

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. Reclamation recognizes that the NEPA process is ongoing and that proposed action may change as a result of that process. If necessary, Reclamation may reinitiate consultation with the Services to address any significant modifications to the proposed action as considered in the BiOps.

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 managed spring pulses	No managed spring pulses	Spring pulses up to 150 TAF 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

Without Action	Current Operation	Proposed Action
Trinity		
No flow control	Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows
Clear Creek		
No base flows	Base flow of 50–100 cfs based on 1960 CDFG MOA	Base flow of 200 cfs October 1 through May 31, 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 managed pulse flows	Two managed 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) 60° F at the Igo gage from June 1 through September 15; and (2) 56° F at the Igo gage from September 15 to October 31.	Daily water temperature in below normal and wetter years 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; 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 coldwater 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 December 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	D-1641 requirements; and risk-based OMR management incorporating real-time monitoring and models

Without Action	Current Operation	Proposed Action
	Actions 1-3 and NMFS RPA Action IV.2.3	
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; Suisun Marsh Salinity Control Gate operation for up to 60 additional days between June 1 – October 31, depending on year type; increased Delta outflow in wet and above normal year types in certain conditions.
No management of Old and Middle River tidal reverse flows	Old and Middle River Managed 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 Managed 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
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 for the introduction of propagated 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
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. During 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 several 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, several 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 has 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.

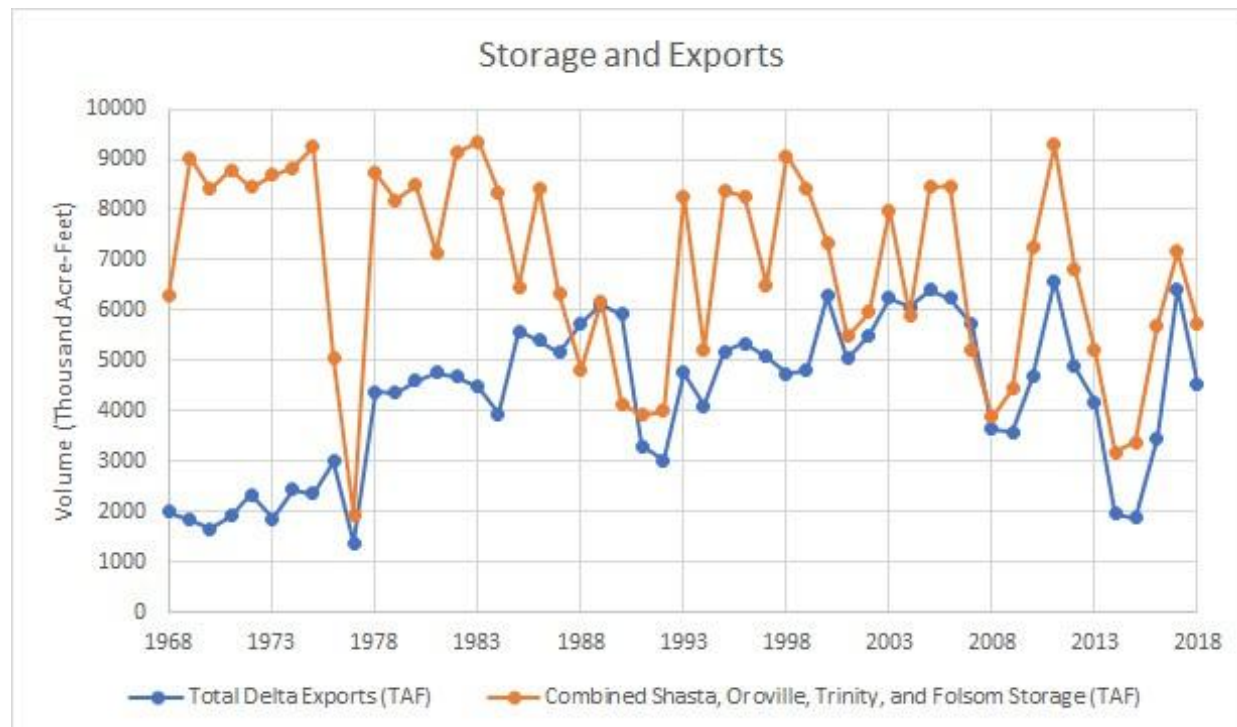


Figure 4-1. Delta Exports and Reservoir End-of-September Storage, 1968–2018

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 should 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 avoid redd dewatering.

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. Increased releases may also occur to facilitate meeting Delta outflow or salinity requirements per D-1641. The Temperature Control Device (TCD) is operated to selectively withdraw cold water from specific elevations to maximize the use of the cold water pool. 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.) through the COA. The amount of water released from each CVP 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 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 bypass hydropower production. This impacts 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 increased power customer costs to ensure Restoration Fund revenues.

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 and outflow. 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.

Different water year type indices assist in determining flows and allocations in different regions. The table below shows these.

Table 4-2. Water Year Type Indices

Index	From	Formula	Use
Sacramento River Index (SRI)	D-1485 WQCP	Sum of the unimpaired runoff in the water year as published in the DWR Bulletin 120 for the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total unimpaired inflow to Oroville Reservoir; Yuba River at Smartville; and American River, total unimpaired inflow to Folsom Reservoir.	
Sacramento Valley Index (SVI)	D-1641	$(0.4) \times \text{Current Apr-Jul runoff forecast (in maf)} + (0.3) \times \text{Current Oct-Mar runoff (in maf)} + (0.3) \times \text{Previous Water Year's Index}$	Used in determining Clear Creek for channel maintenance flows, Delta Smelt Summer-Fall habitat actions, transfer volumes
San Joaquin Index (SJI)	D-1641	$0.6) \times \text{Current Apr-Jul runoff forecast (in maf)} + (0.2) \times \text{Current Oct-Mar runoff (in maf)} + (0.2) \times \text{Previous Water Year's Index}$	Used in determining Stanislaus Stepped Release Plan releases,
Eight River Index (8RI)	D-1641	Sacramento River Runoff + San Joaquin River Runoff	
Shasta Critical	Reclamation	Shasta Critical years are if the forecasted unimpaired inflow for the water year is less than 3.2 MAF or the total accumulated deficiencies below 4 MAF in the immediately prior water year, or series of successive prior water years each of which had inflows of less than 4 MAF, together	Used in determining Settlement and Exchange Contractor delivery, refuge delivery

Index	From	Formula	Use
		with the forecasted deficiency for the current water year exceed 800 TAF	
Trinity River	Reclamation	Determined based on Trinity Inflow	Used in determining Trinity ROD releases

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 4-3 summarizes the number of CVP water service and repayment contracts and the amount of water under contract.

Table 4-3. CVP Water Service and Repayment Contracts

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	9	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

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

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). Reclamation is not proposing to execute or amend any SRS Contracts. Rather, Reclamation proposes to operate the CVP in coordination with the SWP to deliver water for multiple authorized purposes, including the provision of water under the terms of the SRS Contracts and other water contracts as they currently exist.

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 4-4 summarizes senior CVP water rights holders and the amount of water under contract¹.

Table 4-4. 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

¹ Reclamation proposes to operate the CVP in coordination with the SWP to deliver water for multiple authorized purposes, including the provision of water under the terms of the SRS Contracts as they currently exist, which include a Schedule of Monthly Diversions of Water, which sets forth the quantities and allocations of water to be provided, and applicable reductions in Contract Totals during Critical Years. In the modeling for CVP operations, SRS Contractor water demands are based on SRS demands over the last 15 years, as limited by the of Schedule of Monthly Diversions of Water in each SRS Contract. Since 1981, implementation of a variety of water conservation measures has reduced the demand for water under the SRS Contracts. Accordingly, Reclamation does not expect SRS demands to increase above that modeled demand over the planning horizon for this consultation, and therefore has not conducted a quantitative analysis of the various mechanisms for which increased demand would be met. However, increased demand of diversions under the SRS contracts could be met through modifying the coordinated operation of the CVP and SWP facilities in accordance with the operating priorities and project purposes and obligations. Potential modifications may include reduced deliveries to water service contractors, changes to reservoir storage throughout the CVP and SWP and/or modifications to operations of the Shasta temperature control device.

Contractor	Number of Contracts	Contract Quantity (Acre-Feet)
South of Delta Settlement Contractors	9	35,623
North of Delta Refuges—Level 2 CVP	2	151,250
South of Delta Refuges—Level 2 CVP	3	244,994

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 4-5 summarizes the volumes under the water rights settlement agreements.

Table 4-5. 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
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 4-6 shows the maximum contracted annual water supply per DWR's most recent water supply reliability report.

Table 4-6. 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

Contracting Agency	Maximum Supply (Acre-Feet)
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
San Geronio 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 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.

4.8 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 under current compliance requirements, influence 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 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 intends to use a conservative forecast for seasonal planning of reservoir releases (including developing initial and updated allocations) and temperature management planning. Starting in January, Reclamation reviews various exceedances of inflow forecasts to determine a conservative monthly operations outlook. In many cases, Reclamation develops monthly release forecasts and associated allocations based on a 90% exceedance inflow forecast through September. Reclamation may deviate from relying on the 90% exceedance inflow forecast in order to develop a conservative outlook. Such instances include scenarios when a wetter hydrology produces a more conservative outlook, due to, for example, more strenuous regulatory or contract requirements, or the actual conditions are significantly drier than the existing forecast such that a more conservative forecast is appropriate. This conservative approach is intended to minimize the frequency where real-time management results in a drier or warmer (water temperature) condition than forecasted.

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, which include considerations for health and safety, fishery, water quality, other environmental requirements, and water contracts. 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.

While Reclamation does not operate to specific end of water year storage targets in its reservoirs, carryover is a key consideration when making operational decisions. Many conditions are considered which factor into end of water year carryover storage in its facilities. These considerations include (but are not limited to): the previous years' hydrology, previous years' end of water year south of Delta storage, current water year hydrology and current south-of-Delta storage, as well as looking at next years' potential hydrology and impacts resulting from various end-of-water year storage conditions. These factors are all considered when developing operations outlooks and actual real time operational decisions.

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.

4.8.1 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.

4.8.2 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 flows at Wilkins Slough and associated pump intake elevations (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. Several 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.

4.9 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 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 2011, survival was only 0.02, suggesting increased flows alone are not enough 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 lower in 2011 than in 2010 and 2006. There was little separation between the other years based on 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 suggest several 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 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).

4.10 Proposed Action by Basin

Table 4-7 shows each of the components of the proposed action for this consultation, including operational changes, 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 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 4-7. Components of the Proposed Action

Title	Site Specific or Programmatic	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
Upper Sacramento		
Seasonal Operations	Site-specific	Core
Spring Pulse Flows	Site-specific	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	Collaborative Planning
Temperature Modeling Platform	Programmatic	Collaborative Planning
Shasta Temperature Control Device Performance Evaluation	Programmatic	Collaborative Planning
Battle Creek Salmon and Steelhead Restoration Project and Battle Creek Reintroduction Plan	Programmatic	Collaborative Planning
Lower Intakes Near Wilkins Slough	Programmatic	Collaborative Planning
Spawning and Rearing Habitat Restoration	Programmatic	Collaborative Planning
Small Screen Program	Programmatic	Collaborative Planning
Knights Landing Outfall Gates	Programmatic	Collaborative Planning
Winter-Run Chinook Salmon Conservation Hatchery Production	Programmatic	Collaborative Planning
Adult Rescue	Programmatic	Collaborative Planning
Juvenile Trap and Haul	Programmatic	Collaborative Planning
Directors Meeting	Programmatic	Collaborative Planning
Yellow-billed Cuckoo Surveys	Programmatic	Collaborative 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

Title	Site Specific or Programmatic	Implementation Approach
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
Yellow-billed Cuckoo Surveys	Programmatic	Collaborative Planning
Feather		
FERC Project #2100-134	NCO	NCO
American		
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	Collaborative Planning
Nimbus Hatchery Genetic Management Plans	Programmatic	Collaborative Planning
Drought Temperature Management	Programmatic	Core
Yellow-billed Cuckoo Surveys	Programmatic	Collaborative Planning
Stanislaus		
Seasonal Operations	Site-specific	Core
Stanislaus River Stepped Release Plan (including pulse flows)	Site-specific	Scheduling
Alteration of Stanislaus DO Requirement	Site-specific	Core
Spawning and Rearing Habitat Restoration	Programmatic	Collaborative Planning
Temperature Management Study	Programmatic	Core
Yellow-billed Cuckoo Surveys	Programmatic	Collaborative Planning
San Joaquin		
San Joaquin River Restoration Program	NCO	NCO
Lower San Joaquin River Habitat	Programmatic	Collaborative Planning
Yellow-billed Cuckoo Surveys	Programmatic	Collaborative Planning
Delta		
Seasonal Operations	Site-specific	Core
Minimum Export Rate	Site-specific	Core
Delta Cross Channel Operations	Site-specific	Core
Agricultural Barriers	Site-specific	Core
North Bay Aqueduct	Site-specific	Core
Contra Costa Water District Rock Slough Operations	Site-specific	Core

Title	Site Specific or Programmatic	Implementation Approach
Water Transfers	Site-specific	Core
Clifton Court Aquatic Weed and Algal Bloom Management	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
Delta Smelt Summer-Fall Habitat	Site-specific	Collaborative Planning
Delta Smelt Summer-Fall SMSCG Operation	Site-specific	Core
Delta Smelt Summer-Fall Habitat Flow Action	Site-specific	Core
Clifton Court Predator Management	Site-specific	Core
San Joaquin Basin Steelhead Telemetry Study	Site-specific	Collaborative Planning
Steelhead Lifecycle Monitoring Program	Programmatic	Collaborative Planning
San Joaquin Basin Steelhead Collaborative	Programmatic	Collaborative Planning
Sacramento Deepwater Ship Channel Food Study	Programmatic	Collaborative Planning
North Delta Food Subsidies/Colusa Basin Drain Study	Programmatic	Collaborative Planning
Suisun Marsh and Roaring River Distribution System Food Subsidies Study	Programmatic	Collaborative Planning
San Joaquin River Scour Hole Predation Reduction	Programmatic	Collaborative Planning
Tidal Habitat Restoration (Complete 8,000 acres from 2008 biological opinion)	Programmatic	Collaborative Planning
Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project	NCO	NCO
Predator Hot Spot Removal	Programmatic	Collaborative Planning
Delta Cross Channel Gate Improvements	Programmatic	Core
Tracy Fish Facility Improvements	Programmatic	Core
Clifton Court Forebay Mortality Reduction	Site-Specific	Core
Skinner Fish Facility Performance Improvements	Programmatic	Collaborative Planning
Salvage Release Sites	Site-Specific	Core
Small Screen Program	Programmatic	Collaborative Planning
Reintroduction efforts from Fish Conservation and Culture Laboratory	Site-specific	Collaborative Planning
Delta Fish Species Conservation Hatchery	Programmatic	Collaborative Planning
Sediment Supplementation Feasibility Study	Programmatic	Collaborative Planning

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.

4.10.1 Upper Sacramento River (Shasta and Sacramento Divisions)

Reclamation operates the CVP Shasta Division for flood control, agricultural water supplies, M&I water supplies, fish and wildlife, hydroelectric power generation, Delta water quality, and water quality in the upper Sacramento River. The CVP Shasta Division is also authorized for navigation. 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, 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 4-8 as 35 feet of submergence above the top of the gates.

Table 4-8. 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

¹Low level intake bottom

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 stable (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. When spring regulatory constraints are relaxed, exports can increase during excess flow periods and Reclamation can build additional storage in San Luis without increasing releases from upstream reservoirs. This provides more flexibility later in the year for meeting late season demands. 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. In wetter hydrology, during the March through May period, downstream demands are minimal and are generally met through unstored accretions to the system. Under these conditions, Reclamation will aim to reduce Keswick flows below those proposed for the fall-winter period. Operations under these conditions helps build storage in those types of years.

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, temperature control, and exports. 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 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.

In addition to the requirements under 90-5, ramping rates for Keswick Dam between July 1 – March 31 would be reduced between sunset and sunrise:

- Keswick releases > 6,000 cfs, reductions in releases may not exceed 15% per night, and no more than 2.5% per hour.

- Keswick releases 4,000 cfs to 5,999 cfs reductions in releases may not exceed 200 cfs per night, or 100 cfs per hour.
- Keswick releases between 3,250 cfs and 3,999 cfs; reductions in releases may not exceed 100 cfs per night.

Ramping rates do not apply during flood control or if needed for facility operational concerns. The working groups may also determine a need for a variance.

4.10.1.2 Spring Pulse Flows

Under the Core Water Operation, Reclamation would release spring pulse flows of up to 150 TAF in coordination with the Upper Sacramento Scheduling Team when the projected total May 1 Shasta Reservoir storage indicates a likelihood of sufficient cold water to support summer cold water pool management, and the pulse does not interfere with the ability to meet performance objectives or other anticipated operations of the reservoir. Total storage provides a surrogate for the likely cold water pool prior to stratification of the reservoir, 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. Reclamation anticipates that a projected May 1 storage greater than 4 MAF provides sufficient cold water pool management for Tier 1 and may release the spring pulse if it does not impact the ability to meet project objectives. Reclamation could also determine, in coordination with the Upper Sacramento scheduling team, that while the reservoir is less than 4 MAF, there is sufficient water to do a pulse of up to 150 TAF. The Upper Sacramento scheduling team could also determine that the benefits of a spring pulse flow do not outweigh the potential negative impacts on the system, in which case Reclamation would not release one. Reclamation would also not make a spring pulse release if the release would cause Reclamation to drop into a Tier 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), would interfere with meeting performance objectives, or would interfere with the ability to meet other anticipated demands on the reservoir. The Upper Sacramento Scheduling Team would determine the timing, duration, and frequency of the spring pulse within the 150 TAF volume. Wet hydrology downstream of Keswick Dam may meet the need for pulse flows without increased releases.

Based on current science, which may be updated through the Upper Sacramento Scheduling Team, the spring pulse could be 0 to 2 pulses of 10,000 cfs at Wilkins Slough for 3 days each, in a time when Wilkins Slough flows are less than 9,000 cfs. Following the initial three-day pulse targeting 10,000 cfs at Wilkins, Keswick flows could reduce by no more than 15% per night for flows greater than 6,000 cfs, and no more than 200 cfs per night for flows between 4,000 and 5,999 cfs.

4.10.1.3 *Summary of PA Items to Improve Shasta Storage*

As described in the sections below, the PA includes several operational components, that are intended to contribute to increased spring Shasta storage levels as compared to recent years. These include (1) Fall and Winter Refill and Redd Maintenance, which sets minimum late fall and winter flows, including modification of rice decomposition operations compared to the Current Operations Scenario (COS); (2) modified fall outflow requirements compared to the COS; (3) flexibility in export operations (especially in April and May) compared to the COS; and (4) December 2018 changes to COA (which are also included in COS). These operations, as well as real-time operations, are expected to result in increased end of September carryover storage, which Reclamation expects to benefit the following May 1 storage in years without flood control releases.

4.10.1.4 *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 targets 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 with minimal risks of higher temperatures in the late summer and fall. Figure 4-2 provides an approximate estimate of the relationship between temperature compliance, total storage in Shasta Reservoir, and cold water pool in Shasta Reservoir.

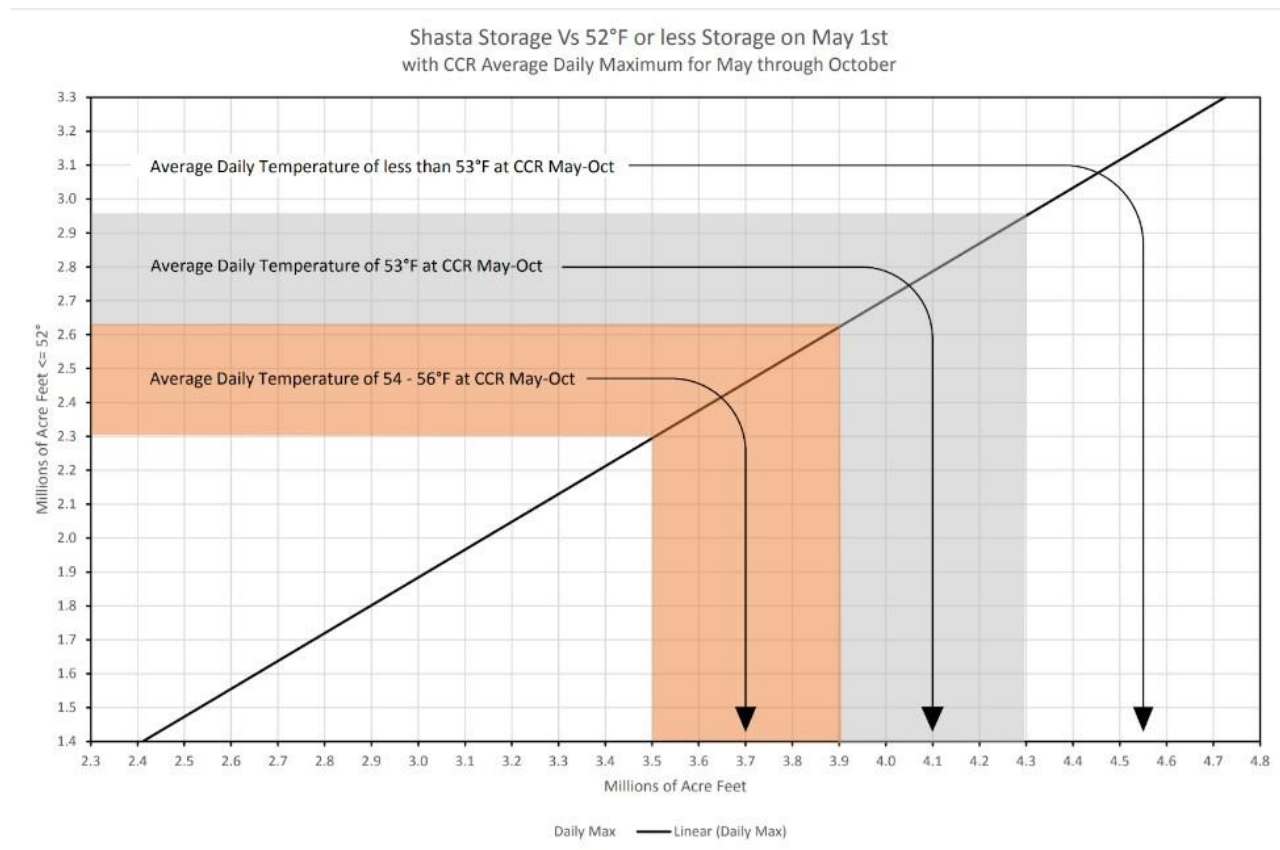


Figure 4-2. Relationship between Temperature Compliance, Total Storage in Shasta Reservoir, and Cold Water Pool in Shasta Reservoir

4.10.1.4.1 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 on May 15, or when the SRTTG 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 SRTTG determines based on real-time monitoring that 95 percent of Winter-Run Chinook Salmon eggs have hatched, and alevin have emerged, whichever is earlier. Real-time information will continue to be considered in this process, which includes redd, carcass, and juvenile surveys.

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, with arrows indicating how temperatures would change in different years with less May 1 forecasted cold water pool. 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. Coldwater pool management is proposed to start as early as May 15th, however temperatures at the start of the temperature management season are often lower than the target temperatures.

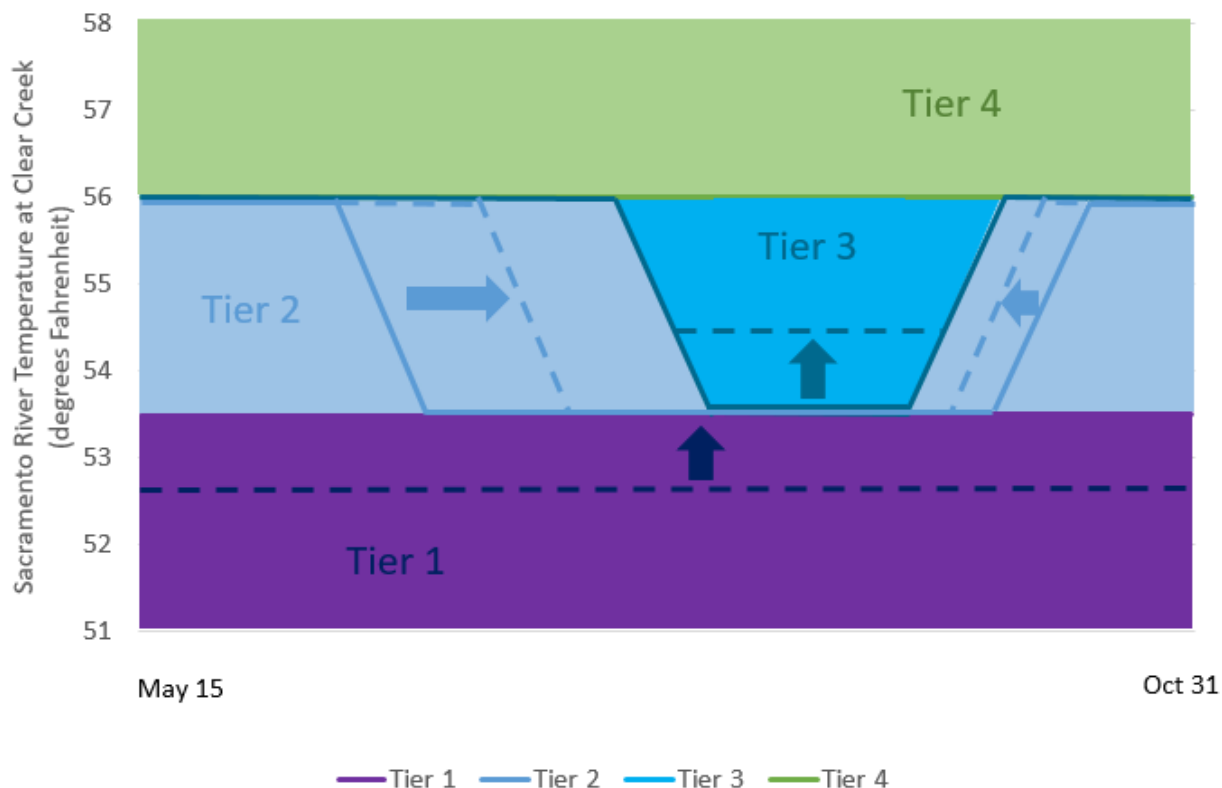


Figure 4-3. Tiered Temperature Management Strategy

- 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. Although Tier 1 years generally have sufficient cold water to maintain 53.5°F through October 31, the unknown meteorology continues to present a risk of temperatures rising above 53.5°F, particularly towards the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur, and thus allowable tolerances will be identified in the annual temperature management plan through coordination with SRTTG.
- 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 period of temperature management with 53.5°F at CCR would be centered on the projected time 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, if 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. Although Tier 2 years generally have sufficient cold water to maintain 56°F after the last observed red through October 31, the unknown meteorology continues to present a risk of temperatures rising above 56°F, particularly towards the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur and thus allowable tolerances will be identified in the annual temperature management plan through coordination with the SRTTG.

- **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 cold water pool management at colder tiers would cause loss of temperature control late in the season), 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). In Tier 3, the targeted temperature at CCR during the early and late periods of cold water pool management will not exceed a daily average of 56°F. Based on latest egg mortality models, real-time monitoring, and expected and current cold water availability, Reclamation would decrease the temperatures during the period of greatest temperature stress on early life stages to minimize adverse effects to the greatest extent possible. During this critical period, temperatures will be targeted between 53.5°F and 56°F. Tier 3 will be selected if Reclamation's temperature management plan indicates that temperatures can be maintained to at least 56°F at CCR, otherwise Reclamation would operate to Tier 4. Although Tier 3 years generally have sufficient cold water to maintain 56°F through October 31, the unknown meteorology continues to present a risk of temperatures rising above 56°F, particularly towards the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur, and thus allowable tolerances will be identified in the annual temperature management plan through coordination with the SRTTG. If the temperature management plan indicates a higher risk of exceeding 56°F before October 1st, this is an indication that the cold water pool may not support a warm early fall and will therefore be treated as a Tier 4 year for the purposes of intervention measures and early season discussions and coordination.
- **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 beginning 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 and would provide this forecast to USFWS and NMFS if it is projected to be a Tier 4 year. 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.

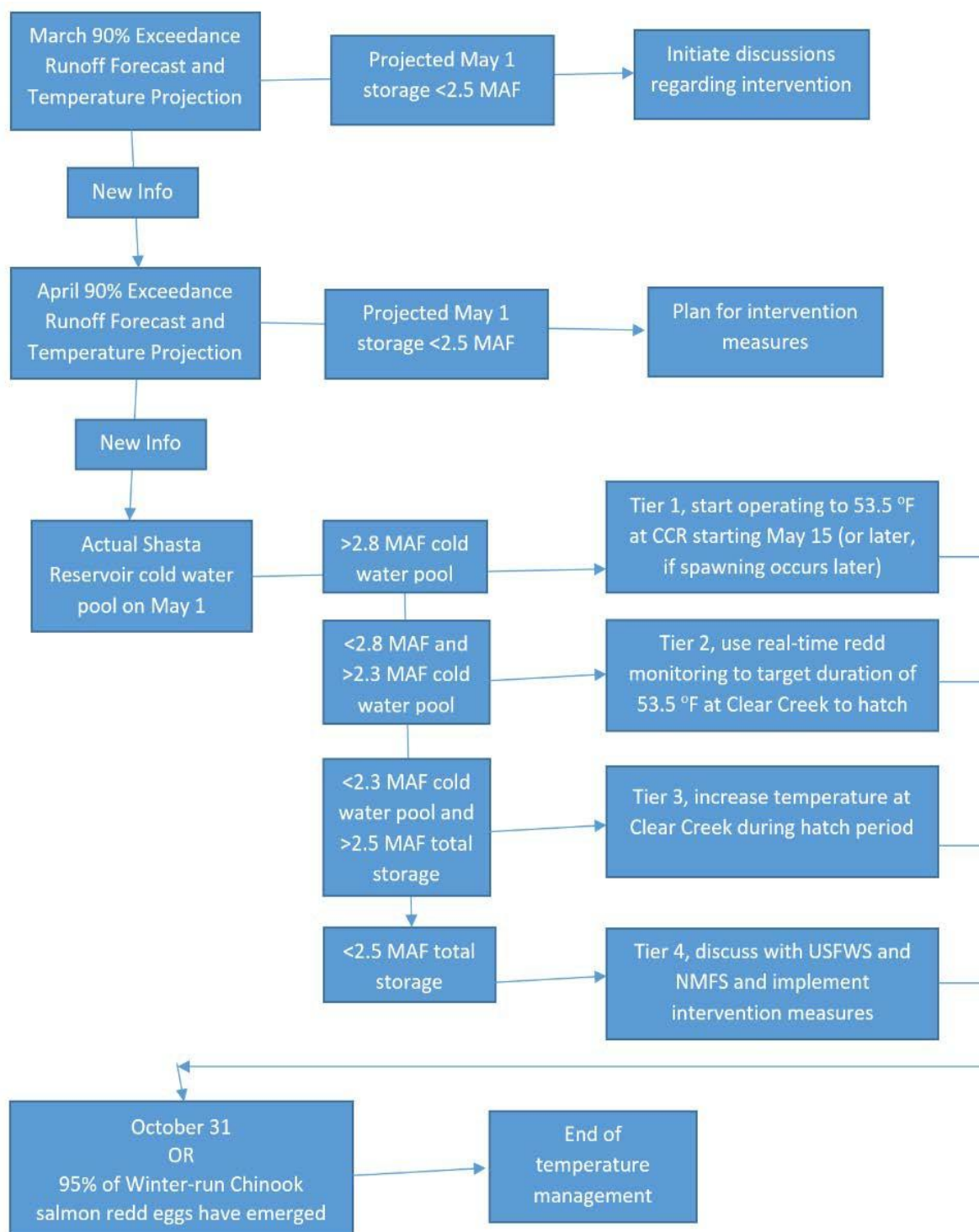


Figure 4-4. Decision Tree for Shasta Reservoir Temperature Management

Reclamation intends to collect temperature profile measurements for Shasta, Whiskeytown, and Trinity Reservoirs on the schedule shown in Table 4-9 and provide these to USFWS and NMFS if it is projected to be a Tier 4 year.

Table 4-9. 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. The draft 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 scenario shall include projected reservoir releases, assumed meteorological conditions, and anticipated water temperatures and target locations for the planned water temperature targets. For the final temperature management plan, Reclamation will use conservative assumptions for determining the Shasta Cold Water Management Plan including relying on the actual May 1st storage, a conservative inflow forecast for inflow May through September, proposed releases based on a conservative forecast and a conservative historical meteorology. Reclamation will utilize a forecast with 90% exceedance in the aggregate (when jointly considering multiple significant known uncertainties such as hydrology and meteorology) to develop conservative water temperature forecasts, although certain circumstances may lead Reclamation to use different exceedance levels to incorporate an appropriately more conservative approach. Reclamation shall share forecast assumptions with NMFS through the SRTTG. Reclamation anticipates NMFS will provide technical assistance through the SRTTG.

Consistent with the Shasta Cold Water Management Plan, Reclamation shall operate the Temperature Control Device at Shasta Dam to manage water temperatures below Keswick Dam and monitor the results. If monitored water temperatures exceed the target temperature (with allowable tolerances) in the Shasta Cold Water Management Plan for longer than 3 consecutive days, Reclamation shall notify NMFS of what actions, if any, are being taken to address the exceedances and will arrange for a follow-up on day 5 if the actions do not resolve the issue.

4.10.1.4.2 Commitment to Cold Water Management Tiers

The temperature tier will be forecasted in April of each water year based on forecasted cold water pool volume and temperature modeling results indicating the feasibility of meeting a particular tier. This tier will be finalized in May when there is additional confidence in the hydrologic forecast. If, as the water year progresses, it is determined that additional cold water is available for temperature control purposes, then the tier may be upgraded to a more beneficial tier. Given the use of conservative forecasts, additional cold water pool would be expected more frequently than less cold water pool, although this would only lead to a change in tiers when the conditions are close to the tier boundaries. Reasons for a mid-season change in tier include (but are not necessarily limited to) changes in hydrology, unusual climate conditions that vary from the climate assumptions in the temperature model, changes in water service delivery patterns and changes in assumptions on water needs for regulatory requirement. Temporary exceedances of target temperatures that are within the allowable tolerances identified in the temperature management plan will not be considered a shift into a different tier. In many cases, these can be corrected with real-time operational adjustments and do not indicate a deficit in cold water pool that would lead to a warmer temperature target. Reclamation will operate to the most protective temperature tier that is achievable.

Once the initial tier is selected by May 15th, Reclamation will not cause a shift into a warmer tier during real-time implementation of the Shasta Cold Water Management Plan except in the event of responding to emergency and/or unforeseen conditions. Examples of emergency and/or unforeseen conditions, may include, but are not limited to, higher water quality control plan compliance requirements, warmer meteorology, changes in forecasted inflow quantities and temperatures to Shasta, facility malfunctions, and higher than expected non-project water diversions (e.g., diverters other than those exercising water service and repayment contracts with Reclamation such as in-Delta diversions, riparian diversions, etc.).

Reclamation intends to check the temperature management plan (and associated tier) at least monthly and will notify NMFS within 2 business days of determining a potential change to the plan or tier is necessary. Reclamation may be able to adjust operations to overcome unexpected events without changing to a lower tier. Should Reclamation be unable to remain within the same or cooler tier identified by the Shasta Cold Water Management Plan, and require a mid-season change in tier, Reclamation will coordinate with NMFS on the need to charter an independent panel, at the end of the temperature management season, consistent “Chartering of Independent Panels” under the “Governance” section of this Proposed Action. The purpose of the independent review will be to evaluate the conditions experienced during the years under review, the success of the implementation of the tiered strategy, the effect of the implementation on the species, and, if needed, to develop recommendations to improve implementation and performance.

4.10.1.4.3 Upper Sacramento Performance Metrics

Reclamation proposes performance objectives for assessing cold water management under the different tiers. The objective is to ensure that the performance falls within the modeled range and shows a tendency towards performing at least as well as the distribution produced by the simulation modeling of the Proposed Action. Reclamation reviewed the modeled temperature dependent mortality over the CalSim-II period of record (1922-2002) with their modeled tier associated with each year. Reclamation’s objective, as described in this proposed action, will be to meet the temperature criteria associated with each tier and expects the associated biological performance will fall within the full range of modeled performance. The summary of modeled results is listed below with the median, average, maximum and minimum, and standard deviation values within the years. Reclamation intends for an independent panel to review and refine potential alternative steps if the objectives are not occurring.

Future downstream temperature performance is estimated using a numeric model and assumed future hydrologic, operations, and meteorological conditions. The temperature model makes decisions to select a TCD configuration based on user defined Shasta Dam tail-bay target temperatures. This model representation is more coarse than actual operational flexibility and sometimes does not capture daily adjustments which can be managed in real-time to avoid downstream temperature exceedances. Historical performance compared to model results confirms real-time adjustment capabilities using short-term forecasts and operational adjustments, however, this does not alleviate actual short-term forecast uncertainty. In the spring, simulated storm events will accurately predict unavoidable downstream temperature exceedances due to warm side-flows that dominate the upper Sacramento River system. Summary of modeled temperature dependent mortality:

- Tier 1 – Maximum (39%); Average (6%); Median (2%); Minimum (0.4%); Std. Dev (+/-9%)
- Tier 2 - Maximum (46%); Average (15%); Median (9%); Minimum (1%); Std. Dev (+/-16%)
- Tier 3 - Maximum (77%); Average (34%); Median (24%); Minimum (6%); Std. Dev (+/-31%)

- Tier 4 – Appropriate performance metrics will be addressed under “Drought and Dry Year Actions” consistent with the “Governance” section of this Proposed Action.

Reclamation reviewed the observed egg-to-fry survival over the past 21 years, excluding years with atypical temperature conditions (2015). Reclamation’s objective in undertaking habitat restoration and facility improvements, as described in this proposed action, will be to improve the egg to fry survival associated with each tier and expects the associated biological performance to increase over time. The summary of results is listed below with the average, maximum and minimum values within the years analyzed. Reclamation intends for an independent panel to review and refine potential alternative steps if the objectives are not occurring.

Summary of historical egg to fry survival:

- Tier 1 - Average (29%); Maximum (49%); Minimum (15%); Median (28%); Std. Dev (10%)
- Tier 2/3 - Average (21%); Maximum (34%); Minimum (15%); Median (20%); Std. Dev (6%)
- Tier 4 - Appropriate performance metrics will be addressed under “Drought and Dry Year Actions” consistent with the “Governance” section of this Proposed Action.

The 75th percentile values of the historical egg to fry survival will be included as a surrogate for expected improvements in ETF survival for each tier from the habitat restoration projects recently completed, currently underway, or proposed to be completed within the proposed action. These values are: Tier 1 – 32%; and Tiers 2/3 – 27%. These values will be updated with the appropriate metrics once modeled results are available on the expected improvements from these projects.

In the course of developing “Drought and Dry Year” actions, Reclamation and DWR will develop a range of alternative strategies for temperature management. The SRTTG may consider alternative strategies to the approach described in this PA during development of plans for Tier 3 years. In acknowledging that Tier 3 years are expected to produce a range of outcomes that increase the threat of viability to salmonid species, Reclamation will work to limit those effects through the SRTTG. These alternative strategies may be based on new or evolving science on the key biological drivers of temperature dependent mortality. These strategies may require additional analytical methods and monitoring specific to the hydrologic and temperature conditions. Reclamation would evaluate and report upon the effectiveness of strategies. These strategies would be coordinated with the conservation measure that addresses two successive years with total egg-to-fry survival less than 15% in each year.

Reclamation will measure upper Sacramento River fisheries populations, in collaboration with federal, state, and local partners, to estimate the total survival from egg incubation to juvenile migration to Red Bluff Diversion Dam, consistent with the monitoring described in Appendix C. Reclamation will estimate and report on the direct mortality and sublethal effects to egg incubation associated with water temperatures below Keswick Dam (temperature dependent mortality) using, at a minimum, the Martin et al. (2017) approach unless superseded by mutual agreement with NMFS. Reclamation will report annually on total survival and temperature dependent mortality consistent with Appendix C. The Annual Reporting will include a technical team (e.g., SRTTG) hindcast evaluation of whether either the total egg to fry survival or the temperature dependent mortality exceeded the Tier objective. This evaluation will consider the central tendency of modeled expected survival results and will contribute to determining whether an independent review of the year is required. The annual accomplishments in each year will be compared to the metrics by the review panels in 2024 and 2028, consistent with “Four Year Reviews” under the “Governance” section of

this PA, to review whether there is a tendency or trajectory that will not lead to matching or exceeding the distribution of the modeled results over the long-term.

If the actual temperature dependent mortality or egg to fry survival fall outside the range described above in any single year, Reclamation will convene with NMFS to determine if an independent panel is necessary. If a panel is determined necessary, Reclamation will charter an independent panel consistent with “Chartering of Independent Panels” under the “Governance” section of this Proposed Action. If the actual results are within the ranges described above, Reclamation will still convene an independent panel consistent with “Four Year Review” under the “Governance” section of this Proposed Action and described above. The purpose of either panel will be to:

1. Review the drivers behind the management of cold water within the tiers including reservoir storage, releases, meteorology, hydrology, and other conditions affecting building and use of cold water (e.g. emergency, uncertainty, etc.).
2. Review the performance objectives, including the methods for determining temperature dependent mortality and methods for determining total survival.
3. Review the Tier types that have occurred during the performance periods of the Proposed Action and the performance within each tier as compared to expected performance. The selected metrics are the average, median, standard deviation, min, and max of the base dataset. Additional higher-order time series statistics may be used at the request of the review panel. The objective is to ensure that the performance falls within the modeled range and shows a tendency towards performing at least as well as the distribution produced by the simulation modeling of the Proposed Action.
4. Recommend potential modifications to CVP and SWP operations that would improve cold water management that are within the agencies’ authorities.
5. Review the effectiveness of habitat restoration, facility improvements, intervention, and research measures.

The panel will prepare a report incorporating discussion of the above items and recommendations, including alternative strategies. NMFS and Reclamation shall meet and confer to discuss the report and any response.

Prior to the initial Four Year Review independent panel, Reclamation shall refine performance objectives for temperature dependent mortality and the total survival of winter-run Chinook salmon from egg incubation to juvenile migration at Red Bluff Diversion Dam. Reclamation expects to participate in an effort by NMFS to establish early life stage survival rates that are required for a positive cohort replacement rate. Reclamation expects NMFS will submit for independent review temperature dependent mortality and egg to fry survival values that, as the species experts and with support from separate analyses, it expects will provide continued support of a viable population. Reclamation expects to participate in the panel and offer technical assistance regarding operations, understanding that these values, or any that result from addressing recommendations from the independent panel, could be adopted with mutual agreement as revised performance metrics for operations.

4.10.1.5 *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 the combined productivity of the remaining redds plus a conservative scenario for the following year is less than the productivity of maintaining, Reclamation will reduce releases to rebuild storage. Real-time fish monitoring data, operational conditions, and modeling will be shared through SRTTG. Reclamation anticipates NMFS will provide technical assistance through the SRTTG.

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 based on 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 4-10 shows the initial schedule for Keswick Releases based on Shasta Reservoir storage condition; these would be refined through future modeling efforts as part of the seasonal operations planning.

Table 4-10. 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

High storage years are not necessarily correlated with a following wetter fall and winter. As a result, Reclamation will manage the real time releases based on conditions observed. In scenarios where higher storage exist at the end of September but the fall hydrology is dry (generally defined as below 90% exceedance of historical hydrology), Reclamation will coordinate with appropriate agencies, including NMFS and CDFW at a minimum, to reduce flows below those described in the table, if possible.

This approach to selecting fall, winter, and spring minimum flows allows Reclamation to build and conserve storage for supporting cold water management and summer demands. Due to the effort to build storage, this often results in flood control releases well over the minimum flows, typically in the December through May periods. The low flow in the fall and winter period directly increases the likelihood and magnitude of the flood control releases in the winter and spring months.

4.10.1.5.1 Operation of Shasta Dam Raise

There is a separate process and environmental impact statement for the Shasta Dam Raise, for which a Record of Decision and Biological Opinions have not been completed. Reclamation would not change operations described in the PA until the Shasta Dam Raise ROD and separate ESA consultations are completed. In the interim, Reclamation would operate the enlarged reservoir consistent with the operations and requirements of the proposed action. The additional storage

created by the 18.5-foot dam raise could be used to improve the ability to meet water temperature objectives and habitat requirements for salmonids during drought years and increase water supply reliability.

4.10.1.5.2 Conservation Measures

Reclamation and DWR are proposing conservation measures to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment as well as contribute to the recovery and enhancement of species and their habitats. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. Actions could be implemented in part or fully through agreements and cost share with the State of California and potentially under the Voluntary Agreement alternative under the State Water Resources Control Board update to the Bay-Delta Water Quality Control Plan.

- **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 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.
- **Temperature Modeling Platform:** Reclamation will continue as part of a collaborative model development effort to develop a new temperature model for the Upper Sacramento River (Shasta and Keswick reservoirs). NMFS Science Center, among others, is participating in the collaborative process. This new model will be on the CEQUAL-W-2 platform with the intention of developing similar platforms for all of Reclamation's major reservoirs.
- **Shasta Temperature Control Device Performance Evaluation:** Reclamation will coordinate with NMFS to study whether there are problems or limitations with the function of the TCD under low storage conditions, and, if necessary, identify potential actions and/or modification for improving operational efficiency of the TCD.
- **Battle Creek Salmon and Steelhead Restoration Project and Battle Creek Reintroduction Plan:** Reclamation will provide funding for ten years towards reintroduction of Winter-run Chinook Salmon to Battle Creek. Reclamation will accelerate implementation of the Battle Creek Salmon and Steelhead Restoration Project, which is intended to reestablish approximately 42 miles of prime salmon and Steelhead habitat on Battle Creek, and an additional 6 miles on its tributaries. The Battle Creek Restoration Project is a collaborative effort among several federal and state agencies and Pacific Gas & Electric Company. The partnership provides a framework for expanding Winter-Run Chinook Salmon spawning to cold water habitat not in the Sacramento River.

In August 2016, the California Department of Fish and Wildlife released the Battle Creek Winter-run Chinook Salmon Reintroduction Plan. The U.S. Fish and Wildlife Service subsequently agreed to take responsibility for implementing the plan, and in 2018, approximately 200,000 juvenile Winter-run Chinook salmon were reintroduced to Battle Creek to jumpstart the

reintroduction effort. These fish have matured and started to return as adults in summer 2019. The jumpstart effort is intended to transition into implementation of the Reintroduction Plan with Reclamation support. Reclamation's support will go towards fish passage construction and reintroduction implementation activities. This includes ten years of annual Plan monitoring and implementation cost up to \$1,400,000 annually. As the Reintroduction Plan continues additional funding will likely be needed to cover the annual costs.

- 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 action would provide grants to senior water right holders within this area to install new diversions and screens that would operate at the 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.
- Spawning Habitat Restoration: Reclamation proposes to create additional spawning habitat by injecting approximately 15,000 – 40,000 tons of gravel annually into the Sacramento River to 2030, using the following sites: Keswick Dam Gravel Injection Site, Market Street Injection Site, Redding Riffle, Turtle Bay, Tobiasson Island, Shea Levee sites, and Kapusta.
- Rearing Habitat Restoration: Reclamation, in coordination with the Sacramento River Settlement Contractors proposes to create 40–60 acres of side channel and floodplain habitat at 10 sites in the Sacramento River by 2030. The potential sites include Salt Creek, Turtle Bay 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, 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.
 - The Sacramento River Settlement Contractors approved *A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort*. Pursuant to the resolution, the SRS Contractors will continue to participate in, and act as project champions for future Sacramento Valley Salmon Recovery Program projects, subject to the availability of funding, regulatory approvals, acceptable regulatory assurances, and full performance of the SRS Contracts.
- Deer Creek Irrigation District Dam (DCID) Fish Passage: Reclamation will provide funding towards this collaborative fish passage project being completed by DCID, Trout Unlimited, California Department of Fish and Wildlife, and U.S Fish and Wildlife Service. The shovel-ready project will construct a natural like fishway downstream of the DCID's dam to provide spring-run Chinook salmon and Central Valley steelhead with unimpeded access to 25 miles of prime spawning habitat with no adverse effect on the DCID diversion. Improving fish passage at this site will improve upstream access to spawning, rearing and holding stream habitat. This will also

improve anadromous fish passage, downstream of the project sites, through fish screen and bypass pipe modifications.

- **Small Screen Program:** 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.
- **Knights Landing Outfall Gates:** Reclamation will provide funding towards reconstruction of the Knights Landing Outfall Gates to reduce the potential for fish straying into the Colusa Basin Drain. These funds will go towards repairing the positive fish barrier hoist system and electric controls.
- **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. Reclamation would coordinate with USFWS and NMFS as part of the “Drought and Dry Year Actions” under the “Governance” section of this PA to determine the need to improve the facility and associate collection facilities. Improvements may include permanent chillers, additional tanks, and other features.
- **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, trapping operations would cease and traps would be removed, as appropriate.
- **Directors Meeting:** In the event of two successive years with total egg-to-fry survival less than 15% in each year, Reclamation will convene a meeting of the Regional Directors of the Department of Water Resources, National Marine Fisheries Service, Fish and Wildlife Service, and California Department of Fish and Wildlife no later than the end of November. The Directors will meet and confer to develop a list of actions to address the potential for a third year of low survival. The Directors will continue to meet monthly, or more often as appropriate, through the next operational season. The Directors will hold a similar meeting in each of the two following Novembers to ensure that the years following the two-year emergency condition appropriately address the need to recover from the multi-year event.

- **Yellow-billed Cuckoo Surveys:** Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

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.

4.10.2.1 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, is discharged into Keswick Reservoir where it mixes with water from Shasta, and then outflows into the Sacramento River, 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.

4.10.2.2 *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.

4.10.2.2.1 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 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 for Reclamation to determine if and when to release supplemental flows from mid-August to late September from Lewiston Dam to prevent an episodic disease outbreak in the lower Klamath River. 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.

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.

4.10.2.4 *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 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. A ramping rate of no more than 25 cfs per hour during nocturnal hours will be used to reduce potential stranding risks to juvenile salmonids during Whiskeytown controlled flow reductions.

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.

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 16 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.

4.10.2.5 *Spring Creek Debris Dam*

Runoff containing acid mine drainage from several inactive copper mines and exposed ore bodies at Iron Mountain Mine is stored in Spring Creek Reservoir. In January 1980, Reclamation, CDFW, and SWRCB executed a memorandum of understanding (MOU) to implement actions that protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. However, since 1990, concentrations of toxic metals in acidic drainage from Iron Mountain Mine have progressively decreased due to several significant remedial actions by the EPA. The completion of:

- EPA's Minnesota Flats Iron Mountain Mine Acid Mine Drainage Treatment Plant (lime neutralization plant) in 1994,
- Slickrock Creek Retention Reservoir in 2004, and
- Dredging of approximately 180,000 cubic yards of contaminated sediments from the Spring Creek arm of Keswick Reservoir in 2009-10

have resulted in a reduction of approximately 95 percent of the toxic metals that historically emptied into the Sacramento River. Lower concentrations of copper and zinc resulting from controlled and uncontrolled Spring Creek Debris Dam releases are expected as compared to pre-1990. The extent of heavy metal influence is usually limited to regions immediately downstream of Keswick Dam.

As a result of dramatic changes to the water quality in the vicinity of the Iron Mountain Mine watershed, Reclamation CDFW, SWRGB and EPA are progressing towards a revision of the 1980 MOU to address the improvements and changed conditions. Operation of the Spring Creek Debris Dam and Shasta Dam have deviated from the 1980 MOU to accommodate for these changes. Reclamation expects a revised MOU with similar guidelines to the interim operation.

The interim operation Reclamation proposes to implement includes actions that will protect the Sacramento River system from heavy metal pollution (i.e., acid mine runoff) from Spring Creek Dam and adjacent watersheds. This includes water quality criteria at the point of compliance (Below Keswick) shown in Table 1 and based upon the criteria for protection of aquatic life in the upper Sacramento River described in the Water Quality Control Plan for the Sacramento River and San

Joaquin River Basins (Basin Plan) (Water Board, 1998) and the California Toxics Rule (CTR) (provided in Water Board, 2003).

Table 4-11: Water Quality Criteria for Surface Water Downstream of Keswick Dam

Analyte	Maximum Concentration for Acute Exposure (µg/L) a	Maximum Concentration for Chronic Exposure (µg/L) b
Dissolved copper	5.6 c,d	4.1 e,f
Dissolved zinc	16 c,d	54 e,f

a The maximum concentration for acute exposure of the 1-hour average concentration.

b The maximum chronic exposure is the continuous concentration (4-day average concentration).

c Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, shall be determined by using the following formulas:

$$\text{Dissolved Copper} = (e^{[0.905 \times \ln(\text{hardness}) - 1.612]})$$

$$\text{Dissolved Zinc} = (e^{[0.830 \times \ln(\text{hardness}) - 0.289]})$$

d Based upon Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) (Water Board, 1998)

e Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, shall be determined by using the following formulas:

$$\text{Dissolved Copper} = 0.96 \times (e^{[0.8545 \times \ln(\text{hardness}) - 1.702]})$$

$$\text{Dissolved Zinc} = 0.986 \times (e^{[0.8473 \times \ln(\text{hardness}) - 0.884]})$$

f Based upon the California Toxics Rule (CTR) (provided in Water Board, 2003)

Reclamation expects continued monitoring of the water quality of Spring Creek Debris Dam, Spring Creek Power Plan, Keswick, and Shasta and increased frequency of monitoring if Spring Creek Debris Dam releases water through the spillway or drops below the minimum elevation threshold. The operation described herein is also dependent on the water treatment capabilities afforded by EPA.

When storage within Spring Creek Reservoir is less than capacity at 795 feet (approximately 5 TAF) and above 720 feet (note Reclamation's operation is conservative and includes an operational factor of safety of 5 feet), Reclamation is able to make controlled undiluted releases that result in allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. These undiluted releases from Spring Creek Debris Dam can occur throughout the year, typically December through June and less frequently in other months.

When Spring Creek Reservoir storage exceeds the capacity of the reservoir at 795 feet (approximately 5 TAF) water must be released through the spillway. In this situation Reclamation anticipates an "emergency" relaxation of the criteria, as consistent with past protocol, of: a 50 percent increase in the objective concentrations of copper and zinc. Although the general operational goal is to avoid use of the Spring Creek Debris Dam spillway, some storm events or series of events are unavoidable. The spillway operation typically occurs during a large storm or series of events, January through April, and are coincident with large flood management flows released from Keswick Dam. In recent years EPA, Reclamation, DFG, and the RWQCB have agreed not to use the emergency criteria until a spill is imminent. During significant rain events Spring Creek Debris Dam releases may target a dilution ratio with Keswick releases to achieve an acceptable water quality below Keswick Dam. Spring Creek Reservoir spillway dilution flows from Keswick are expected to

be coincident with large flood management flows and are unlikely to impact water supply or cold water pool resources.

Reclamation does not plan to operate Spring Creek Reservoir below elevation 720 feet to avoid potentially significant degraded water quality when reservoir soils are exposed. However, if Spring Creek Reservoir is less than 720 feet then a minimum dilution flow of 250 cfs from Spring Creek Power Plant and increased water quality monitoring is expected.

At any time that dilution flows are necessary, Reclamation plans to minimize the build-up of toxic metals in the Spring Creek arm of Keswick Reservoir. To accomplish this, the releases from the debris dam are coordinated with releases from Spring Creek Powerplant (Spring Creek Power Plant draws water from Whiskeytown Reservoir) to keep the metals in circulation within the main body of Keswick Reservoir.

4.10.2.6 *Clear Creek Restoration Program*

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

4.10.2.7 *Yellow-billed Cuckoo Surveys*

Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

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.

4.10.4 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), the temperature control shutters on the power plant intakes for Folsom Dam, 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 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 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 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 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 water agencies would coordinate with Reclamation to identify and implement appropriate actions to improve forecasted storage conditions, and the American River 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 will continue to work with the American River Group, a group that includes federal, state, and local agencies, water users, and NGOs, to coordinate spring pulse flow timing and communicate upcoming releases.

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.

4.10.4.1 *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.

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. 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. In addition to the pulse flow under the 2017 Flow Management Standard, to the extent feasible, Reclamation proposes to accommodate additional 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. 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.

Reclamation will ramp down releases in the American River below Nimbus Dam as follows in Table 4-12 below.

Table 4-12: American River Ramping Rates

Lower American River Daily Rate of Change (cfs)	Amount of decrease in 24 hrs (cfs)	Maximum change per step (cfs)
20,000 to 16,000	4,000	1,350
16,000 to 13,000	3,000	1,000
13,000 to 11,000	2,000	700
11,000 to 9,500	1,500	500
9,500 to 8,300	1,200	400
8,300 to 7,300	1,000	350
7,300 to 6,400	900	300
6,400 to 5,650	750	250
5,650 to 5,000	650	250
<5,000	500	100

Ramping rates do not apply during flood control or if needed for facility operational concerns. The working groups may also determine a need for a variance.

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 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.

4.10.4.3 Conservation Measures

Reclamation and DWR are proposing conservation measures to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological

assessment as well as contribute to the recovery and enhancement of species and their habitats. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. Actions could be implemented in part or fully through agreements and cost share with the State of California and potentially under the Voluntary Agreement alternative under the State Water Resources Control Board update to the Bay-Delta Water Quality Control Plan.

- **Spawning and Rearing Habitat Restoration:** 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 following projects: Paradise Beach, Howe Avenue to Watt Avenue rearing habitat, William Pond Outlet, Upper River Bend, Ancil Hoffman, 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 Hatchery Genetics Management Plans (HGMPs) for Central Valley Steelhead and Fall-run Chinook Salmon for use in Nimbus Fish Hatchery management. Reclamation intends to improve the status of CV steelhead and Fall-run Chinook salmon in the American River by developing these plans. The steelhead HGMP will describe hatchery operations and associated monitoring to reduce genetic introgression from the out-of-basin Nimbus Hatchery broodstock, implement practices to reduce straying and eliminate inter-basin transfers from Nimbus hatchery, and promote a CV steelhead DPS population in the American River. The fall-run Chinook Salmon HGMP will describe hatchery operations and associated monitoring to reduce impacts on hatchery Chinook salmon on natural fall-run Chinook salmon and minimize effects on the genetic diversity and run-timing of American River fall-run Chinook salmon. Within six months of completion of the consultation, Reclamation will work with CDFW and NMFS to establish a clear understanding on this conservation measure's 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.
- **Yellow-billed Cuckoo Surveys:** Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from

ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

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).

4.10.5.1 *Seasonal Operations*

Winter and spring pumping operations generally maximize exports of excess, unregulated, unstored water to help meet project demands later in the 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).

4.10.5.2 *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.

4.10.5.3 *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 Reclamation proposes to operate the DCC gates consistent with past operations. If during this period Knights Landing Catch Index or Sacramento Catch Index are greater than three fish per day Reclamation proposes to operate in accordance with Table 4-13 and Table 4-14 to determine whether to close the DCC gates and for how long.

From December 1 to January 31, the DCC gates will be closed, except to prevent exceeding a D-1641 water quality threshold.

If drought conditions are observed (i.e. fall inflow conditions are less than 90% of historic flows) Reclamation and DWR will consider opening the DCC gates for up to 5 days for up to two events within this period to avoid D-1641 water quality exceedances. Reclamation and DWR will coordinate with USFWS, NMFS and the SWRCB on how to balance D-1641 water quality and ESA-listed fish requirements. Reclamation and DWR will conduct a risk assessment that 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 also consider the cumulative entrainment from prior years. Reclamation will share this information with WOMT to describe how 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, or a greater range of an adverse effect, not considered under this proposed action, Reclamation will not open the DCC. During a DCC gates opening between December 1 and January 31, the CVP and SWP will divert at Health and Safety pumping levels.

From February 1 to May 20, the DCC gates will be closed consistent with D-1641. From May 21 to June 15, Reclamation will close the DCC gates for a total of 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 timing and duration of the gate closure.

Table 4-13. 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 5.0fish 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 3.0 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

Date	Action Triggers	Action Responses
	Water quality criteria per D-1641 are met, real-time hydrodynamic and salinity modeling shows water quality concern level targets are not exceeded during	Within 48 hours of start of LMR attraction flow release, close the DCC gates for up to 5 days
	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 4-14. 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

4.10.5.4 *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 May and July and removed in November. Barriers would include at least one culvert open to allow for fish migration when water temperatures are less than 71.6°F. 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.

4.10.5.5 *North Bay Aqueduct*

The North Bay Aqueduct and Barker Slough Pumping Plant will continue to operate under applicable regulatory requirements with an annual maximum diversion of 125 TAF. The maximum daily diversion rate for the Pumping Plant is 175 cfs.

Reclamation and DWR will work with the Service to develop Delta Smelt minimization measures by the end of the 2019 calendar year. These minimization measures will aim to protect larval delta smelt from entrainment through the BSPP and will consider reduction in diversion through the NBA at the appropriate spring period and appropriate water year types by using effective detection measures or an appropriate proxy.

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.

4.10.5.6 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. 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 environmental 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 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.

4.10.5.7 Water Transfers

Reclamation and DWR propose to transfer project and non-project water supplies through CVP and SWP facilities, including north-to-south transfers and Sacramento River north-to-north transfers. The quantity and timing of Keswick releases would be similar to those that would occur absent the transfer. 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 4-15.

Table 4-15. Proposed Annual North to South Water 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 during dry conditions, 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.

4.10.5.8 Clifton Court Aquatic Weed 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, a chelated copper herbicide (copper-ethylenediamine complex and copper sulfate pentahydrate) and, 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 production of taste and odor compounds of algal toxins. Dense growth of submerged aquatic weeds 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 trash racks. This mass of uprooted and broken vegetation essentially forms a watertight plug at the trash racks 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 trash racks. 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 trash racks and louvers. The objective is to decrease the weed load on the trash racks 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. 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, 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 is at or above 77°F 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 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.
- Apply Aquathol K and copper-based aquatic pesticides, as needed, during periods of activated Delta Smelt and salmonid protective measures and when average daily water temperature in CCF is below 77°F 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 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. 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, 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.
- Apply peroxygen-based aquatic algaecides, as needed, year-round.
- There are no anticipated impacts on fish with the use of 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.
- For Aquathol K and copper compounds, the radial intake gates will be closed at the entrance to CCF prior to the application of pesticides to allow fish to move out of the targeted treatment areas and toward the salvage facility and to prevent any possibility of aquatic pesticide diffusing into the Delta.
- For Aquathol K and copper compounds, the radial gates will remain closed for a minimum of 12 and up to 24 hours after treatment to allow for the recommended duration of contact time between the aquatic 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 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 will be made by a licensed applicator under the supervision of a California Certified Pest Control Advisor.
- Aquatic herbicides and algaecides will be applied by boat 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 shoreline and move systematically farther offshore, 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.
- Water quality samples to monitor copper and endothall concentrations within or adjacent to the treatment area, per the NPDES permit requirements, will 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 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.
- 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 77°F through the first rainfall

flush event, which can occur as late as 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 77°F, 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 algacides 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 gate closure and prior to the applications 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, lowers the water level in the CCF to decrease the total amount of herbicide 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 Aqueduct via Banks PP will reduce the exposure time of any ESA-listed fish species present in CCF.

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 the 1980's 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 on an as needed basis to meet D-1641 water quality standards in Montezuma Slough. The water quality standard include the period between October through May. Operations are determined from data at D-1641 compliance stations, hydrologic conditions, weather, Delta outflow, tide, fishery considerations, and other factors. The duration of gate operation may range from no use to full use for the entire October through May period. Assuming no significant long-term changes in the operational data mentioned above, it is expected that gate operations

(outside of additional actions described under Delta Smelt Summer-Fall Habitat Action) will remain at current levels (17-69 days) necessary to meet D-1641 standards. During drought conditions, gate operations are more likely to span the entire October through May period to meet D-1641 standards.

The SMSCG boat lock portion of the gate will be held partially open during SMSCG operation to allow for continuous salmon passage opportunity. After an engineering solution is implemented to prevent boaters from entering the boat lock prior to the operator closing it, the gate will be held open at all times. However, the boat lock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

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 a maximum approach velocity of 0.2 ft/second at the intake fish screen except during September 14 – October 20, when RRDS diversion rates are controlled to maintain a maximum approach velocity of 0.7 ft / s for fall flood up operations.

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.

The Goodyear Slough Outfall (GYSO) connects the south end of Goodyear Slough to Suisun Bay. Prior to construction of the outfall, Goodyear Slough was a dead-end run slough. The GYSO was designed to increase circulation and reduce salinity in Goodyear Slough so as to provide higher water quality to the wetland managers who flood their ponds with Goodyear Slough water. GYSO has a series of four passive intakes that drain to Suisun bay. The outfall is equipped with slide gates on the interior of the outfall structure to allow DWR to close the system as needed for maintenance or repairs. The intakes and outfall of GYSO are unscreened but are equipped with trash racks to prevent damage. Any fish that entered the system would be able to leave via the intake or the outfall, as GYSO is an open system.

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.

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 (described below). Grimaldo et al. (2017) indicate that -5,000 cfs is an inflection point in OMR for fish entrainment. OMR could be more positive than -5,000 cfs if additional real-time OMR restrictions are triggered (described below) or constraints other than OMR control exports. Reclamation and DWR propose to operate to an OMR index computed using an equation. An OMR index allows for shorter-term operational planning and real-time adjustments. 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. The 3-day trigger allows for efficient power scheduling.

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): To minimize project influence on migration (or dispersal) of Delta Smelt, Reclamation and DWR proposes to reduce exports for 14 consecutive days so that the 14-day averaged OMR index for the period shall not be more negative than -2,000 cfs, in response to “First Flush” conditions in the Delta. The population-scale migration of Delta Smelt is believed to occur quickly in response to inflowing freshwater and turbidity (Grimaldo et al. 2009; Sommer et al. 2011). Thereafter, the best available scientific information suggests that fish make local movements, but there is no evidence for further population-scale migration (Polansky et al. 2018). “First Flush” conditions may be triggered between December 1 and January 31 and include:
 - running 3-day average of the daily flows at Freeport is greater than 25,000 cfs and
 - running 3-day average of the daily turbidity at Freeport is 50 NTU or greater, or
 - real-time monitoring (Appendix C) indicates a high risk of migration and dispersal into areas at high risk of future entrainment.
- This “First Flush” may only be initiated once during the December through January period and will not be required if:
 - spent female Delta Smelt are collected in monitoring surveys.
- Salmonids Presence: 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 and Performance Objectives:

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”): After the Integrated Early Winter Pulse Protection (above) or February 1 (whichever comes first) and until a ripe or spent female is detected or April 1 (whichever is first), 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. The purpose of this action is to minimize the risk to adult Delta smelt in the Old and Middle River Corridor, where they are subject to higher entrainment risks. This action seeks to avoid the formation of a turbidity bridge from the San Joaquin River shipping channel to the south Delta fish facilities, which historically has been associated with elevated salvage of pre-spawning adult Delta Smelt. If the daily average turbidity at Bacon Island cannot be maintained less than 12 NTU, Reclamation and DWR will manage exports to achieve an OMR no more negative than -2,000 cfs until the daily average turbidity at Bacon Island drops below 12 NTU. However, if 5 consecutive days of OMR less negative than -2,000 cfs do not reduce turbidity at Bacon Island below 12 NTU in a given month, Reclamation and DWR may determine that OMR restrictions to manage turbidity are infeasible, and will instead implement an OMR target that is deemed protective, based on turbidity, adult Delta Smelt distribution and salvage, but not a more negative OMR than -5,000 cfs.

Reclamation and DWR recognize that readings at individual sensors or localized groups of sensors can generate spurious results in real-time. To avoid triggering an OMR flow action during a sensor error or a localized turbidity spike that might be caused by local flows or a wind-driven event, Reclamation and DWR will consider and review data from other locations. In the event that the daily average turbidity at OBI is 12 NTU (or greater) and Reclamation and DWR believe that a Turbidity Bridge Avoidance action is not warranted based on additional data sources (isolated and/or wind-driven turbidity event at OBI), Reclamation and DWR will take no additional action and provide the supporting information to the Service within 24 hours.

Larval and Juvenile Delta Smelt: Reclamation and DWR will use results produced by USFWS approved life cycle models to manage the annual entrainment levels of larval/juvenile Delta Smelt. The Service's models will be publicly vetted and peer reviewed prior to March 15, 2020. The USFWS will coordinate with the Delta Fish Monitoring Working Group to identify a Delta Smelt recruitment level that Reclamation and DWR can use in OMR management. The life cycle models statistically link environmental conditions to recruitment, including factors related to loss as a result of entrainment such as OMR flows. In this context, recruitment is defined as the estimated number of post-larval delta smelt in June per number of spawning adults the prior February-March.

Reclamation and DWR, in coordination with the Service will operationalize the life cycle model results through the use of real-time monitoring for the spatial distribution of Delta Smelt. On or after March 15 of each year, if QWEST is negative, and larval or juvenile delta smelt are within the entrainment zone of the pumps based on real-time sampling of spawning adults or young of year life stages, Reclamation and/or DWR will run hydrodynamic models and forecasts of entrainment, informed by the EDSM or other relevant survey data to estimate the percentage of larval and juvenile delta smelt that could be entrained. If necessary, Reclamation will manage exports to limit entrainment to be protective based on the modeled recruitment levels. Reclamation and DWR will re-run hydrodynamic models when operational changes or new sampling data indicate a potential change in entrainment risk. This process will continue until the offramp criteria have been met as described in the "End of OMR Management" below. In the event the life cycle models cannot be operationalized in a manner that can be used to inform real-time operations then Reclamation, DWR and the Service will coordinate to develop an alternative plan to provide operational actions protective of this life stage.

- Cumulative Loss Threshold:
 - Reclamation and DWR propose to avoid exceeding cumulative loss thresholds over the duration of the Biological Opinions for:

- Natural Winter-Run Chinook Salmon (cumulative loss= 8,738)
- Hatchery Winter-Run Chinook Salmon (cumulative loss= 5,356)
- Natural Central Valley Steelhead from December through March (cumulative loss= 6,038)
- Natural Central Valley Steelhead from April 1 through June 15th (cumulative loss= 5,826).

Natural Central Valley Steelhead are separated into two time periods to protect San Joaquin origin fish that historically appear in the Mossdale trawls later than Sacramento origin fish. The loss threshold and loss tracking for hatchery Winter-Run Chinook Salmon does not include releases into Battle Creek. Loss (for development of thresholds and ongoing tracking) for Chinook salmon are based on length-at-date criteria.

- The cumulative loss thresholds shall be based on cumulative historical loss from 2010 through 2018. Reclamation's and DWR's performance objectives are intended to avoid loss such that this cumulative loss threshold (measured as the 2010-2018 average cumulative loss multiplied by 10 years) will not be exceeded by 2030.
- If, at any time prior to 2024, Reclamation and DWR exceed 50% of the cumulative loss threshold, Reclamation and DWR will convene an independent panel to review the actions contributing to this loss trajectory and make recommendations on modifications or additional actions to stay within the cumulative loss threshold, if any.
- In the year 2024, Reclamation and DWR will convene an independent panel to review the first five years of actions and determine whether continuing these actions are likely to reliably maintain the trajectory associated with this performance objective for the duration of the period.
- If, during real-time operations, Reclamation and DWR exceed the cumulative loss threshold, Reclamation and DWR would immediately seek technical assistance from USFWS and NMFS, as appropriate, on the coordinated operation of the CVP and SWP for the remainder of the OMR management period. In addition, Reclamation and DWR shall, prior to the next OMR management season, charter an independent panel to review the OMR Management Action consistent with "Chartering of Independent Panels" under the "Governance" section of this Proposed Action. The purpose of the independent review shall be to evaluate the efficacy of actions to reduce the adverse effects on listed species under OMR management and the non-flow measures to improve survival in the south Delta and for San Joaquin origin fish.
- Single-Year Loss Threshold:
 - In each year, Reclamation and DWR propose to avoid exceeding an annual loss threshold equal to 90% of the greatest annual loss that occurred in the historical record from 2010 through 2018 for each of:
 - Natural Winter-Run Chinook Salmon (loss= 1.17% of JPE)
 - Hatchery Winter-Run Chinook Salmon (loss= 0.12% of JPE)
 - Natural Central Valley Steelhead from December through March (loss =1,414)
 - Natural Central Valley Steelhead from April through June 15 (loss = 1,552)

- Natural Central Valley Steelhead are separated into two time periods to protect San Joaquin Origin fish that historically appear in the Mossdale trawls later than Sacramento origin fish. The loss threshold and loss tracking for hatchery Winter-Run Chinook Salmon does not include releases into Battle Creek. Loss (for development of thresholds and ongoing tracking) for Chinook salmon are based on length-at-date criteria.
- During the year, if Reclamation and DWR exceed the average annual loss from 2010 through 2018, Reclamation and DWR will review recent fish distribution information and operations with the fisheries agencies at WOMT and seek technical assistance on future planned operations. Any agency may elevate from WOMT to a Directors discussion, as appropriate.
 - During the year, if Reclamation and DWR exceed 50% of the annual loss threshold, Reclamation and DWR will restrict OMR to a 14-day moving average OMR index of no more negative than -3,500 cfs, unless Reclamation and DWR determine that further OMR restrictions are not required to benefit fish movement because a risk assessment shows that the risk is no longer present based on real-time information.
 - The -3500 OMR operational criteria adjusted and informed by this risk assessment will remain in effect for the rest of the season. Reclamation and DWR will seek NMFS technical assistance on the risk assessment and real-time operations.
 - During the year, if Reclamation and DWR exceed 75% of the annual loss threshold, Reclamation and DWR will restrict OMR to a 14-day moving average OMR index of no more negative than -2,500 cfs, unless Reclamation and DWR determine that further OMR restrictions are not required to benefit fish movement because a risk assessment shows that the risk is no longer present based on real-time information.
 - The -2500 OMR operational criteria adjusted and informed by this risk assessment will remain in effect for the rest of the season. Reclamation and DWR will seek NMFS technical assistance on the risk assessment and real-time operations.
 - Risk assessments (identified above): Reclamation and DWR will evaluate and adjust OMR restrictions under this section by preparing a risk assessment that considers several factors including, but not limited to, real-time monitoring, historical trends of salmonids exiting the delta, entering the south delta, fish detected in salvage, and relevant environmental conditions. Risks will be measured against the potential to exceed the next single year loss threshold. Reclamation and DWR will share its risk assessment and supporting documentation with USFWS and NMFS, seek their technical assistance, discuss the risk assessment and future operations with WOMT at its next meeting, and elevate to the Directors as appropriate.
 - If, during real-time operations, Reclamation and DWR exceed the single-year loss threshold, Reclamation and DWR would immediately seek technical assistance from USFWS and NMFS, as appropriate, on the coordinated operation of the CVP and SWP for the remainder of the OMR management period. In addition, Reclamation and DWR shall, prior to the next OMR management season, charter an independent panel to review the OMR Management Action consistent with “Chartering of Independent Panels” under the “Governance” section of this Proposed Action. The purpose of the independent review shall be to evaluate the efficacy of actions to reduce the effects on listed species under OMR management and the non-flow measures to improve survival in the south Delta and for San Joaquin origin fish.

Reclamation and DWR propose to continue monitoring and reporting the salvage at the Tracy Fish Collection Facility and Skinner Delta Fish Protection Facility. Reclamation and DWR propose to

continue the release and monitoring of yearling Coleman NFH late-fall run as yearling Spring-Run Chinook Salmon surrogates.

4.10.5.10.3 Storm-Related OMR Flexibility:

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. A storm related event occurs when precipitation falls in the Central Valley and Delta watersheds and Reclamation and DWR determine that the Delta outflow index indicates a higher level of flow available for diversion. Reclamation and DWR will define storm-related events in the first year of implementation of this proposed action. 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 shall not pursue storm-related OMR flexibility for capturing peak flows from storm-related events if:

- Integrated Early Winter Pulse Protection (above) or Additional real-time OMR restrictions (above) are triggered. Under such conditions, Reclamation and DWR have already determined that more restrictive OMR is required.
- An evaluation of environmental and biological conditions indicates more negative OMR would likely cause Reclamation and DWR to trigger an Additional real-time OMR restriction (above).
- Salvage of yearling Coleman NFH late-fall run as yearling Spring-Run Chinook Salmon surrogates exceeds 0.5% within any of the release groups.
- Reclamation and DWR identify changes in spawning, rearing, foraging, sheltering, or migration behavior beyond those anticipated to occur under OMR management.

Reclamation and DWR will continue to monitor conditions may resume management of OMR to no more negative than -5,000 cfs if conditions indicate the above offramps are necessary to avoid additional adverse effects. If storm-related flexibility causes the conditions in “Additional Real-Time OMR Restrictions”, Reclamation and DWR will implement additional real-time OMR restrictions.

4.10.5.10.4 End of OMR Management:

OMR criteria may control operations until June 30 (for Delta Smelt and Chinook salmon), until June 15 (for steelhead/rainbow trout), or when the following species-specific off ramps have occurred, whichever is earlier:

- Delta Smelt: when the daily mean water temperature at CCF reaches 77°F 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 71.6°F for 7 days during June (the 7 days do not have to be consecutive).

4.10.5.10.5 Real-Time Decision Making and Salvage Thresholds

When real-time monitoring demonstrates that criteria in “Additional Real-Time OMR Restrictions and Performance Objectives” are not supported, then Reclamation and DWR may confer with the

Directors of NMFS, USFWS, and CDFW if they desire to operate to a more negative OMR than what is specified in this section. Upon mutual agreement, the Directors of NMFS and USFWS may authorize Reclamation and DWR to operate to a more negative OMR than the “Additional Real-Time OMR Restrictions”, but no more negative than -5000 cfs. This process would be separate from the risk analysis process referenced above.

4.10.5.11 Delta Smelt Summer-Fall Habitat

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 current conceptual model is that Delta Smelt habitat should include low salinity conditions of 0-6ppt, turbidity of approximately 12 NTU, temperatures below 75°F, food availability, and littoral or open water physical habitats (FLaSH Synthesis, pp. 15-25). The Delta Smelt Summer-Fall 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. The Delta Smelt Summer-Fall Habitat Action is to provide these habitat components in the same geographic area through a range of action to improve water quality and food supplies.

Reclamation and DWR propose to use structured decision making to implement Delta Smelt habitat actions. In the summer and fall (June through October) of below normal, above normal and wet years, based on the Sacramento Valley Index, the environmental and biological goals are, to the extent practicable, the following:

- Maintain low salinity habitat in Suisun Marsh and Grizzly Bay 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 action will initially include modifying project operations to maintain a monthly average 2 ppt isohaline at 80 km from the Golden Gate in above normal and wet water years in September and October. Reclamation and DWR will also implement additional measures that are expected to achieve additional benefits. These measures include, but are not limited to:

- Suisun Marsh Salinity Control Gate (SMSCG) operations for up to 60 additional days (not necessarily consecutive) from June 1 through October 31 of below normal and above normal, years. This action may also be implemented in wet years if preliminary analysis shows expected benefits;
- Food enhancement actions, e.g., those included in the Delta Smelt Resiliency Plan to enhance food supply. These projects include the North Delta food-web project, Sacramento River Deepwater Ship Channel lock reoperation, and Roaring River distribution system reoperation. Reclamation and DWR will monitor dissolved oxygen at Roaring River distribution system drain location(s) during Delta Smelt food distribution actions to ensure compliance with Water Quality Objectives established in the San Francisco Bay Basin Plan. These actions are listed in further detail below:
 - *Sacramento Deepwater Ship Channel Food Study*: 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 food web 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 Study*: 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 food web 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 and Roaring River Distribution System Food Subsidies Study*: 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. Reclamation and DWR will monitor dissolved oxygen at Roaring River Distribution System drain location(s) to ensure compliance with Water Quality Objectives established in the San Francisco Bay Basin Plan when Delta Smelt food actions are being taken.
 - If the measures above (or others developed through collaborative science processes) result in benefits that are determined to provide similar or better protection than the 80 km salinity management action, Reclamation and DWR will work with USFWS to modify this component of the PA to implement the new actions in lieu of the salinity management action. When determining whether or not the measures above provide similar or better protection, Reclamation and DWR will consider, at minimum, the following:
 - Habitat acreages in Suisun Marsh, Grizzly Bay, and other adjacent areas available to support Delta Smelt recruitment (e.g. 0-6 ppt at Belden's Landing, non-lethal temperatures, etc.),
 - Recruitment projections based on lifecycle modeling and/or monitoring to evaluate the expected trend in Delta Smelt with and without the 80 km salinity management action, and
 - The presence (or absence) of Delta Smelt in both the target areas (main Delta channels and Suisun Marsh) and other areas (such as Montezuma Sough and Cache Slough), including information from monitoring, presence/absence modeling, or similar tools.

These considerations (listed above) and implementation of other actions will be more fully defined and developed through the structured decision making or other review process. The review will include selection of appropriate models, sampling programs, and other information to be used. The process will be completed prior to implementation and may be improved in subsequent years as additional information is synthesized and reviewed as described below.

Reclamation and DWR will develop a Delta Smelt Summer-Fall Habitat Action Plan to meet the environmental and biological goals in years when summer-fall habitat actions are triggered. In above normal and wet years, operating to a monthly average X2 of 80 km in September and October is the

initial operation to provide a specific acreage of low salinity habitat. In every action year, Reclamation and DWR may propose, based on discussions with the USFWS, a suite of actions that would meet the action's environmental and biological goals.

Although Reclamation and DWR agree to treat the Delta Smelt Summer-Fall Habitat Action as an in-basin use, Reclamation intends to meet Delta outflow augmentation in the fall primarily through export reductions as they are the operational control with the most flexibility in September and October. Storage releases from upstream reservoirs may be used to initiate the action by pushing the salinity out further in August and early September; however, the need for this initial action will depend on the hydrologic, tidal, storage, and demand conditions at the time. In addition, storage releases may be made in combination with export reductions during the fall period during high storage scenarios where near-term flood releases to meet flood-control limitations are expected. In these scenarios, Reclamation will make releases in a manner that minimizes redd dewatering where possible. In the event that Reclamation determines the Delta outflow augmentation necessary to meet 2 ppt isohaline at 80 km from the Golden Gate as described above cannot be met through primarily export reductions and is expected to have a high storage cost, Reclamation will still implement the rest of this action, and will meet with NMFS and USFWS to discuss alternate potential approaches that improve habitat conditions.

4.10.5.11.1 Collaborative Planning Process

Reclamation shall form a Delta Coordination Group (Reclamation, DWR, USFWS, NMFS, CDFW, and representatives from federal and state water contractors). The Group will utilize one of the existing structured decision-making models, or adopt a new model, to analyze proposed summer-fall habitat actions. Through the Delta Coordination Group Reclamation and DWR shall develop a multi-year science and monitoring plan consistent with the structured decision-making models within 9 months of signing the ROD. The Delta Coordination Group may use the IEP or CSAMP (or similar entity) to review project design and the science and monitoring plan.

Within six months of signing the National Environmental Policy Act Record of Decision ("ROD"), the Delta Coordination Group shall meet to select a structured decision-making model; and complete model runs testing various approaches to satisfying the environmental and biological goals, utilizing the available tool box of approaches. The Delta Coordination Group shall provide the initial results of its modeling exercise in a memorandum to Reclamation, DWR, and USFWS.

The process for Delta Smelt Summer-Fall Habitat Action development and approval is as follows:

- **January:** Reclamation and DWR will provide a synthesis of potential updates to the science and monitoring plan annually based on available data and analysis from prior years. Preliminary analyses from prior year will be shared with DCG.
- **March:** The water year designation is not fully known until approximately May 1; however, planning for a summer-fall action requires several weeks. Therefore, the Delta Coordination Group will develop an initial proposal accounting for varying forecasted hydrology and temperatures. The proposal will include the hypotheses to be tested, the suite of actions and operations to test the hypotheses, potential off-ramps, and expected outcomes.
- **April:** In April of each below normal, above normal or wet water year, Reclamation and DWR shall meet to develop a Habitat Action Plan accounting for forecasted hydrology and temperatures over the summer and fall. The Habitat Action Plan shall describe how the proposed action will meet the environmental and biological goals as well as assess and apply off-ramps as needed. The preliminary action shall be selected and fully described by April 30.

- June through October: Reclamation and DWR share preliminary monitoring results through the Delta Coordination Group.
- October (of following calendar year when an action is taken): Reclamation and DWR shall provide a synthesis of the study results to the Delta Coordination Group by October of the following year an action is undertaken. The Delta Coordination Group shall review the synthesis of results and use the results of the monitoring to inform a subsequent Structured Decision-Making modeling exercise using the tool box of available approaches. Reclamation and DWR shall provide the results of the subsequent structured decision-making exercise to USFWS by March of the following year.

The Delta Smelt Summer-Fall Habitat action would be incorporated into the “Four Year Review” under the “Governance” section of this PA, and all reasonable and practical recommendations shall be incorporated into the Delta Smelt Summer-Fall Habitat Action. The structured decision-making model and the multi-year science and monitoring plan will be part of this Peer Review.

4.10.5.12 Conservation Measures

Reclamation and DWR are proposing conservation measures to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment as well as contribute to the recovery and enhancement of species and their habitats. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. Actions could be implemented in part or fully through agreements and cost share with the State of California and potentially under the Voluntary Agreement alternative under the State Water Resources Control Board update to the Bay-Delta Water Quality Control Plan.

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 flow of the water to guide entrained fish into holding tanks before transport by truck to release sites 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 be used; each unit increases the velocity through the TFCF primary channel by approximately 0.5 ft/sec.

The primary louvers are in the primary channel just downstream of the trash rack structure. The traveling water screen is in the secondary channel.

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 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.

4.10.5.12.2 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.

4.10.5.12.3 Additional Measures

- *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.
- *Steelhead Lifecycle Monitoring Program*: Develop infrastructure that will support a functioning life cycle monitoring program in the Stanislaus River and a Sacramento basin CVP tributary (e.g. Clear Creek, Upper Sacramento, American River) to evaluate how actions related to stream flow enhancement, habitat restoration, and/or water export restrictions affect biological outcomes including juvenile and adult population abundance, age structure, growth and smoltification rates, and anadromy and adaptive potential in these two populations. The goal of this monitoring program will be to improve understanding of steelhead demographics and, when combined with other steelhead-focused parts of the Proposed Action (San Joaquin and Delta steelhead telemetry study), inform actions that will increase steelhead abundance and improve steelhead survival through the Delta.
- *San Joaquin Basin Steelhead Collaborative*: Within 1 year, Reclamation will coordinate with CSAMP to sponsor a workshop for developing a plan to monitor steelhead populations within the San Joaquin Basin and/or the San Joaquin River downstream of the confluence of the Stanislaus River, including steelhead and rainbow trout on non-project San Joaquin tributaries. The goal for the monitoring program will be to estimate the juvenile and adult population abundance in the San Joaquin River basin. The plan would be delivered to the IEP for prioritization and implementation, where feasible, for actions within the responsibility of the CVP and SWP and other members of the IEP. If the IEP is not able to implement the plan, the plan may be raised at the Director Level Collaborative Planning Meeting described under the “Governance” section of this PA for resolution.
- *San Joaquin River Scour Hole Predation Reduction*: Reclamation and DWR would form a project team to address the scour hole in the San Joaquin River at the Head of Old River. The project team would plan and implement measures to reduce the predation intensity at that site through modifications to the channel geometry and associated habitats.
- *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:
 - *Tidal Habitat Restoration*: 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.
- *Predator Hot Spot Removal*: 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.
- *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.
- *Clifton Court Forebay Mortality Reduction:* DWR would continue implementation of projects to reduce mortality of ESA-listed fish species. These measures that would be implemented include: (a) continued evaluation of predator relocation methods; (b) controlling aquatic weeds; and (c) exploration of additional predation reduction measures. Please see Appendix G for study results from the last decade.
- *Skinner Fish Facility Performance Improvements:* DWR proposes to continue implementing studies to better understand and continuously improve the performance of the Skinner Fish Facility including: a) operational changes to salvage release scheduling and location to reduce post-salvage predation, and b) continued refinement and improvement of the fish sampling and hauling procedures and infrastructure to improve the accuracy and reliability of data and fish survival.
- *Salvage 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.
- *Reintroduction Efforts for Delta Smelt:* Reclamation proposes to fund a two-phase process that would lead to annual supplementation of the wild Delta Smelt population with propagated fish within 3-5 years from issuance of the biological opinion. The first step in this process will be the development of a supplementation strategy within one year of the issuance of the BiOp that will describe the capacity needed at hatchery facilities to accommodate the Delta Smelt production needed to meet genetic and other hatchery considerations with a goal of increasing production to a number and the life stages necessary to effectively augment the population. The Service will be the lead on the development of this supplementation strategy. The strategy will include identification of regulatory processes to address, science studies to complete, potential facility expansion and improvements, and schedules and deliverables to support the second phases and the larger Conservation Hatchery, described below.

The second step will involve using the existing UC Davis Fish Conservation and Culture Laboratory (FCCL). Reclamation and DWR are the primary funding sources for FCCL, which maintains the refugial population of Delta Smelt and generates additional captive-bred fish for research. The FCCL has maintained a continuous refugial population since 2008. The FCCL has closed the life cycle of Delta Smelt meaning that they can produce new generations of fish at their

facility with or without the addition of new wild spawners, and keep enough progeny alive to repeat the process for multiple generations. Annually, the FCCL exports approximately 33,000 fish of different life stages for use in research. Additionally, approximately 32,000 adults are reared in the refuge population. To achieve these production levels, the FCCL frequently removes fish at the egg and juvenile stages. Additional funding will support expansion of facilities to maintain these fish and increase rearing capacity to provide up to approximately 125,000 adults within 3 years. By 2030, Reclamation proposes to support a larger Conservation Hatchery, described below, to take over the role of supplementing the wild population.

- *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 habitat.
- *Sediment Supplementation Feasibility Study*: Reclamation proposes to develop and implement a sediment supplementation feasibility study. The goal of this study will be to determine methods to reintroduce sediment in the Delta to increase turbidity which would provide better habitat conditions for all life stages of Delta Smelt, including increased cover for juveniles and feeding facilitation for larval smelt. This study will include, at minimum, consideration of sediment placement upstream of the Delta during low flow periods in the spring, summer and/or fall, followed by sediment remobilization following inundation during seasonal high flows. Reclamation will coordinate with the Service and other agencies to address necessary permitting for this study. Reclamation will coordinate with the Service on the design and findings of this study, including monitoring measures to assess its effectiveness and feasibility as a long-term management program, a method to phase implementation if required for permitting and other compliance needs.

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 Donnell's 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 Donnell's 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 several 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 Vernal is.

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 4-13.

Table 4-13. 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.

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.

4.10.6.2 Conservation Measures

Reclamation and DWR are proposing conservation measures to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment as well as contribute to the recovery and enhancement of species and their habitats. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. Actions could be implemented in part or fully through agreements and cost share with the State of California and potentially under the Voluntary Agreement alternative under the State Water Resources Control Board update to the Bay-Delta Water Quality Control Plan.

- Spawning Habitat Restoration: Under the CVPIA (b)(13) program, Reclamation’s annual goal of gravel placement is approximately 4,500 tons in the Stanislaus River.
- Rearing Habitat Restoration: Reclamation proposes to construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030.
- Temperature Management Study: 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.
- Yellow-billed Cuckoo Surveys: Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other

agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

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 reducing or avoiding impacts on water deliveries to all 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 year type.

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.

Yellow-billed Cuckoo Surveys: Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

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 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.

4.11 Items Not Included in This Consultation

This document includes context on the entirety of operations of the CVP and SWP. However, not all 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

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.

4.12.1 Core Water Operation

The Core Water Operation serves as the foundation for meeting regulatory requirements 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 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 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, tribes, and other participants will communicate, and coordinate real-time water operations decisions. The Charter also describes the deliverables, schedule, and decision-making processes.

The Core Water Operation also provides for regulatory coordination in the event conditions exceed the ability to anticipate how Reclamation and DWR would operate (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.

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 would inform the risk analysis performed by Reclamation and DWR.

4.12.2 Scheduling

For components of the proposed action identified as part of the Scheduling implementation approach, fishery agencies and 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 those schedules as feasible.

4.12.3 Collaborative Planning

As part of the Proposed Action, Reclamation will pursue and implement certain actions through collaborative planning with the goal of continuing to identify and undertake actions that benefit listed species. Collaborative planning will make use of the Collaborative Science and Adaptive Management Program, Central Valley Project Improvement Act, Interagency Ecological Program, and Delta Plan Interagency Implementation Committee, successors to the forums, or complementary forums, e.g. Voluntary Agreement forums. Each of these programs has established governance, work planning, implementation, reporting, and independent review.

Where necessary, Reclamation and DWR will form project teams comprised of fishery agency and water users that assist Reclamation and DWR on the implementation of specific actions. The CVPIA develops priorities across CVPIA fish-related provisions and watersheds in the Central Valley. The process uses an Adaptive Resource Management (ARM) approach with support from Decision-Support Models (DSMs) to prioritize implementation of management actions that have the highest probability of achieving biological objectives for naturally produced populations of native anadromous fish. The ARM approach also guides plans for monitoring and research by synthesizing existing monitoring data, annually updating DSMs using new information, and estimating the value

of new information to the decision-making process. CSAMP and DPIIC have similar tools in various stages of development.

The Sacramento River Settlement Contractors approved *A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort*. Pursuant to the resolution, the SRS Contractors will continue their active engagement and leadership in the ongoing collaborative Sacramento River Science Partnership effort.

Reclamation will use CSAMP to convene an annual Directors Level Collaborative Planning meeting with NMFS, DWR, CDFW and USFWS to review collaborative planning actions (including restoration, monitoring, and research actions), discuss the resources each agency can contribute, and discuss strategies for collectively influencing and supporting the likelihood that priority restoration, monitoring, and research actions and their beneficial effects will be implemented.

Reclamation and DWR have a strong record of accomplishment in benefiting species through habitat restoration, facility improvements, monitoring, and science, as documented in work plans and accomplishment reports. Specific examples of recent projects in partnership with stakeholders, but not an exhaustive list, include:

- Shasta Division (Sacramento River)
 - Market Street gravel addition in 2019
 - Reading Island side channel restoration in 2018
 - Lake California side channel restoration in 2018
 - Additional gravel at the Keswick Dam launch site in 2018
- Clear Creek planning and 2019 award of funds for the completion of the Phase 3C
- American River
 - Nimbus side channel restoration in 2014;
 - Sacramento Bar restoration in 2016.
- Stanislaus River
 - Goodwin Canyon gravel addition in 2016;
 - Landcaster Road side channel in 2017.
- Delta and Suisun Marsh
 - McCormack Williamson Tract tidal and floodplain habitat in 2018
 - Yolo Flyway Farms tidal restoration in 2018
 - Decker Island tidal restoration in 2018
 - Tule Red tidal restoration in scheduled for fall of 2019
 - Winter Island tidal restoration scheduled for fall of 2019
 - Dutch Slough tidal and floodplain restoration construction ongoing since 2018
 - Fremont Weir adult fish passage in 2019
 - Knight's Landing Outflow Gates in 2016

- Wallace Weir barrier and rescue facility in 2019
- Suisun Marsh Gate Reoperation Pilot in 2018
- Roaring River Drain Gate Installation in 2018
- Fish Passage and Screening
 - Deer Creek Irrigation District Dam in 2017;
 - Mill Creek Fish Passage Assessment and Restoration Project in 2016;
 - Lower Deer Creek Falls Fish Passage Improvement Project in 2018;
 - RD2035 Woodland Davis intake in 2016;
 - Small screen program through the Family Farm Alliance for Locke Ranch on the Mokelumne, Hidden Valley Range on the San Joaquin, Clover Creek/Millville on Clover Creek, and Oswald WD on the Feather River in 2017;
- Science and Monitoring
 - Directed Outflow Project in 2017, 18, and 19
 - Enhanced Delta Smelt Monitoring Program
 - Six-Year Steelhead Telemetry Study
 - Salmon and Sturgeon Assessment of Indicators by Lifestage
 - Salvage Monitoring Studies

The action agencies' collaborative planning programs are robust and account for the technical, social, and economic complexities of implementing large-scale habitat restoration programs. Reclamation has the authority to undertake these actions, subject to appropriations, under Reclamation Law including authorizations for the Central Valley Project, Fish and Wildlife Coordination Act, Central Valley Project Improvement Act (1992), Calfed Bay-Delta Authorization Act (2004), and Water Infrastructure Improvements for the Nation (WIIN) Act (2016). Reclamation's historical annual appropriations bills include funding of spawning and rearing habitat, fish screens, fish salvage, hatcheries, and specific restoration programs. Sources include the Bay-Delta Fund, Central Valley Project Restoration Fund, and Water and Related Resources Fund. Future obligations and expenditures are subject to appropriation by Congress.

To fund these actions, DWR has the statutory authority to require the reimbursement in the SWP contracts for water and power for any costs DWR incurs for SWP-related fish and wildlife preservation (Water Code Sections 11912, 12937 and 12938).

Reclamation and DWR also commit to continue to support collaborative efforts that are underway in other forums that will benefit species. Reclamation and/or DWR agree to track, and where appropriate and within the agencies' authority, champion, sponsor, and/or implement projects consistent with applicable laws, similar to the processes described for the projects identified above.

4.12.4 Compliance and Performance Reporting

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

Appendix C. Changes to the proposed action would occur based on the reinitiation triggers provided by 50 CFR 402.16. These triggers include:

- a) If the amount or extent of taking specified in the incidental take statement is exceeded;
- 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) 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) If a new species is listed or critical habitat designated that may be affected by the identified action.

Reclamation will monitor take for evaluating trigger (a) above; Reclamation will monitor the effects of the proposed action for the purpose of evaluating trigger (b) above. 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.

4.12.5 Drought and Dry Year Actions

Within 18 months of executing the Record of Decision, Reclamation shall coordinate with DWR to develop a voluntary toolkit to be exercised at the discretion of Reclamation, DWR, other agencies, participating water users, and/or others for the operation of Shasta Reservoir during critical hydrologic year types. The toolkit shall include, at a minimum: measures at the Livingston-Stone National Fish Hatchery; the potential for translocation of fish; and facility improvements to reduce the adverse effects of critical and dry years on listed species. Drought and dry year planning will include the measures under Shasta Cold Water Pool Management Dry Years, Drought Years, and Successive Dry Years.

In Tier 3 and Tier 4 years, Reclamation shall meet and confer with USFWS, NMFS, DWR, CDFW, and Sacramento River Settlement Contractors on voluntary measures to be considered if drought conditions continue into the following year, including measures that may be beyond Reclamation and DWR’s discretion. If dry conditions continue, Reclamation will regularly meet with this group (and potentially other agencies and organizations) to evaluate current hydrologic conditions and the potential for continued dry conditions that may necessitate the need for development of a drought contingency plan (that may include actions from the toolkit) for the water year.

The Sacramento River Settlement Contractors approved A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort. Pursuant to the resolution, during drier water years with operational conditions as described in the Tier 3 and Tier 4 scenarios, the SRS Contractors will meet and confer with Reclamation, NMFS, and other agencies as appropriate to determine if there is any role for the SRS Contractors in connection with Reclamation’s operational decision-making for Shasta Reservoir annual operations in those years. This determination will include consideration of what actions are feasible, consistent with the terms of the SRS Contracts. In addition to the 25% reduction during Shasta Critical Years as set forth in the SRS Contracts, the types of actions that may be considered include, but are not necessarily limited to: (1) the scheduling of spring diversions by the SRS Contractors; (2) voluntary, compensated water transfers by the SRS Contractors subject to Reclamation approval; and (3)

delayed SRS Contractor diversion for rice straw decomposition during the fall months. Any mutually agreeable proposed actions resulting from these meet and confer discussions must be consistent with the terms of the SRS Contracts and may also be subject to other regulatory approvals.

By February of each year following a critical hydrologic year type, Reclamation shall report on the measures employed and assess the effectiveness. The toolkit shall be revisited at a frequency of not more than 5 years after the ROD.

4.12.6 Chartering of Independent Panels

Reclamation and DWR agree to charter independent panels to review actions as described in certain components of the Proposed Action. Independent panels shall review actions consistent with the standards of the Delta Stewardship Council and applicable Reclamation and DWR guidance. Experts on the panel shall provide information and recommendations but shall not make consensus recommendations to Reclamation. NMFS and USFWS may provide technical assistance and input in the development of the charter. Reclamation and DWR shall provide the results of the independent review to NMFS and USFWS. Reclamation shall coordinate with DWR to document a response to the independent review including whether implementation of alternative strategies would require reinitiation consistent with the reinitiation triggers provided by 50 CFR 402.16. Nothing the chartering of and responding to independent panels precludes NMFS nor USFWS from exercising its statutory responsibilities under the ESA.

4.12.7 Four Year Reviews

In January of 2024 and January of 2028, Reclamation and DWR would charter an independent panel to review the following actions:

- Upper Sacramento Performance Metrics
- OMR management and measures to improve juvenile salmonid survival through the South delta
- OMR management measures and life cycle models used to manage Delta Smelt larval/juvenile entrainment.
- Delta Smelt Summer and Fall Habitat Actions
- Steelhead Research and Monitoring Actions

Reclamation and DWR may incorporate additional information into the reviews in coordination with local, state, and federal partners.