation proposes to continue maintenance activities at Nimbus Basin, Upper Sailor Bar, Lower Sailor Bar, Upper Sunrise, Lower Sunrise and River Bend restoration sites.
- Nimbus Hatchery: Reclamation will complete a Hatchery Genetics Management Plan for Steelhead and a Hatchery Management Plan for Fall-run Chinook Salmon as part of Nimbus Fish Hatchery management. Reclamation will work with CDFW and NMFS to establish clear goals, appropriate time horizons, and reasonable cost estimates for this effort.
- Drought Temperature Management: In severe or worse droughts, Reclamation proposes to evaluate and implement alternative shutter configurations at Folsom Dam to allow temperature flexibility ~~as part of adaptive management~~.

~~4.9.5~~4.10.5 Delta

CVP and SWP facilities in the Delta provide for delivery of water supply to areas within and immediately adjacent to the Delta, and to regions south of the Delta. The major CVP features are the DCC, Contra Costa Canal and Rock Slough Intake facilities, Jones Pumping Plant, and TFCF. The main SWP Delta features are Suisun Marsh facilities, Banks Pumping Plant, CCF, Skinner Fish Facility, and Barker Slough Pumping Plant. These facilities and their operation under the proposed action are described in subsequent sections.

The CVP Jones Pumping Plant, located about 5 miles north of Tracy, has six fixed-speed pumps. It has a permitted diversion capacity of 4,600 cfs and sits at the end of an earth-lined intake channel about 2.5 miles long. The Jones Pumping Plant discharges into the head of the Delta Mendota Canal (DMC). The upper portion of the DMC is heavily impacted by subsidence which limits the maximum pumping rates to less than the permitted capacity. The SWP Banks Pumping Plant, located near the Jones Pumping Plant, has 11 variable speed pumps that allow for more control over the diversion rate. Pumping is limited to a maximum permitted capacity of 10,300 cfs per day. The Banks Pumping Plant discharges into the California Aqueduct. The Delta Mendota Canal Intertie (capacity 467 cfs from DMC to California Aqueduct; Capacity 900 cfs from California Aqueduct to DMC) is used to move water between the California Aqueduct and the Delta Mendota Canal. This structure was built to help both projects more effectively move water from the Delta into the San Luis Reservoir. This helps both projects when there are system restrictions that may prevent one party from moving water.

Banks pumps water directly from storage in CCF. The CCF radial gates are closed during critical periods of the ebb/flood tidal cycle to protect water levels experienced by local agricultural water diverters in the south Delta area. As a practical matter, Banks pumping rates are constrained operationally by limits on Clifton Court diversions from the Delta. The maximum daily diversion limit from the Delta into CCF is 13,870 acre-feet per day (6,990 cfs/day) and the maximum averaged diversion limit over any 3 days is 13,250 acre-feet per day (6,680 cfs/day). In addition to these requirements, DWR may increase diversions from the Delta into CCF by one-third of the San Joaquin River flow at Vernalis from mid-December through mid-March when flows at Vernalis exceed 1,000 cfs. These limits are listed in the USACE Public Notice 5820A Amended (Oct. 13, 1981).

During July through September, the maximum daily diversion limit from the Delta into CCF is increased from 13,870 acre-feet per day (6,990 cfs/day) to 14,860 acre-feet per day (7,490 cfs/day) and the maximum averaged diversion limit over any 3 days is increased from 13,250 acre-feet per day (6,680 cfs/day) to 14,240 acre-feet per day (7,180 cfs/day). These increases are for the purpose of recovering water supply losses incurred earlier in the same year to protect ESA-listed fish species. Those increases are a separate action permitted for short-term time periods. Further, Banks Pumping Plant will pump 195,000 acre-feet to the CVP in accordance with the 2018 COA Addendum.

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct for delivery to the Solano County Water Agency (SCWA) and the Napa County Flood Control and Water Conservation District (Napa County FC&WCD) (NBA entitlement holders).

~~4.9.5.1~~4.10.5.1 *Seasonal Operations*

Winter and spring pumping operations generally maximize exports of excess, unregulated, unstored water to help meet project demands later in the ~~seasonand~~season and for Delta water quality. In order to minimize and avoid adverse effects on listed species, actions have been taken or imposed in the past to protect fish migration and minimize fish entrainment at Jones and Banks Pumping Plants. These restrictions limit the projects' ability to export excess water in the winter and spring and place a higher reliance on exporting previously stored water in the summer and fall.

Summer is generally a period of higher export potential. During the summer the CVP and SWP typically operate to convey previously stored water across the Delta for exporting at the Project pumps or other Delta facilities. Delta concerns during the summer are typically focused on maintaining salinity and meeting outflow objectives while maximizing exports with the available water supply.

Fall Delta operations typically begin as demands decrease, accretions increase within the system, and reservoir releases are decreasing to start conserving water. Exports are typically maximized to export available water in the system and may decrease if the fall remains dry. As precipitation begins to fall within the Sacramento and San Joaquin Basins, the reservoirs focus on building storage and managing for flood control. The enactment of D-1641 required higher spring releases; as a result, reservoir storage levels were lower in the fall and Reclamation and DWR had less need for flood releases. The 2008 biological opinion included an adaptive management action requiring an increase in fall flows to manage salinity in years following wet and above-normal years. However, lower fall outflows would better mimic historical (pre-project) conditions, and analyses indicate that the CVP and SWP have had negligible effects on fall outflows measured using X2 as a proxy (Hutton et al. 2017).

~~4.9.5.2~~4.10.5.2 *Minimum Export Rates*

Water rights, contracts, and agreements specific to the Delta include D-1641, COA and other related agreements pertaining to CVP and SWP operations and Delta watershed users. In order to meet health and safety needs, critical refuge supplies, and obligations to senior water rights holders, the combined CVP and SWP export rates at Jones Pumping Plant and Banks Pumping Plant will not be required to drop below 1,500 cfs. Reclamation and DWR propose to use the Sacramento River, San Joaquin River, and Delta channels to transport water to export pumping plants located in the south Delta.

~~4.9.5.3~~4.10.5.3 *Delta Cross Channel*

The DCC is a controlled diversion channel between the Sacramento River and Snodgrass Slough. When DCC gates are open, water is diverted from the Sacramento River through a short excavated channel into Snodgrass Slough and then flows through natural channels for about 50 miles to the vicinity of Banks and Jones Pumping Plants.

Reclamation operates the DCC in the open position to (1) improve the movement of water from the Sacramento River to the export facilities at the Banks and Jones Pumping Plants; (2) improve water quality in the central and southern Delta; and (3) reduce salinity intrusion rates in the western Delta. During the late fall, winter, and spring, the gates are often periodically closed to protect out-migrating salmonids from entering the interior Delta and to facilitate meeting the D-1641 Rio Vista flow objectives for fish passage. In addition, whenever flows in the Sacramento River at Sacramento reach 20,000 to 25,000 cfs (on a sustained basis), the gates are closed to reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates.

Reclamation proposes to operate the DCC gates to reduce juvenile salmonid entrainment risk beyond actions described in D-1641, consistent with Delta water quality requirements in D-1641. From October 1 to November 30, if the Knights Landing Catch Index or Sacramento Catch Index are greater than three fish per day Reclamation proposes to operate in accordance with Table 4-~~11~~10 and Table 4-~~12~~11 to determine whether to close the DCC gates and for how long. From December 1 to ~~May 20~~January 31, the DCC gates will be closed, unless Reclamation determines that it can avoid D-1641 water quality exceedances by opening the DCC gates for up to 5 days for up to two events within this period. ~~If~~During a critical year following a dry or critical year, if there is a conflict between water quality and species ~~in the~~between December /1 to January 31 period~~ due to drought~~, Reclamation and DWR propose to coordinate with USFWS~~ and~~, NMFS ~~through the Fish Monitoring Working Group.~~ and the SWRCB on how to balance competing requirements.

From May 21 to June 15, Reclamation will close the DCC gates for 14 days during this period, consistent with D-1641. Reclamation and DWR's risk assessment will consider the Knights Landing RST, Delta juvenile fish monitoring program (Sacramento trawl, beach seines), Rio Vista flow standards, acoustic telemetered fish monitoring information as well as DSM2 modeling informed with recent hydrology, salinity, and tidal data. Reclamation will evaluate this information to determine if fish responses may be altered by DCC operations. If the risk assessment determines that survival, route entrainment, or behavior change to create a new adverse effect not considered under this proposed action, Reclamation will not open the DCC.

Table 4-~~11.~~ 10. Delta Cross Channel October 1–November 30 Action

Date	Action Triggers	Action Responses
October 1–November 30	Water quality criteria per D-1641 are met and either the Knights Landing Catch Index or Sacramento Catch Index is greater than five fish per day	Within 48 hours, close the DCC gates and keep closed until the catch index is less than three fish per day at both the Knights Landing and Sacramento monitoring sites
	Water quality criteria per D-1641 are met, either Knights Landing Catch Index or the Sacramento Catch Index are greater than three fish per day but less than or equal to five fish per day	Within 48 hours of trigger, DCC gates are closed. Gates will remain closed for 3 days
	Water quality criteria per D-1641 are met, real-time hydrodynamic and salinity modeling shows water quality concern level targets are not exceeded during ~~28-day period following DCC closure and there is no observed deterioration of interior Delta water quality~~	Within 48 hours of start of LMR attraction flow release, close the DCC gates for up to 5 days ~~(dependent upon continuity of favorable water quality conditions)~~
	28-day period following DCC closure and there is no observed deterioration of interior Delta water quality	(dependent upon continuity of favorable water quality conditions)
	Water quality criteria per D-1641 are met, real time hydrodynamic and salinity modeling shows water quality concern level targets are exceeded during 14-day period following DCC closure	No closure of DCC gates
	The KLCI or SCI triggers are met but water quality criteria are not met per D-1641 criteria	Monitoring groups review monitoring data and provide to Reclamation. Reclamation and DWR determine what to do with a risk assessment

Table 4-~~12.~~ 11. Water Quality Concern Level Targets

Water Quality Concern Level Targets (Water Quality Model simulated 14-day average Electrical Conductivity)	Water Quality Concern Level Targets (Water Quality Model simulated 14-day average Electrical Conductivity)
Jersey Point	1800 umhos/cm
Bethel Island	1000 umhos/cm
Holland Cut	800 umhos/cm
Bacon Island	700 umhos/cm

~~4.9.5.4~~4.10.5.4 *Agricultural Barriers*

DWR proposes to continue to install three agricultural barriers at the Old River at Tracy, Middle River, and Grant Line Canal each year when necessary~~.~~ to improve quality and channel water levels in the south Delta area. The barriers are installed between April to July and removed in November. Barriers would include at least one culvert open to allow for fish migration when water temperatures are less than 22°C. The barriers provide an adequate agricultural water supply in terms of quantity, quality, and channel water levels to meet the needs of water users in the south Delta area.

~~4.9.5.5~~4.10.5.5 *North Bay Aqueduct*

~~The proposed operation of Barker Slough Pumping Plant is a maximum 7-day average diversion rate that shall not exceed 50 cfs from January 15 through March 31 of dry and critically dry years (per the current forecast based on D-1641) if larval Delta Smelt are detected at Station 716 during the annual Smelt Larval Survey.~~

The North Bay Aqueduct and Barker Slough Pumping Plant will continue to operate under applicable regulatory requirements.

4.10.5.5.1 Sediment Removal

Sediment accumulates in the concrete apron sediment trap in front of the BSPP fish screens and within the pump wells behind the fish screens. Sediment removal from the sediment trap and the pump wells will be removed as needed.

4.10.5.5.2 Aquatic Weed Removal

Aquatic weeds will be removed, as needed, from in front of the fish screens at BSPP. Aquatic weeds accumulate on the fish screens, blocking water flow, and causing water levels to drop behind the screens in the pump wells. The low water level inside of the pump wells causes the pumps to automatically shut off to protect the pumps from cavitation. Aquatic weed removal system consists of grappling hooks attached by chains to an aluminum frame. A boom truck, staged on the platform in front of the BSPP pumps, will lower the grappling system into the water to retrieve the accumulated aquatic vegetation. The removed aquatic weeds will be transported to two aggregate base spoil sites located near the pumping plant.

~~4.9.5.6~~4.10.5.6 *Contra Costa Water District Operations*

The CCWD diverts water from the Delta for irrigation and M&I uses under its CVP contract, under its own water right permits and license issued by the SWRCB, and under East Contra Costa Irrigation District's pre-1914 water right. The CCWD water system includes the Mallard Slough, Rock Slough, Old River, and Middle River (on Victoria Canal) intakes; the Rock Slough Fish Screen (constructed in 2011 under the authority of CVPIA 3406(b)(5)); the Contra Costa Canal and shortcut pipeline; and the Los Vaqueros Reservoir. The Rock Slough Intake, Contra Costa Canal, and shortcut pipeline are owned by Reclamation, and operated and maintained by CCWD under contract with Reclamation. Mallard Slough Intake, Old River Intake, Middle River Intake, and Los Vaqueros Reservoir are owned and operated by CCWD. The Rock Slough Intake, Contra Costa Canal, and shortcut pipeline are owned by Reclamation" add a footnote that says "Federal legislation providing the authority for Reclamation to transfer title of the facilities was passed by Congress and signed by the President in March 2019. CCWD and Reclamation are beginning the title transfer process, which includes conducting the required environmetal and property record review to execute the transfer.

Operations at CCWD's intakes and Los Vaqueros Reservoir are governed by biological opinions from NMFS (NMFS 1993, 2007, 2010, 2017) and USFWS (USFWS 1993a, 1993b, 2000; 2007, 2010, 2017), an MOU with CDFW (CDFG 1994), and an incidental take permit from CDFW (CDFW 2009), which are separate from the biological opinions for the coordinated long-term operation of the CVP and SWP. Reclamation is not consulting on the biological opinions that govern CCWD's intakes and Los Vaqueros Reservoir, nor will this consultation amend or supersede those separate biological opinions. For the proposed action in this consultation, CCWD's operations are

consistent with the current implementation of the operational criteria specified in those separate biological opinions.

Reclamation will work with CCWD to ensure that implementation of the proposed action will not restrict CCWD operations beyond the restrictions of the separate biological opinions, allowing CCWD to have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current conditions.

Rock Slough Intake is located on Rock Slough at the head of the Contra Costa Canal, approximately 3.5 miles west of the junction of Rock Slough and Old River. The Rock Slough Fish Screen (RSFS) was constructed in 2011 at the Rock Slough Intake for the protection of listed species, in accordance with provisions specified in the 1993 USFWS biological opinion for the Los Vaqueros Project (USFWS 1993).

The 2008 USFWS biological opinion for the coordinated long-term operation of the CVP and SWP (USFWS 2008) and the 2009 CDFW ITP for the CCWD operations (CDFG 2009) considered the effects of the diversion of water at Rock Slough intake before the RSFS was constructed. In accordance with the 2009 ITP, CCWD obtained 36 acres of aquatic species habitat mitigation credits intended to address all of CCWD's intakes, assuming that Rock Slough was unscreened. Aquatic species impacts are now less given that the RSFS has been constructed (Reclamation 2016).

USFWS 2008 quantified incidental take and exempted prohibitions associated with all CCWD diversions as all Delta Smelt inhabiting the water diverted in the assumed 195 thousand acre-feet (TAF) maximum diversion amount (USFWS 2008, 2017). In a 2009 letter from USFWS regarding the effects of the RSFS on ~~delta smelt~~Delta Smelt and its critical habitat, USFWS acknowledges that "[s]ince the Rock Slough diversion will now be screened, less entrainment will be expected than what was described in the 2008 biological opinion and the expected incidental take remains the same."

In the proposed action, CCWD's operations are consistent with the operational criteria specified in separate biological opinions and permits that govern operations at CCWD's intakes and Los Vaqueros Reservoir (NMFS 1993, 2007, 2010, 2017; USFWS 1993a, 1993b, 2000, 2007, 2010, 2017; CDFG 1994, 2009) and remain unchanged from the current operations scenario.

Reclamation is not consulting on the NMFS 2017 biological opinion at this time and is not requesting any amendments to that biological opinion. However, the NMFS 2017 biological opinion indicates that the NMFS 2009 biological opinion on the long-term coordinated operations of the CVP and SWP, which is the subject of this consultation, analyzed the actual diversion of water through the Rock Slough Intake (NMFS 2017: 87). Consistent with the 2008 USFWS biological opinion, Reclamation is requesting incidental take coverage for all water diverted at the Rock Slough Intake up to the maximum capacity of the intake (350 cfs) for the maximum annual diversion of 195 TAF.

~~4.9.5.7~~4.10.5.7 *Water Transfers*

Reclamation and DWR propose to transfer project and non-project water supplies through CVP and SWP facilities. Water transfers would occur through various methods, including, but not limited to, groundwater substitution, release from storage, and cropland idling, and would include individual and multi-year transfers. The effects of developing supplies for water transfers in any individual year or a multi-year transfer is evaluated outside of this proposed action. Water transfers would occur from July through November in total annual volumes up to those described in Table 4-~~13~~12.

Table 4-~~13~~12. Proposed Annual Water ~~Transfers~~Transfer Volume

Water Year Type	Maximum Transfer Amount (TAF)
Critical	Up to 600
Dry (following Critical)	Up to 600
Dry (following Dry)	Up to 600
All other years	Up to 360

As part of this proposed action, Reclamation and DWR will provide a transfer window from July 1 through November 30. Allowing fall transfers is expected to have water supply benefits and may provide flexibility to improve Sacramento River temperature operations, such as occurred during the 2014–2015 drought conditions. Real-time operations may restrict transfers within the transfer window so that Reclamation and DWR can meet other authorized project purposes, e.g., when pumping capacity is needed for CVP or SWP water.

~~4.9.5.8~~4.10.5.8 *Clifton Court Aquatic Weed ~~Removal~~and Algal Bloom Management*

DWR will apply herbicides or will use mechanical harvesters on an as-needed basis to control aquatic weeds and algal blooms in CCF. Herbicides may include Aquathol K, ~~Komeen®,~~ a chelated copper herbicide (copper-ethylenediamine complex and copper sulfate pentahydrate) and ~~Nautique®,~~ a copper carbonate compound, or other copper-based herbicides. Algaecides may include peroxygen-based algaecides (e.g., PAK 27). These products are used to control algal blooms that can degrade drinking water quality through ~~tastes and odors and~~ production of taste and odor compounds of algal toxins. Dense growth of submerged aquatic weeds~~, predominantly Egeria densa,~~ can cause severe head loss and pump cavitation at Banks Pumping Plant when the stems of the rooted plant break free and drift into the trashracks. This mass of uprooted and broken vegetation essentially forms a watertight plug at the trashracks and vertical louver array. The resulting blockage necessitates a reduction in the pumping rate of water to prevent potential equipment damage through cavitation at the pumps~~.~~ and excessive weight on the louver array causing collapse of the structure. Cavitation creates excessive wear and deterioration of the pump impeller blades. Excessive floating weed mats also reduce the efficiency of fish salvage at the Skinner Fish Facility. Ultimately, this all results in a reduction in the volume of water diverted by the SWP. In addition, dense stands of aquatic weeds provide cover for unwanted predators that prey on listed species within the CCF. Aquatic weed control is included as a conservation measure to reduce mortality of ESA-listed fish species within the CCF (see section *4.95.11.3 Skinner Fish Facility Improvements*).

Mechanical methods are utilized to manually remove aquatic weeds. A debris boom and an automated weed rake system continuously remove weeds entrained on the trashracks. During high weed load periods such as late summer and fall when the plants senesce and fragment or during periods of hyacinth entrainment, boat-mounted harvesters are operated on an as-needed basis to remove aquatic weeds in the Forebay and the intake channel upstream of the trashracks and louvers. The objective is to decrease the weed load on the trashracks and to improve flows in the channel. Effectiveness is limited due to the sheer volume of aquatic weeds and the limited capacity and speed of the harvesters. Harvesting rate for a typical weed harvester ranges from 0.5 to 1.5 acres per hour or 4 to 12 acres per day. Actual harvest rates may be lower due to travel time to off-loading sites, unsafe field conditions such as high winds, and equipment maintenance.

Aquatic weed and algae treatments would occur on an as-needed basis depending upon the level of vegetation biomass, the cyanotoxin concentration from the harmful algal blooms (HAB~~), or~~

~~concentration of taste and odor compounds.~~), or concentration of taste and odor compounds . The frequency of aquatic herbicide applications to control aquatic weeds is not expected to occur more than twice per year, as demonstrated by the history of past applications. Aquatic herbicides are ideally applied early in the growing season when plants are susceptible to them during rapid growth and formation of plant tissues; or later in the season, when plants are mobilizing energy stores from their leaves towards their roots for overwintering senescence. The frequency of algaecide applications to control HABs is not expected to occur more than once every few years, as indicated by monitoring data and demonstrated by the history of past applications. Treatment areas are typically about 900 acres, and no more than 50% of the 2,180 total surface acres.

Aquatic weed assemblages change from year to year in the CCF from predominantly *Egeria densa* to one dominated by curly-leaf pondweed, sago pondweed, and southern naiad. To effectively treat a dynamic aquatic weed assemblage and harmful algal blooms, multiple aquatic pesticide compounds are required to control aquatic weeds and algal blooms in CCF. The preferred products are:

- Aquathol K, an endothall-based aquatic herbicide, that is effective on pondweeds;
- copper-based compounds that are effective on *E. densa*, cyanobacteria and green algae. The copper-based aquatic herbicides include copper sulfate pentahydrate and chelated copper herbicides; and
- peroxygen-based algaecides (e.g., PAK 27) that are effective on cyanobacteria.
- Aquathol K

The dipotassium salt of endothall is used for control of aquatic weeds and is the active ingredient in Aquathol® K (liquid formulation). Aquathol K is a widely used herbicide to control submerged weeds in lakes and ponds, and the short residual contact time (12-48 hours) makes it effective in both still and slow-moving water. Aquathol K is effective on many weeds, including hydrilla, milfoil, and curly-leaf pondweed, and begins working on contact to break down cell structure and inhibit protein synthesis. Without the ability to grow, the weed dies. Full kill takes place in 1 to 2 weeks. As weeds die, they sink to the bottom and decompose. Aquathol K is not effective at controlling E. densa.

Aquathol K is registered for use in California and has effectively controlled pondweeds and southern naiad in CCF and in other lakes. Endothall has low acute and chronic toxicity effects to fish. The LC50 for salmonids is 20-40 times greater than the maximum concentration allowed to treat aquatic weeds. The EPA maximum concentration allowed for Aquathol K is 5 ppm. A recent study (Courter et al. 2012) of the effect of Cascade® (same endothall formulation as Aquathol K) on salmon and steelhead smolts showed no sublethal effects until exposed to 9-12 ppm, that is, 2-3 times greater than the 5 ppm maximum concentration allowed by the EPA and about 4-6 times greater than the 2-3 ppm applied in past CCF treatments. In the study, steelhead and salmon smolts showed no statistical difference in mean survival between the control group and treatment groups, however, steelhead showed slightly lower survival after 9 days at 9-12 ppm. Based on the studies with salmonids, Aquathol K applied at or below the EPA maximum allowable concentration of 5 ppm poses a low to no toxicity risk to salmon, steelhead and other fish. No studies have assessed the exposure risk to green sturgeon.

When aquatic plant survey results indicate that pondweeds are the dominant species in CCF, Aquathol K will be selected due to its effectiveness in controlling these species. Aquathol K will be applied according to the label instructions, with a target concentration dependent upon plant biomass, water volume, and forebay depth. The target concentration of treatments is 2- to 3 ppm, which is well below the concentration of 9-12 ppm where sublethal effects have been observed (Courter et al.

2012). DWR monitors herbicide concentration levels during and after treatment to ensure levels do not exceed the Aquathol K application limit of 5 ppm. Additional water quality testing may occur following treatment for drinking water intake purposes. Samples are submitted to a laboratory for analysis. There is no "real time" field test for endothall. No more than 50% of the surface area of CCF will be treated at one time. A minimum contact time of 12 hours is needed for biological uptake and treatment effectiveness, but the contact time may be extended up to 24 hours to reduce the residual endothall concentration for NPDES compliance purposes.

4.10.5.8.1 Copper-based Aquatic Herbicides and Algaecides

Copper herbicides and algaecides include chelated copper products and copper sulfate pentahydrate crystals. When aquatic plant survey results indicate that E. densa is the dominant species, copper-based compounds will be selected due to their effectiveness in controlling this species. E. densa is not affected by application of Aquathol K. Copper-based algaecides are effective at controlling algal blooms (cyanobacteria) that produce cyanotoxins or taste and odor compounds.

Copper herbicides and algaecides will be applied in a manner consistent with the label instructions, with a target concentration dependent upon target species and biomass, water volume and the depth of the forebay. Applications of copper herbicides for aquatic weed control will be applied at a concentration of 1 ppm with an expected dilution to 0.75 ppm upon dispersal in the water column. Applications for algal control will be applied at a concentration of 0.2 to 1 ppm with expected dilution within the water column. DWR will monitor dissolved copper concentration levels during and after treatment to ensure levels do not exceed the application limit of 1 ppm, per NPDES permit required procedures. Treatment contact time will be up to 24 hours. If the dissolved copper concentration falls below 0.25 ppm during an aquatic weed treatment, DWR may opt to open the radial gates after 12 hours but before 24 hours to resume operations. Opening the radial gates prior to 24 hours would enable the rapid dilution of residual copper and thereby shorten the exposure duration of ESA-listed fish to the treatment. No more than 50% of the surface area of CCF will be treated at one time.

4.10.5.8.2 Peroxygen-Based Algaecides

PAK 27 algaecide active ingredient is sodium carbonate peroxyhydrate. An oxidation reaction occurs immediately upon contact with the water destroying algal cell membranes and chlorophyll. There is no contact or holding time requirement, as the oxidation reaction occurs immediately and the byproducts are hydrogen peroxide and oxygen. There are no fishing, drinking, swimming, or irrigation restrictions following the use of this product. PAK 27 has NSF/ANSI Standard 60 Certification for use in drinking water supplies at maximum-labeled rates and is certified for organic use by the Organic Materials Reviews Institute (OMRI).

PAK 27, or equivalent product, will be applied in a manner consistent with the label instructions, with permissible concentrations in the range of 0.3 to 10.2 ppm hydrogen peroxide. No more than 50% of the surface area of CCF will be treated at one time.

The following are operational procedures to minimize impacts on listed species during aquatic herbicide treatment for application of Aquathol K and copper-based products and algaecide treatment for application of peroxide-based algaecides in CCF:

- Apply Aquathol K and copper-based aquatic pesticides, as needed, ~~after~~from June 28 to August 31.

- Apply Aquathol K and copper-based aquatic pesticides, as needed, prior to June 28 or after August 31 if the average daily water temperatures within CCF ~~are~~ is at or above above 25°C ~~or after~~and if Delta smelt, salmonids, and green sturgeon are not at additional risk from the treatment as conferred by NMFS and USFWS.
    - Prior to treatment outside of the June 28 ~~(as July 1 is a critical operational~~to August 31 timeframe~~) and prior to the activation of Delta Smelt and salmonid protective measures following the first flush rainfall event in fall/winter~~, DWR will notify and confer with NMFS and USFWS on whether ESA-listed fish species are present and at risk from the proposed treatment.
- Apply Aquathol K and copper-based aquatic pesticides ~~within CCF~~, as needed, during periods of activated Delta Smelt and salmonid protective measures and when average daily water temperature in CCF is below 25°C if the following conditions are met:
    - Prior to treatment outside of the June 28 to August 31 timeframe, DWR will notify and confer with NMFS and USFWS on whether ESA-listed fish species are present and at risk from the proposed treatment.
    - The herbicide application ~~begins~~does not begin until after the radial gates have been closed for 24 hours or after the period of predicted Delta Smelt and salmonid survival within CCF (e.g. ~~temperatures within CCF are above 25°C~~after predicted mortality has occurred due to predation or other factors) has been exceeded, and
    - The radial gates remain closed for 24 hours after the completion of the application, ~~or~~unless it is conferred that rapid dilution of the herbicide would be beneficial to reduce the exposure duration to listed fishes present within the CCF.
- ~~The applied herbicide is PAK 27.~~Apply peroxygen-based aquatic algaecides, as needed, year-round.
- There are no anticipated impacts on fish with the use of ~~PAK 27~~peroxygen-based aquatic algaecides in CCF during or following treatment.
- Monitor the salvage of listed fish at the Skinner Fish Facility prior to the application of the aquatic herbicides and algaecides in CCF.
- ~~Close~~For Aquathol K and copper compounds, the radial intake gates will be closed at the entrance to CCF prior to the application of ~~herbicides~~pesticides to allow fish to move out of the ~~proposed~~targeted treatment areas and toward the salvage facility and to prevent any possibility of aquatic ~~herbicide~~pesticide diffusing into the Delta.
- For Aquathol K and copper compounds, the radial gates will remain closed for ~~12~~ a minimum of 12and up to 24 hours after treatment to allow for the recommended duration of contact time between the aquatic ~~herbicide or algaecide~~ pesticide and the treated vegetation or cyanobacteria in the forebay~~.~~, and to reduce residual endothall concentration for drinking water compliance purposes. (Contact time is dependent upon ~~herbicide~~pesticide type, applied concentration, and weed or algae assemblage). Radial gates would be reopened after a minimum of 36 hours (24 hours~~.~~ pre-treatment closure plus 12 hours post-treatment closure).
- For peroxide-based algaecides, the radial gates will be closed prior to the application of the algaecide to prevent any possibility of the algaecide diffusing into the Delta. The radial gates may reopen immediately after the treatment as the required contact time is less than 1 minute and there is no residual by-product of concern.

- Application ~~would~~will be made by a licensed applicator under the supervision of a California Certified Pest Control Advisor.
- Aquatic herbicides and algaecides ~~would~~will be applied by boat~~, starting~~ or by aircraft.
    - Boat applications will be by subsurface injection system for liquid formulations and boat-mounted hopper dispensing system for granular formulations. Applications would start at the ~~shore~~shoreline and ~~moving~~move systematically farther offshore ~~in its application~~, enabling fish to move out of the treatment area.
    - Aerial applications of granular and liquid formulations will be by helicopter or aircraft. No aerial spray applications will occur during windspeeds above 15 mph to prevent spray drift.
- Application would be to the smallest area possible that provides relief to SWP operations or water quality. No more than 50% of CCF will be treated at one time.
- ~~Monitoring of~~Water quality samples to monitor copper and endothall ~~concentration in~~concentrations within or adjacent to the ~~water column~~treatment area, per the NPDES permit requirements, will ~~occur~~be collected before, during and after application. Additional water quality samples may be collected during the following treatment for drinking water compliance purposes. No monitoring of copper or endothall concentrations in the sediment or detritus is proposed.
- No monitoring of peroxide ~~(PAK 27)~~ concentration in the water column will occur during and after application as the reaction is immediate and there is no residual. Dissolved oxygen concentration will be measured prior to and immediately following application within and adjacent to the treatment zone.
- ~~No aerial spray applications will occur during rain or within 48 hours of forecasted precipitation.~~
- A spill prevention plan will be implemented in the event of an accidental spill.

Aquatic weed and algae treatments would occur on an as-needed basis. The timing of application is an avoidance measure and is based on the life history of Chinook Salmon and Steelhead in the Central Valley's Delta region and of Delta Smelt. Green sturgeon are present in the area year-round. Migrations of juvenile Winter-Run Chinook Salmon and Spring-Run Chinook Salmon primarily occur outside of the summer period in the Delta. Central Valley Steelhead have a low probability of being in the south Delta during late June when temperatures exceed 25°C through the first rainfall flush event, which can occur as late at December in some years (Grimaldo 2009). Delta Smelt are not expected to be in CCF during this time period. Delta Smelt are not likely to survive when water temperatures reach a daily average of 25°C, and they are not expected to occur in the Delta prior to the first flush event. Therefore, the likelihood of herbicide exposure to Chinook Salmon, Central Valley Steelhead, and Delta Smelt during the proposed herbicide treatment timeframe in CCF is negligible.

Additional protective measures will be implemented to prevent or minimize adverse effects from herbicide applications. As described above, applications of aquatic herbicides and algaecides will be contained within CCF. The radial intake gates to CCF will be closed prior to, during, and following the application. The radial gates will remain closed during the recommended minimum contact time based on herbicide type, application rate, and aquatic weed or algae assemblage. Additionally, following the gatge closure and prior to ~~aquatic herbicide~~the applications ~~following gate closures~~of Aquathol K and copper-based pesticides, the water is drawn down in the CCF via the Banks Pumping Plant. This drawdown helps facilitate the movement of fish in the CCF toward the fish diversion screens and into the fish protection facility, ~~and it~~ lowers the water level in the CCF to decrease the total amount of herbicide ~~that would need~~needed to be applied, per volume of water, and aides in the

dilution of any residual pesticide post-treatment. Following reopening of the gates and refilling of CCF, the rapid dilution of any residual pesticide and the downstream dispersal of the treated water into the California Aquaduct via Banks PP will reduce the exposure time of any ESA-listed fish species present in CCF.

~~4.9.5.9~~4.10.5.9 *Suisun Marsh Preservation Agreement*

The SMPA among DWR, Reclamation, CDFW, and Suisun Resource Conservation District (SRCD) contains provisions for DWR and Reclamation to mitigate the effects on Suisun Marsh channel water salinity from SWP and CVP operations and other upstream diversions. The SMPA requires DWR and Reclamation to meet salinity standards in accordance with D-1641, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements.

There are two primary physical mechanisms for meeting salinity standards set forth in D-1641 and the SMPA: (1) the implementation and operation of physical facilities in the Marsh; and (2) management of Delta outflow (i.e., facility operations are driven largely by salinity levels upstream of Montezuma Slough and salinity levels are highly sensitive to Delta outflow). Physical facilities (described below) have been operating since 1988 and have proven to be a highly reliable method for meeting standards.

The SMSCG are located on Montezuma Slough about 2 miles downstream from the confluence of the Sacramento and San Joaquin Rivers, near Collinsville. The objective of Suisun Marsh Salinity Control Gate operation is to decrease the salinity of the water in Montezuma Slough. The gates control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west through Suisun Marsh.

The SMSCG are operated during the salinity control season, which spans from October to May. Operational frequency is affected by hydrologic conditions, weather, Delta outflow, tide, fishery considerations, and other factors. The boat lock portion of the gate is now held open at all times during SMSCG operation to allow for continuous salmon passage opportunity. However, the boat lock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

Assuming no significant long-term changes in the drivers mentioned above, it is expected that gate operations will remain at current levels (17–69 days per year) except perhaps during the most critical hydrologic conditions.

The Roaring River Distribution System (RRDS) was constructed to provide lower salinity water to 5,000 acres of private and 3,000 acres of CDFW managed wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly Islands. The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough. Water is diverted through a bank of eight 60-inch-diameter culverts equipped with fish screens into the Roaring River intake pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. After the listing of Delta Smelt, RRDS diversion rates have been controlled to maintain an average approach velocity below 0.7 ft/second at the intake fish screen.

The Morrow Island Distribution System (MIDS) allows Reclamation and DWR to provide water to the ownerships so that lands may be managed according to approved local management plans. The system was constructed primarily to channel drainage water from the adjacent managed wetlands for discharge into Suisun Slough and Grizzly Bay. This approach increases circulation and reduces salinity in Goodyear Slough. The MIDS is used year-round, but most intensively from September through June. When managed wetlands are filling and circulating, water is tidally diverted from Goodyear Slough just south of Pierce Harbor.

~~4.9.5.10~~4.10.5.10 *OMR Management*

Reclamation and DWR propose to operate the CVP and SWP in a manner that maximizes exports while minimizing entrainment of fish and protecting critical habitat. Net flow OMR provides a surrogate indicator for how export pumping at Banks and Jones Pumping Plants influence hydrodynamics in the south Delta. The management of OMR, in combination with other environmental variables, can minimize or avoid the entrainment of fish in the south Delta and at CVP and SWP salvage facilities. Reclamation and DWR propose to maximize exports by incorporating real-time monitoring of fish distribution, turbidity, temperature, hydrodynamic models, and entrainment models into the decision support for the management of OMR to focus protections for fish when necessary and provide flexibility where possible, consistent with the WIIN Act Sections 4002 and 4003, as described below. Estimates of species distribution will be described by multi-agency Delta-focused technical teams. Reclamation and DWR will make a change to exports within 3 days of the trigger when monitoring, modeling, and criteria indicate protection for fish is necessary.

Reclamation and DWR propose to operate to an OMR index computed using an equation. An OMR index allows for short-term operational planning and real-time adjustments.

~~OMR Management:~~ From the onset of OMR management to the end, Reclamation and DWR will operate to an OMR index no more negative than a 14-day moving average of -5,000 cfs unless a storm event occurs (~~see~~described below ~~for storm-related OMR flexibility).~~). Grimaldo et al. (2017) indicate that -5,000 cfs is an inflection point in OMR for fish entrainment. OMR could be more positive than -~~5000~~5,000 cfs if additional real-time OMR restrictions are triggered as described below.

4.10.5.10.1 Onset of OMR Management:

Reclamation and DWR shall start OMR management when one or more of the following conditions have occurred:

- Integrated Early Winter Pulse Protection (“First Flush” Turbidity Event): The population-scale migration of ~~delta smelt~~Delta Smelt is believed to occur quickly in response to inflowing freshwater and turbidity (Grimaldo et al. 2009; Sommer et al. 2011). Thereafter, best available scientific information suggests that fish make local movements, but there is no evidence for further population- scale migration (Polanksy et al. 2018). As it relates to ~~delta smelt~~Delta Smelt, the Integrated Early Winter Pulse Protection action is intended to minimize ~~Project~~project influence on migration (or dispersal) that occurs coincident with “First Flush” conditions in the Delta. When the running 3-day average of the daily flows at Freeport is greater than 25,000 cfs and the running 3-day average of the daily turbidity at Freeport is 50 NTU or greater for the period from December 1 through January 31, Reclamation and DWR propose to reduce exports for 14 consecutive days so that the 14-day averaged OMR index for the period shall not be more negative than -~~3,500~~2,000 cfs. This “First Flush” action may only be initiated once during the

December through January period to limit the CVP/SWP influence on ~~delta smelt's~~Delta Smelt population-scale migration/dispersal. The action will not be required if: ~~1)~~

- the Freeport flow and turbidity conditions are met after January 31, or ~~2)~~
- water temperature reaches 12 degrees Celsius based on a three station daily mean at Honker Bay, Antioch, and Rio Vista, or ~~3) when ripe or spent delta smelt are collected in a monitoring survey.~~
- when ripe or spent Delta Smelt are collected in a monitoring survey.

- Salmonids: After January 1, if more than 5 percent of any one or more salmonid species (wild young-of-year Winter-Run, wild young-of-year Spring-Run, or wild Central Valley Steelhead) are estimated to be present in the Delta as determined by their appropriate monitoring working group based on available real-time data, historical information, and modeling.

4.10.5.10.2 Additional Real-Time OMR Restrictions:

Reclamation and DWR shall manage to a more positive OMR than -5,000 cfs based on the following conditions:

- Turbidity Bridge Avoidance ("South Delta Turbidity"): In years when a "First Flush" occurs, once ~~delta smelt~~Delta Smelt have dispersed, there is not evidence that large, population-scale movements continue. The turbidity avoidance action described below reflects current understanding about how to protect ~~delta smelt~~Delta Smelt from damaging levels of entrainment after a ~~Flush~~First Flush and in years when a First Flush does not occur. The proposed additional OMR Management is meant to supplement the protection provided to pre-spawning adult Delta ~~smelt~~Smelt that have migrated up the San Joaquin River shipping channel. This action begins after the completion of the Integrated Early Winter Pulse Protection (above) or February 1, whichever comes first. The purpose of this action is to avoid the formation of a continuous turbidity bridge from the San Joaquin River shipping channel to the fish facilities, which historically has been associated with elevated salvage of ~~delta smelt~~Delta Smelt. Reclamation and DWR propose to manage exports in order to maintain daily average turbidity in Old River at Bacon Island (OBI) at a level of less than 12 NTU. ~~-~~If turbidity does not exceed 12 NTU at OBI, then there will be no explicit limit on OMR flow for the purposes of protecting ~~delta smelt~~Delta Smelt. If daily average turbidity at OBI cannot be maintained less than 12 NTU, the 3-day averaged OMR index shall not be more negative than ~~-5000~~2,000 cfs, until the 3-day average turbidity at OBI drops below 12 NTU. ~~The OBI site shall be redundantly telemetered to avoid data gaps.~~ The action is to be taken from February 1-March 31 even if the Integrated Early Winter Pulse Protection action has not occurred earlier in the water year. The action will no longer be required on or after April 1.
- Larval and Juvenile Delta Smelt: When Q-West is negative and larval or juvenile ~~smelt~~Delta Smelt are within the entrainment zone of the pumps based on real-time sampling, Reclamation and/or DWR propose to run hydrodynamic models informed by the EDSM, 20 mm or other relevant survey data to estimate the percentage of larval and juvenile ~~smelt~~Delta Smelt that could be entrained, and operate to avoid ~~no~~ greater than 10 percent loss of modeled larval and juvenile cohort Delta Smelt (~~Typically~~typically this would come into effect beginning the middle of March).
- Wild Central Valley Steelhead Protection: Reclamation and DWR would operate to OMR of -2,500 cfs for 5 days whenever more than 5 percent of Steelhead are present in the Delta and the natural-origin Steelhead loss trigger exceeds 10 Steelhead per TAF. The timing of this action is intended to provide protections to San Joaquin origin Central Valley Steelhead, but the loss-

density trigger is based on loss of all Steelhead since there is currently no protocol to distinguish San Joaquin-basin and Sacramento-basin Steelhead in salvage. Reclamation would use the current loss equation for Steelhead or a surrogate. This action will no longer be required after May 31.

- Salvage or Loss Thresholds: Reclamation and DWR propose a cumulative annual salvage or loss threshold equal to 1 percent of the abundance estimate based on EDSM for adult Delta Smelt~~;~~, as modified; loss equal to 1 percent of the Winter-Run Chinook Salmon JPE (genetically confirmed) or 2 percent of the Winter-Run Chinook Salmon JPE (based on length -at -date); loss equal to 1 percent of the Spring- Run Chinook Salmon JPE (or 0.5 percent of yearling Coleman NFH late-fall run as yearling Spring-Run Chinook Salmon surrogates); salvage equal to 3,000 juvenile Central Valley Steelhead, and salvage equal to 100 juvenile Green Sturgeon. Reclamation and DWR ~~may~~propose to operate to a more positive OMR, as described below, when the daily salvage loss indicates that continued OMR of -5,000 cfs ~~may~~is likely to exceed the cumulative salvage loss thresholds ~~as described below~~:
    - Restrict OMR to a 14-day moving average OMR index of -3,500 cfs when a species-specific cumulative salvage or loss threshold exceeds 50 percent of the threshold. The OMR restriction to -3,500 cfs will persist until the species-specific offramp is met.
    - Restrict OMR to a 14-day moving average OMR index of -2,500 cfs (or more positive if determined by Reclamation) when cumulative salvage or loss threshold for any of the above species exceeds 75 percent of the threshold. The OMR restriction to -2,500 cfs will persist until the species-specific offramp is met.

  Species specific OMR restrictions will end when the individual species-specific off ramp from "End of OMR management criteria," below, are met.

4.10.5.10.3 Storm-Related OMR Flexibility: ~~If Reclamation and DWR are not implementing additional real-time OMR restrictions, consistent with other applicable legal requirements,~~

Reclamation and DWR may operate to a more negative OMR up to a maximum (otherwise-permitted) export rate at Banks and Jones Pumping Plants of 14,900 cfs (which could result in a range of OMR values) to capture peak flows during storm-related events. Reclamation and DWR will continue to monitor fish in real-time and will operate in accordance with "Additional Real-time OMR Restrictions," above.

Under the following conditions, Reclamation and DWR would not cause OMR to be more negative for capturing peak flows from storm-related events.

- Additional real-time OMR restrictions, above, are triggered, then Reclamation would operate in accordance with those additional real-time OMR restrictions and would not cause OMR to be more negative for capturing peak flows from storm-related events.
- Actual cumulative expanded salvage of Delta Smelt is greater than 50% of the average smelt index over the prior three years of non-zero FMWT surveys and a Cumulative Salvage Index of 7.98 during December 1 – January 20 or cumulative expanded salvage of Delta Smelt is greater than or equal to 75% of the average smelt index calculated described above.
- Predicted adult or juvenile Delta Smelt salvage would exceed 50% during December 1 – January 20 or cumulative expanded salvage is greater than or equal to 75% as determined above, based on the data sources in the Secretarial Memo dated January 17, 2019.

- Measured cumulative loss to date since October 1 for winter-run Chinook salmon (based on length-at- date criteria) is greater than the percentage below of a loss threshold calculated as 2% of the JPE:
  - January 1 – 15 2%
  - January 16 – 31 4%
  - February 1 – 14 6%
  - February 15 – 28 9%
  - March 1 – 15 21%
  - March 16 – 31 26%
  - April 1 – End of OMR 30%
- Predicted cumulative loss for winter-run Chinook salmon is greater than 30% of the loss threshold described above in "Additional Real-Time OMR Restrictions" [1 percent of the Winter-Run Chinook Salmon JPE (genetically confirmed) or 2 percent of the Winter-Run Chinook Salmon JPE (based on length-at-date)] or salvage for steelhead is greater than 50% of the salvage threshold described above in "Additional Real-Time OMR Restrictions".
- Changes in spawning, rearing, foraging, sheltering, or migration behavior beyond those described in the forthcoming biological opinion for this project.

4.10.5.10.4 End of OMR Management:

OMR criteria may control operations until June 30, or when both of the following have occurred, whichever is earlier:

- Delta Smelt: when the daily mean water temperature at CCF reaches 25°C for 3 consecutive days.
- Salmonids: when more than 95 percent of salmonids have migrated past Chipps Island, as determined by their monitoring working group, OR after daily average water temperatures at Mossdale exceed 72°F for 7 days during June (the 7 days do not have to be consecutive).

Figure 4-5 shows OMR management in a decision tree.

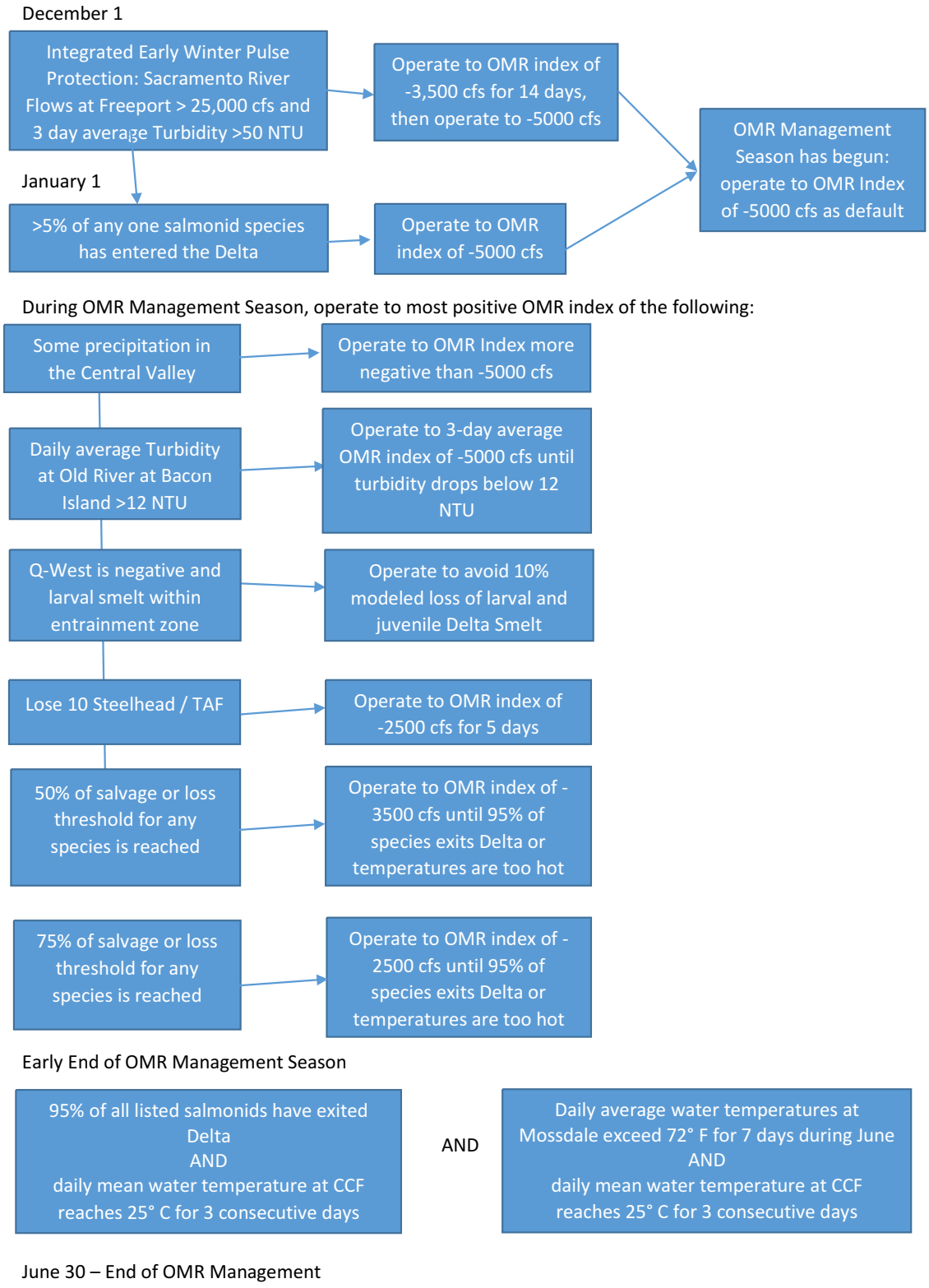

Figure 4-5. Decision Tree for Old and Middle River Reverse Flow Management

Reclamation and DWR may confer with the Directors of NMFS, USFWS, and CDFW if ~~the Additional Real-Time OMR Restrictions are not required for the protection of species and Reclamation and DWR~~ they desire to operate to a more negative OMR~~. The~~ than what is specified in "Additional Real-Time OMR Restrictions". Upon mutual agreement, the Directors of NMFS and USFWS may authorize Reclamation to operate to a more negative OMR. than the "Additional Real-Time OMR Restrictions", but no more negative than -5,000 cfs. The Director of CDFW may authorize DWR to operate to a more negative OMR. than the "Additional Real-Time OMR Restrictions", but no more negative than -5,000cfs.

4.10.5.11 *Delta Smelt Summer-Fall Habitat*

Reclamation and DWR propose to use structured decision making to identify and use a variety of actions to achieve the environmental and biological goals below, as described further in Appendix C. The Delta Smelt Habitat Action shall take actions to meet these environmental and biological goals in the summer and fall (June through October) of below normal, above normal, and wet water years according to the Sacramento Valley Index. The Delta Smelt Habitat Action is intended to improve Delta Smelt food supply and habitat, thereby contributing to the recruitment, growth, and survival of Delta Smelt.

The environmental and biological goals of the Delta Smelt Habitat Action are: maintain low salinity habitat in Suisun marsh and Grizzly Bay for as many days as possible in June through October of below normal, above normal, and wet years, when water temperatures are suitable; manage the low salinity zone to overlap with turbid water and available food supplies; and establish contiguous low salinity habitat from Cache Slough Complex to the Suisun Marsh.

The current conceptual model is that Delta Smelt habitat should include low salinity conditions of 0-6 ppt, turbidity of approximately 12 NTU, temperatures below 25°C, food availability, and littoral or open water physical habitats (FLaSH Synthesis, pp. 15-23). The Delta Smelt Habitat Action is being undertaken recognizing that the highest quality habitat in this large geographical region includes areas with complex bathymetry, in deep channels close to shoals and shallows, and in proximity to extensive tidal or freshwater marshlands and other wetlands. Low salinity would be measured as a 14-day average based on data from Belden's Landing (or other station(s) and averaging periods, as appropriate)

The Delta Smelt Habitat Action is to provide these habitat components in the same geographic area through a range of actions to improve water quality and food supplies. The action may include, but is not limited to the following components:

- Suisun Marsh Salinity Control Gate (SMSCG) operations for up to 60 days (not necessarily consecutive) in below normal, above normal, and wet years;
- Delta outflow up to the quantity that would have been required to meet a 2 ppt isohaline at 80 km from the Golden Gate Bridge in above normal and wet water years in September and October to the extent that such action would advance the biological goals identified above;
- Enhancement actions, e.g., those included in the Delta Smelt Resiliency Plan to enhance food supply, the North Delta food-web project, Sacramento River Deepwater Ship Channel lock reoperation, and Roaring River distribution system reoperation.

In below normal, above normal, and wet water year types, actions would focus on non-flow measures, such as operation of the SMSCG for up to 60 days (not necessarily consecutive) in the summer and fall. In below normal years, initial actions would include operating the SMSCG in the

summer with no additional Delta outflow augmentation above that which is necessary to comply with D-1641. In above normal and wet years, initial actions would include operation of the SMSCG in the summer and fall. In addition, if necessary and helpful to meet the environmental and biological goals described above, Delta outflow may be augmented in above normal and wet years based on scientific information on the relationship of the low-salinity zone as an appropriate proxy of delta smelt habitat. In the event that both the SMSCG and Delta outflow components are implemented in the same year, the water cost of operating the SMSCG would be subtracted from the Delta outflow augmentation flow volume.

~~4.9.5.11~~4.10.5.12 *Conservation Measures*

Conservation measures are included to further avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. The TFCF and the Skinner Fish Facility are identified specifically due to their significance as project features and then additional measures are listed.

~~4.9.5.11.1~~4.10.5.12.1 Tracy Fish Collection Facility

Reclamation proposes to continue to screen fish from Jones Pumping Plant with the TFCF. The TFCF uses behavioral barriers consisting of primary louvers and four rotating traveling screens aligned in a single row 7 degrees to the ~~secondary channel,~~flow of the water to guide entrained fish into holding tanks before transport by truck to release sites ~~within~~at the confluence of the Delta. The TFCF was designed to handle smaller fish (less than 200 mm) that would have difficulty fighting the strong pumping plant- induced flows, as the intake is essentially open to the Delta and impacted by tidal action. The number of pumps (units) running at the Jones Pumping Plant (JPP) dictates the flow and velocity at the TFCF. There are 6 units at JPP but a maximum of 5 can used; each unit increases the velocity through the TFCF primary channel by approximately 0.5 ft/sec.

The primary louvers are located in the primary channel just downstream of the trashrack structure. The ~~secondary~~ traveling ~~screens are~~water screen is located in the secondary channel.

~~Hauling trucks used to transport salvaged fish to release sites inject oxygen and contain an eight parts per thousand salt solution to reduce stress. The CVP uses two release sites, one on the Sacramento River near Horseshoe Bend and the other on the San Joaquin River immediately upstream of the Antioch Bridge. As a conservation measure, Reclamation proposes to increase the number of release sites to reduce predation.~~

~~Predator Removal:~~The louvers allow water to pass through onto the pumping plant, but the openings between the slats are tight enough and angled against the flow of water to prevent most fish from passing between them and to enable the fish to enter one of four bypass entrances along the louver arrays. Reclamation proposes to install a carbon dioxide injection device to allow remote controlled anesthetization of predators in the secondary channels of the TFCF.

The current primary louver cleaning procedures and operations involve lifting each individual louver panel, 36 total, out of the water in order to spray wash the debris. Generally, each primary louver panel is lifted and lowered back into place three times per day, although frequency of cleaning may be increased or decreased according to pumping rate and debris loads. It takes approximately 3-7 minutes to lift, spray clean, and lower each louver panel back into place. While export pumping may be reduced to address damaged louver panels, issues during cleaning, or other maintenance scenarios

where facilities are not capable of effectively salvaging fish, complete shutdown of pumping usually does not occur due to issues related to the primary louvers. At 5 Jones Pumping Plant units running, louvers are cleaned before the incoming tide as much as possible. The morning day shift usually begin cleaning as soon as they start their work, around 0600. During high debris periods, operators monitor differentials and clean before any problems arise. At a minimum, all 36 louver panels are cleaned 2-3 times a day but during heavy debris loads, operators clean 3-6 times a day. At 2-4 JPP units, operators determine when to clean and making sure the louvers do not reach 1 ft differential. At 1 JPP unit, operators will normally clean periodically during the incoming tide. Generally, less frequent cleaning is required in early summer (low averages of 60 minutes per day) and much higher during the winter months (high averages of 440 minutes per day). This means that there is a louver panel lifted 1-7.5 hours per day depending on season, pumping rates, and debris loads.

When south Delta hydraulic conditions allow, and conditions within the original design criteria for the TFCF, the louvers are operated to achieve water approach velocities for striped bass of approximately 1 foot per second from May 15 through October 31 and for salmon of approximately 3 feet per second from November 1 through May 14.

Fish passing through the facility are sampled at intervals of 30 minutes every 2 hours year-round. Approximately 52 different species of fish are entrained into the TFCF each year; however, the total numbers are significantly different for the various species salvaged. Fish observed during sampling intervals are identified by species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to the release sites in the north Delta away from the pumps. Hauling trucks used to transport salvaged fish to release sites inject oxygen and contain an 8 parts per thousand salt solution to reduce stress. In addition, TFCF personnel monitor for the presence of spent female Delta Smelt in anticipation of expanding the salvage operations to include sub-20 mm larval Delta Smelt detection.

TFCF personnel monitor for the presence of spent female Delta Smelt by euthanizing all adult Delta Smelt that are collected in the 30-minute fish count, determine the gender and the gonadal or sexual maturation stage of the Delta Smelt, and determine if the eggs have reached Stage IV, the stage when eggs are ready for release (0.9 to 10 mm in diameter and easily stripped). Stages V (i.e., postvitellogenic stage) and VI (i.e., postovulatory, or spent stage) are expected soon after Stage IV observation. Stages are determined and reported real-time when a biologist is present or the following morning after smelt detection and collection. Stage or gonad maturation is determined using egg stage descriptions from Mager (1996).

Larval smelt sampling at the TFCF commences once a trigger is met (detection of a spent female at CVP and SWP being one of three triggers). Fish count screen with a 2.4 mm mesh size opening is replaced with one that has a mesh size of 0.5 mm to retain larval fish. Sampling is done four times a day (04:00, 10:00, 16:00, 22:00) and all larval smelt are identified to species and reported the day after collection.

Salvage of fish occurs at the TFCF 24 hours per day, 365 days per year. Fish are salvaged in flow-through holding tanks (6.1-m diameter, 4.7-m deep) that provide continuous flows of water (Sutphin and Wu 2008). Fish are maintained in these holding tanks for 8-24 hours depending on the species of fish that are being salvaged, the number of fish salvaged, and debris load. The number of fish that are salvaged in TFCF holding tanks is generally estimated by performing a 30 minute fish-count subsample every 120 minutes (2 hours). The number of each species of fish collected in the subsample is determined and then multiplied by 4 (120 pumping minutes/30 minute fish-count subsample = expansion factor of 4) to estimate the total number of each species of fish, as well as the

total number of fish, that were salvaged in TFCF holding tanks during the 120 minute period. Pumping minutes and fish-count minutes could potentially deviate from 120 minutes and 30 minutes, respectively, which would change the expansion factor used to estimate total fish salvage.

If no Chinook Salmon, Steelhead, or Delta Smelt are salvaged, fish can be maintained in TFCF holding tank for up to 24 hours. If a Chinook Salmon or Steelhead is collected during fish-counts, fish can only be maintained in TFCF holding tanks for up to 12 hours. If a Delta Smelt is collected during fish-count, salvaged fish may only be held in TFCF holding tanks for up to 8 hours. When fish can be maintained in TFCF holding tanks for 24 hours, fish transport (fish-haul) generally occurs each morning. When 2 fish- hauls per day are necessary, a night fish haul is added. When 3 fish-hauls are necessary, they are usually completed at 7 am, 3pm, and 9:30 pm each day. Fish-haul is also dictated by the Bates Tables which uses size classes, species, and water temperature as indicators for when to conduct a fish-haul.

During normal operations, salvaged fish are transported approximately 49.9 km and released at one of two Reclamation release sites near the confluence of the Sacramento and San Joaquin Rivers (Antioch Fish Release Site and Emmaton Fish Release Site). In general, the Emmaton Fish Release Site is used for fish-hauls performed during daytime hours and the Antioch Fish Release Site is used for fish-hauls performed during nighttime hours. This is done for safety and security reasons as the Antioch Fish release Site has a gate that can be locked behind the operator after he/she enters the release site area. Upon arrival at release sites, operators measure certain important water quality parameters (dissolved oxygen, salinity, and temperature) prior to releasing fish. This is done to verify that water quality parameters remain acceptable during fish transport. As a conservation measure, Reclamation proposes to increase the number of release sites to reduce predation.

Reclamation would conduct studies and physical improvements aimed to improve fish survival and improve TFCF efficiency, reducing mortality through the facility, fish hauling and release operations through the Tracy Fish Facility Improvement Program. Activities include louver improvement and replacement, predation studies and piscivorous predator control, improvement of hydrologic monitoring and telemetry systems, holding area improvements including fish count automation and tank aeration and screening, improvement of data management as well as aquaculture facility maintenance, operation and improvements. TFCF studies are established at annual multi-agency meetings of the Tracy Tech Advisory Team. Reclamation would provide written reports of study results on the TFFIP website.

~~4.9.5.11.2~~4.10.5.12.2 Skinner Fish Facility

DWR proposes to continue to screen fish from Banks Pumping Plant with the. Skinner Fish Facility, located west of the CCF, 2 miles upstream of the Banks Pumping Plant. The Skinner Fish Facility has behavioral barriers to keep fish away from the pumps that lift water into the California Aqueduct. Large fish and debris are directed away from the facility by a 388-foot-long trash rack. Smaller fish are diverted from the intake channel into bypasses by a series of behavioral barriers (metal louvers), while the main flow of water continues through the louvers and toward the pumps. These fish pass through a secondary system of louvers or screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks. The sampling frequency at TFCF will be maintained at the Skinner Fish Facility.

~~4.9.5.11.3~~4.10.5.12.3 Additional Measures

- ~~Operations~~

- ~~*Suisun Marsh Salinity Control Gates Operation*: In addition to the October through May operation to meet Suisun water quality standards, Reclamation and DWR propose operating the SMSCG on the tidal cycle to meet the physical and biological features of Delta Smelt critical habitat in below-normal and above-normal Sacramento Valley Index year types in June through September for 60 days, not necessarily consecutive, as part of the adaptive management framework, based on data gathered over time to allow for assessment of the action. A Delta scheduling group would meet to provide scheduling recommendations to Reclamation and DWR in late spring. Slater and Baxter (2014) posit that food is limited for Delta Smelt in August and September. Reclamation and DWR would increase tidal operations of the SMSCG to direct more fresh water in Suisun Marsh, which is intended to reduce salinities in Suisun Marsh, increase food, and improve habitat conditions for Delta Smelt in the region. This would be combined with Roaring River Distribution System management for food production and flushing fresh water through the Roaring River Distribution System to increase the low salinity habitat in Grizzly and Honker Bays. Reclamation and DWR will continue to meet existing D-1641 salinity requirements in the Delta and Suisun Marsh, which will require additional Delta outflow. Reclamation and DWR would implement monitoring of physical factors to evaluate this action as part of the adaptive management plan.~~

- ~~*Fall Delta Smelt Habitat*: Reclamation proposes to manage for Delta Smelt habitat in the fall of Above Normal and Wet years (between D-1641 and the 2008 biological opinion). Delta Smelt habitat would be defined in terms of all of the physical and biological features of critical habitat.~~

- *San Joaquin Basin Steelhead Telemetry Study*: Continuation of the 6-Year Steelhead telemetry study for the migration and survival of San Joaquin Origin Central Valley Steelhead~~.~~

- *Sacramento Deepwater Ship Channel:* Reclamation proposes to partner with the City of West Sacramento and West Sacramento Area Flood Control Agency to repair or replace the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. When combined with an ongoing foodweb study, the reconnected ship channel has the potential to flush food production into the north Delta. An increase in food supply is likely to benefit Delta Smelt and their habitat.

- *North Delta Food Subsidies / Colusa Basin Drain:* DWR, Reclamation, and water users propose to increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and the Tule Canal to Cache Slough, improving the aquatic foodweb in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production.

- *Suisun Marsh Food Subsidies:* Water users propose to add fish food to Suisun Marsh through coordinating managed wetland flood and drain operations in Suisun Marsh, Roaring River Distribution System food production, and reoperation of the Suisun Marsh Salinity Control Gates. As noted in the Delta Smelt Resiliency Strategy, this management action may attract Delta Smelt into the high-quality Suisun Marsh habitat in greater numbers, reducing use of the less food-rich Suisun Bay habitat (California Natural Resources Agency 2016). Infrastructure in the Roaring River Distribution System may help drain food-rich water from the canal into Grizzly Bay to augment Delta Smelt food supplies in that area. In addition, managed wetland flood and drain

operations can promote food export from the managed wetlands to adjacent tidal sloughs and bays.

- Habitat Restoration: DWR and Reclamation propose to continue to implement existing restoration efforts that are part of the environmental baseline but are not yet complete, including:
  - Completing, by 2030, the remaining approximately 6,000 acres of tidal habitat restoration in the Delta of the 8,000 acres DWR has begun. Reclamation and/or DWR would monitor, operate, and maintain the tidal habitat restoration, including obtaining permanent land rights. Consistent with the current regulatory process, future separate consultations would address the effects to listed species from habitat restoration.
  - *Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project*: Reclamation and DWR will provide increased acreage of seasonal floodplain rearing habitat available in the lower Sacramento River basin~~.~~ by 2030.
  - Reclamation would coordinate with water users to remove predator hot spots in the Bay-Delta. This includes minimizing lighting at fish screens and bridges, and possibly removing abandoned structures.

~~- Facility Improvements: Reclamation and DWR would continue implementation of projects to reduce mortality of ESA-listed fish species:~~

  - *Delta Cross-Channel Gate Improvements:* The DCC is more than 65 years old and its gates rely on remote operators to travel to the facility to change their position. When the gates are open, they provide a critical diversion structure for freshwater reaching the CVP south Delta pumping station. The gates are closed to prevent scouring (during high flows), reduce salinity intrusion in the western Delta, and protect Sacramento River ESA-listed and non-listed salmonids. Additional DCC operation would allow for improved exports and water quality without additional adverse effects on salmonids. Reclamation proposes to evaluate improvements to automate and streamline operation of the Delta Cross-Channel gates. Reclamation would modernize DCC's gate materials and mechanics to include adding industrial control systems, increasing additional staff time, and improve physical and biological monitoring associated with the DCC daily and/or tidal operations as necessary to maximize water supply deliveries.
  - *Tracy Fish Facility Improvements:* Reclamation would improve the TFCF to reduce loss by: (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, (3) Constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) Construct additional fish handling systems and holding tanks to improve system reliability; and (5) Incorporate remote operation into the design and construction of the facility. Facility improvements will improve survival of fish salvaged and potentially reduce the loss factors to allow for additional certainty on OMR management with low impacts from salvaging salmonids.
  - *Skinner Fish Facility Improvements:* DWR would continue implementation of projects to reduce mortality of ESA-listed fish species. These measures that would be implemented include: (a) electro-shocking and relocating predators; (b) controlling aquatic weeds; (c) developing a fishing incentives or reward program for predators; and (d) operational changes when listed species are present. Please see Appendix G~~, *Clifton Court Forebay Predation Studies*~~ for study results from the last decade.
  - *Release Sites:* Reclamation proposes to continue work with DWR to incorporate flexibility in salvage release sites, using DWR's sites, or sites on a barge.

- *Small Screen Program*: Reclamation and DWR propose to continue to work with existing authorities (Anadromous Fish Screen Program) to screen small diversions throughout Central Valley CVP/SWP streams and the Bay-Delta.

- ~~Intervention~~
  - *Delta Fish Species Conservation Hatchery:* Reclamation proposes to partner with DWR to construct and operate a conservation hatchery for Delta Smelt, by 2030. The conservation hatchery would breed and propagate a stock of fish with equivalent genetic resources of the native stock and at sufficient quantities to effectively augment the existing wild population, so that they can be returned to the wild to reproduce naturally in their native habitat.
  - ~~The existing Fish~~ *Conservation and Culture Laboratory (FCCL~~)~~):* The existing FCCL will be used in the interim to begin supplementation prior to construction of the new conservation hatchery. Reclamation will support development of a supplementation strategy in coordination with and subject to approval by USFWS. This strategy will include studies to develop necessary information to begin a supplementation program, a focus on capturing existing genetic diversity and expansion of FCCL to produce maximum numbers of Delta Smelt. Current production is approximately 50,000 adult Delta Smelt; the strategy will have a goal of increasing production by 2025 to a number and the life stages necessary to effectively augment the population as determined by USFWS. The strategy will be in place 1 year from issuance of the biological opinion. Work done at the FCCL will guide construction and operation of the Conservation Hatchery described above.

~~4.9.6~~4.10.6 Stanislaus River (East Side Division)

Reclamation operates the CVP East Side Division for flood control, agricultural water supplies, hydroelectric power generation, fish and wildlife protection, and recreation. In the Stanislaus River watershed, Reclamation owns and operates New Melones Dam and Reservoir (2.4 MAF capacity). The Tri-Dam Project, a partnership between the Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), consists of Donnells and Beardsley Dams, located upstream of New Melones Reservoir on the middle fork Stanislaus River, and Tulloch Dam and Powerplant, located approximately 6 miles downstream of New Melones Dam on the mainstem Stanislaus River. Releases from Donnells and Beardsley Dams affect inflows to New Melones Reservoir. The main water diversion point on the Stanislaus River is Goodwin Dam, located approximately 2 miles downstream of Tulloch Dam. OID and SSJID manage the Tulloch and Goodwin Dam infrastructure through separate agreements with both Reclamation and Reclamation's CVP water service contractors (Stockton East Water District and the Central San Joaquin Water Conservation District) to meet Reclamation's Stanislaus River objectives, CVP contractor deliveries, and deliveries to the OID and SSJID service areas.

The Stanislaus River watershed has annual obligations that exceed the average annual runoff in a given year due to a number of factors, including SWRCB water rights decisions D-1641, D-1422 and D-1616, the 1987 CDFG agreement, CVPIA objectives, the 2009 biological opinion, the 1988 Agreement and Stipulation with OID and SSJID, riparian water right diverters, and CVP water delivery contracts.

Over the past decade, Reclamation has worked with Stanislaus River water users and related agencies in developing a revised operating plan for New Melones Reservoir that addresses multiple objectives, including a more predictable and sustainable operation, minimizing low storage conditions in successive drought years, and providing flows to support listed species and critical habitat. These

efforts have allowed multiple agencies and stakeholders to provide input on potential solutions; however, a final plan has not been completed.

The operating plan described below is intended to replace often overlapping and conflicting operational components of previous federal and state flow requirements, and is representative of Reclamation's contribution to any current or future flow objectives on the Lower San Joaquin River at Vernalis.

~~4.9.6.1~~4.10.6.1 *Seasonal Operations*

Reclamation proposes to meet water rights, contracts, and agreements that are specific to the East Side Division and Stanislaus River. Senior water right holders (OID and SSJID) will receive annual water deliveries consistent with the 1988 Agreement and Stipulation, and water will be made available to CVP contractors in accordance with their contracts and applicable shortage provisions.

In high storage, high inflow conditions, Reclamation will operate for flood control in accordance with the USACE flood control manual. Because New Melones is a large reservoir relative to its annual inflow, flood control is relatively infrequent; however, Tulloch Lake, located downstream of New Melones Reservoir, is subject to high local inflows, and may be in flood control operations for brief periods when New Melones Reservoir is not. During these periods, releases from Tulloch may be used to meet flow objectives, schedules, or requirements on the lower Stanislaus River below Goodwin Dam.

Reclamation proposes to operate New Melones Reservoir (as measured at Goodwin Dam) in accordance with a Stepped Release Plan (SRP) that varies by hydrologic condition/water year type as shown in Table 4-~~14~~13.

Table 4-~~14~~13. New Melones SRP Annual Releases by Water Year Type

Water Year Type	Annual Release (TAF)
Critical	184.3
Dry	233.3
Below normal	344.6
Above normal	344.6
Wet	476.3

The New Melones SRP will be implemented similarly to current operations under the 2009 biological opinion with a default daily hydrograph, and the ability to shape monthly and seasonal flow volumes to meet specific biological objectives. The default daily hydrograph is the same as prescribed under current operations for critical, dry, and below normal water year types. The difference occurs in above normal and wet years, where the minimum requirement for larger releases is reduced from current operations to promote storage for potential future droughts and preserve cold water pool. When compared to minimum daily flows from Appendix 2-E of the 2009 biological opinion (2-E), the daily hydrograph for the New Melones SRP is identical for critical, dry, and below normal year types; above normal and wet year types follow daily hydrographs for below normal and above normal year types from 2-E, respectively. The complete daily hydrograph for the New Melones SRP is available in Appendix B~~, *New Melones Stepped Release Plan Daily Hydrographs for Critical, Dry, Below Normal, Above Normal, and Wet Year Types*~~.

For the New Melones SRP, Reclamation proposes to classify water year types using the San Joaquin Valley "60-20-20" Water Year Hydrologic Classification (60-20-20) developed for D-1641 implementation. Previous operating plans for New Melones Reservoir relied on the New Melones Index (NMI) to determine water year type, calculated by summing end-of-February storage and forecasted inflow through September. Because the reservoir can store more than twice its average inflow, the NMI resulted in a water year type determination that was more closely tied to storage rather than hydrology. Changing from the NMI to 60-20-20 is expected to provide operations that better represent current hydrology and correlate more closely to water year types for other nearby tributaries.

Reclamation proposes to convene the Stanislaus Watershed Team (successor to the Stanislaus Operating Group), consisting of agency representatives and local stakeholders having direct interest on the Stanislaus River, at least monthly to share operational information and improve technical dialogue on the implementation of the New Melones SRP. The Stanislaus Watershed Team will also provide input on the shaping and timing of monthly or seasonal flow volumes to optimize biological benefits.

During the summer, Reclamation is required to maintain applicable dissolved oxygen standards on the lower Stanislaus River for species protection. Reclamation currently operates to a 7.0 mg/L dissolved oxygen requirement at Ripon from June 1 to September 30. Reclamation proposes to move the compliance location to Orange Blossom Bridge, where the species are primarily located at that time of year.

~~4.9.6.2~~4.10.6.2 *Conservation Measures*

Conservation measures are included to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses.

- Spawning Habitat: Under the CVPIA (b)(13) program, Reclamation's annual goal of gravel placement is approximately 4,500 tons in the Stanislaus River.
- Rearing Habitat: Reclamation proposes to construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030.
- Temperature Management: Reclamation will study approaches to improving temperature for listed species on the lower Stanislaus River, to include evaluating the utility of conducting temperature measurements/profiles in New Melones Reservoir.

~~4.9.7~~4.10.7 San Joaquin River (Friant Division)

Reclamation operates the Friant Division for flood control, irrigation, M&I, and fish and wildlife purposes. Facilities include Friant Dam, Millerton Reservoir, and the Friant-Kern and Madera Canals. Friant Dam provides flood control on the San Joaquin River, provides downstream releases to meet senior water rights requirements above Gravelly Ford, provides Restoration Flow releases under Title X of Public Law 111-11, and provides conservation storage as well as diversion into Madera and Friant-Kern Canals for water supply. Water is delivered to about a million acres of agricultural land in Fresno, Kern, Madera, and Tulare Counties in the San Joaquin Valley via the Friant-Kern Canal south into Tulare Lake Basin and via the Madera Canal northerly to Madera and Chowchilla Irrigation Districts. A minimum of 5 cfs is required to pass the last holding contract diversion located about 40 miles downstream of Friant Dam near Gravelly Ford.

The SJRRP implements the San Joaquin River Restoration Settlement Act in Title X of Public Law 111-11. USFWS and NMFS issued programmatic biological opinions in 2012 that included project-level consultation for SJRRP flow releases. Programmatic ESA coverage is provided for flow releases up to a certain level, recapture of those flows in the Lower San Joaquin River and the Delta, and all physical restoration and water management actions listed in the Settlement.

The Stipulation of Settlement of NRDC vs. Rogers, is based on two goals—the Restoration Goal and the Water Management Goal. To achieve the Restoration Goal, the Settlement calls for, among other things, releases of water from Friant Dam to the confluence of the Merced River (referred to as Restoration Flows) according to the hydrographs in Settlement Exhibit B. To achieve the Water Management Goal, the Settlement calls for the development and implementation of a plan for recirculation, recapture, reuse, exchange or transfer of Restoration Flows for the purpose of reducing or avoiding impacts on water deliveries to all of the Friant Contractors caused by Restoration Flows. Recapture of Restoration Flows may occur upstream of a capacity restricted reach, or downstream of the Merced River confluence. Recapture can occur at Banta-Carbona, Patterson, or West Stanislaus Irrigation District facilities, or at Jones or Banks Pumping Plants. Recapture of Restoration Flows in the Sacramento San Joaquin Delta under this proposed action would average 65 TAF, ranging from approximately 25 TAF to 78 TAF depending on the ~~yeartype.~~ year type.

~~4.9.7.1~~4.10.7.1 *Conservation Measures*

Lower SJR Rearing Habitat: Reclamation may work with private landowners to create a bottom-up, locally driven regional partnership to define and implement a large-scale floodplain habitat restoration effort in the Lower San Joaquin River. This stretch of the San Joaquin River is cut-off from its floodplain due to an extensive levee system, with two notable exceptions at Dos Rios Ranch (1,600 acres) and the San Joaquin River National Wildlife Refuge (2,200 acres). In recent years, there has been growing interest in multi-benefit floodplain habitat restoration projects in the Central Valley that can provide increased flood protection for urban and agricultural lands, improved riparian corridors for terrestrial plants and wildlife, and enhanced floodplain habitat for fish. The resulting restoration could include thousands of acres of interconnected (or closely spaced) floodplain areas with coordinated and/or collaborative funding and management. Such a large scale effort along this corridor would require significant support from a variety of stakeholders, which could be facilitated through a regional partnership.

~~4.9.8~~4.10.8 South of Delta

San Luis Reservoir is an offstream storage facility located along the California Aqueduct downstream of Jones and Banks Pumping Plants. The CVP and SWP share San Luis Reservoir storage roughly 50/50 (CVP has 966 TAF of storage, SWP has 1062 TAF of storage). San Luis Reservoir is used by both Projects to meet deliveries to their contractors during periods when Delta pumping is insufficient to meet demands. San Luis Reservoir is also operated as a conveyance facility to supply water to the CVP San Felipe Division in San Benito and Santa Clara Counties.

San Luis Reservoir operates as a regulator on the CVP/SWP system, accepting any water pumped from Banks and Jones that exceeds contractor demands, then releasing that water back to the aqueduct system when the pumping at Jones and Banks is insufficient to meet demands. The reservoir allows the CVP/SWP to meet peak-season demands that are seldom balanced by Jones and Banks pumping.

As San Luis Reservoir is drawn down to meet contractor demands, it usually reaches its low point in late August or early September. From September through early October, demand for deliveries usually drops to be less than the Jones and Banks diversions from the Delta, and the difference in Jones and Banks pumping is then added to San Luis Reservoir, reversing its spring and summer decline and eventually filling the San Luis Reservoir - typically before April of the following year.

4.104.11 Items Not Included in This Consultation

This document includes context on the entirety of operations of the CVP and SWP. However, not all of these actions are being consulted on, either because they were the subject of prior consultations or due to other legal authority. Reclamation and DWR are consulting on the exercise of discretion in operational decision making, including how to comply with the terms of their respective existing water supply and settlement contracts (which includes the impacts of maximum water diversions under the terms of these contracts), and other legal obligations. Reclamation and DWR are not consulting on:

- Flood control
- Folsom Water Control Manual
- Oroville Dam and Feather River operations
- Execution of new CVP water service or repayment contracts, or the prior execution of existing contracts that were the subject of separate but parallel prior consultations
- Execution of new settlement contracts and agreements, or the prior execution of existing contracts that were the subject of separate but parallel prior consultations
- Contract conversion
- Operations and maintenance activities of CVP minor facilities
- Exchange Contractor deliveries from Friant Dam
- SJRRP flows and lower SJR recapture
- TRRP flows
- Coordinated Operation Agreement
- D-1641
- Contra Costa Water District Operations
- Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan
- Suisun Marsh Preservation Agreement
- California WaterFix
- Battle Creek Restoration Program

~~4.11~~4.12 Governance

Reclamation anticipates three implementation approaches for the proposed action. The first, Core Water Operation, involves Reclamation and DWR operating the projects within the bounds of the proposed action with regular performance monitoring and reporting. The second, Scheduling, includes water-shed based groups of the five agencies (i.e., Reclamation, DWR, USFWS, NMFS, CDFW) and water users providing input to Reclamation and DWR on scheduling and routing specific blocks of water identified in the proposed action (i.e., pulse flows). The third, Collaborative Planning, involves program teams of the five agencies and water users working together to define, study, and implement specific components of the proposed action.

The Core Water Operation serves as the foundation for meeting ~~the~~regulatory requirements ~~of D-1641~~ and providing for Reclamation and DWR to operate the CVP and SWP, while reducing the stressors on listed species influenced by those ongoing operations. through real-time monitoring. The Core Water Operation consists of operational actions that do not require subsequent concurrence ~~or extensive coordination~~ to define annual operation. For the Core Water Operation, Reclamation would implement activities, monitor performance, and report on compliance with the commitments in the proposed action. The ~~CVP and SWP Water Operations Charter, Appendix C, *ROC*~~ Real -Time Water Operations Charter, (Charter) described in Appendix C describes how Reclamation and DWR will monitor and report on ESA Section 7 commitments under the proposed action and how the five agencies, public water agencies, and other participants will ~~plan,~~ communicate, and coordinate real-time water operations decisions ~~on the Core Water Operation.~~. The Charter also describes the deliverables, schedule, and decision making processes.

~~Portions of the Core Water Operation rely upon real-time monitoring to inform Reclamation and DWR on how to minimize and/or avoid stressors on listed species. Some elements of the Core Water Operation provide for seasonal input by the federal and state fish agencies on the scheduling and routing of certain flow volumes to benefit fisheries.~~ The Core Water Operation also provides for regulatory coordination in the event conditions exceed the ability to anticipate how Reclamation and DWR would operate (~~i.e., "outliers").~~e.g., Tier 4 Shasta Cold Water Pool management). Reclamation and DWR must demonstrate compliance with the commitments in the proposed action and provide sufficient information for an evaluation of reinitiation triggers through regular monitoring and reporting.

~~Aspects of the proposed action that are adaptively managed will require additional coordination that occurs more than once, for example, implementing spawning and rearing projects annually. Reclamation and DWR will form program teams with fish agency and stakeholder representatives on adaptively managed commitments. The governance of project teams will remain consistent with requirements under the ESA and CESA; however, within the program teams, fish agencies may also participate in a capacity as action agencies for specific projects under their authorities and resources, where appropriate.~~

~~Within the Core Water Operation, several different types of coordination occur on different time scales:~~

~~Real-Time Species Distribution and Life Stage Monitoring: Fish agencies~~As part of Core Water Operation, fishery agencies would provide information to Reclamation and DWR on the real-time disposition of species through specific monitoring workgroups. This information ~~informs~~would inform the risk analysis performed by Reclamation and DWR. ~~This coordination occurs seasonally. Examples: OMR Management, Shasta cold water pool management.~~

- ~~Flow~~ For components of the proposed action identified as part of the Scheduling~~: Fish implementation approach, fishery~~ agencies and ~~other stakeholders~~water users in watershed-based groups would provide scheduling recommendations to Reclamation and DWR on duration, timing, and magnitude of specific blocks of water. Reclamation and DWR will evaluate and consider the recommendations and operate the CVP and SWP to ~~these~~those schedules as feasible. ~~Examples: Clear Creek, Stanislaus River, Suisun Marsh Salinity Control Gates.~~
- ~~Outlier Years: In outlier years, fish agencies would work with Reclamation and DWR to identify options and intervention measures. Examples: Tier 4 of Shasta cold water pool management, extreme drought, emergency conditions.~~
- ~~Seasonal and Annual Reviews:~~For aspects of the proposed action that are implemented through Collaboratively Planning, Reclamation and DWR will ~~report on activities to fish agencies and determine whether to reinitiate on one or more components (although either party may also trigger reinitiation in real-time).~~
- ~~Project Teams: Programmatic activities will have~~form program teams ~~that develop the specific project descriptions and obtain the appropriate permits. Examples: Spawning~~comprised of fishery agency and stakeholder representatives that inform Reclamation and DWR decisions on all aspects of the action. Example collaborative planning actions include spawning and rearing habitat, Delta Fish Conservation Hatchery~~.~~

~~Under the CVP and SWP Water Operation Charter, decisions shall be made consistent with authorizing legislation and the regulations and policies under~~ , and the ~~ESA and CESA, as appropriate.~~

~~Reclamation and DWR shall retain sole discretion for:~~

- ~~Water operations of the CVP and SWP, including allocations, under Reclamation Law and the SWP authorization.~~
- ~~Agency appropriations (budget requests, fund alignment, contracting, etc.).~~
- ~~Section 7 action agency and applicant (consultation).~~
- ~~Coordination and cooperation with PWAs as required by contracts and agreements.~~

~~CDFW, USFWS, and NMFS shall retain sole discretion for:~~

- ~~Consultation under Section 7 of the federal ESA and California Fish and Game Code, as appropriate, Incidental Take Statements/Permits, and enforcement.~~
- ~~Agency appropriations.~~

~~SWRCB~~

- ~~Enforcement as allowable under federal and state law.~~

~~Operating Entities other than CVP and SWP shall retain sole discretion for:~~

- ~~Operation of non-CVP and non-SWP diversion facilities.~~
- ~~Meeting the the terms of contracts and/or agreements.~~

~~Participating in the cooperation and coordination provisions under the WIIN Act~~Delta Smelt Habitat Action.

Reclamation and DWR will annually report on water operations and fish performance seasonally and in an annual summary. The monitoring programs and schedule for reporting are described in ~~the Charter~~Appendix C. Changes to the proposed action would occur based on the reinitiation triggers provided by 50 CFR 402.16. These triggers include:

a) ~~(a)~~ If the amount or extent of taking specified in the incidental take statement is exceeded;

b) ~~(b)~~ If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

c) ~~(c)~~ If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or

d) ~~(d)~~ If a new species is listed or critical habitat designated that may be affected by the identified action.

Reclamation will monitor take for the purpose of evaluating trigger (a) above; Reclamation will monitor the effects of the proposed action for the purpose of evaluating trigger (b) above. ~~If, through adaptive management,~~If Reclamation decides to modify the proposed action, Reclamation will evaluate the changes to the proposed action based on trigger (c) above. Consistent with 50 CFR 402.16, the USFWS and/or NMFS may also reinitiate formal consultation as appropriate. Reclamation will coordinate with DWR as an "applicant" and support DWR's coordination with CDFW.