

Appendix F, Modeling

Section 1-1 CalSim 3, DSM2, and HEC-5Q Modeling Simulations and Assumptions

Introduction

This section summarizes the modeling simulations and assumptions for the No Action Alternative, Exploratory 1, Exploratory 3, and Alternative 2.

No Action Alternative

This section presents the assumptions used in developing the CalSim 3, DSM2 and HEC5Q simulations of the No Action Alternative considered for the LTO. The No Action Alternative represents CVP and SWP operations to comply with the “current” regulatory environment as of February 28, 2022 under projected Year 2040 conditions. The No Action Alternative assumptions include existing facilities and on going programs that existed as of February 28, 2022-the publication date of the Notice of Intent (NOI). The No Action Alternative assumptions also include facilities and programs that received approvals and permits by February 28, 2022 because those programs were consistent with existing management direction as of the Notice of Intent. The No Action Alternative model does not include any potential future habitat restoration areas due to the uncertainty on system effects depending on potential locations of such areas within the Delta.

The No Action Alternative includes projected climate change and sea level rise assumptions corresponding to 2022 median ± 15 and 15cm sea level rise (SLR). Changes in climate results in the changes in the reservoir and tributary inflows included in CalSim 3. The sea level rise changes result in modified flow-salinity relationships in the Delta. The climate change and sea level rise assumptions are described in detail Appendix F Attachment 1-1 Climate Change. The CalSim 3 simulation for the No Action Alternative does not consider any adaptation measures that would result in managing the CVP and SWP system in a different manner than today to reduce climate impacts. For example, future changes in reservoir flood control reservation to better accommodate a seasonally changing hydrograph may be considered under future programs but are not considered under this consultation.

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 *Callouts Tables*.

Hydrology

Inflows/Supplies

The CalSim 3 model includes 2022 Median ± 15 and 15cm SLR as described in Appendix F Attachment 1-1 Climate Change.

Level of Development

CalSim 3 assumes an average 2004-2013 historical land use, which determines irrigation demand, surface runoff, field scale deep percolation, and other local hydrology inputs.

Urban demands are based on the 2020 Urban Water Management Plans.

Demands, Water Rights, CVP/SWP Contracts

CalSim 3 uses applied water demands, determined by CalSimHydro, based on average 2004-2013 land use. Urban demands are based on 2020 Urban Water Management Plans. Demand units are classified as CVP project, SWP project, local project or non-project. CVP and SWP demands are separated into different classes based on contract type.

Deliveries are limited by water rights and/or project contract obligations, as applicable.

CVP south of Delta service contractor demands are reflected as full contract obligation.

The detailed listing of CVP and SWP contract assumptions are included in the delivery specifications tables in Appendix F Section 1-3 *CalSim 3 Contracts*.

Facilities

All CVP-SWP existing facilities are simulated based on operations criteria under the current regulatory environment.

CalSim 3 includes representation of all the existing CVP and SWP storage and conveyance facilities. Assumptions regarding selected key facilities are included in the callout tables in Appendix F Section 1-2 Callouts Tables.

CalSim 3 also represents flood control weirs located along the Sacramento River – including Moulton Weir, Colusa Weir, Tisdale Weir, Fremont Weir at the upstream end of the Yolo Bypass (Reclamation, 2017), and the Sacramento Weir.

The No Action Alternative includes the Freeport Regional Water Project located along the Sacramento River near Freeport and the City of Stockton Delta Water Supply Project (30 mgd capacity).

A brief description of the key export facilities that are located in the Delta and included under the No Action Alternative is provided below.

The Delta serves as a natural system of channels to transport river flows and reservoir storage to the CVP and SWP facilities in the south Delta, which export water to the projects' contractors through two pumping plants: CVP's C.W. Jones Pumping Plant and SWP's Harvey O. Banks

Pumping Plant. Jones and Banks Pumping Plants supply water to agricultural and urban users throughout parts of the San Joaquin Valley, South Lahontan, Southern California, Central Coast, and South San Francisco Bay Area regions.

The Contra Costa Canal and the North Bay Aqueduct supply water to users in the northeastern San Francisco Bay and Napa Valley areas.

Fremont Weir

Fremont Weir is a flood control structure located along the Sacramento River at the head of the Yolo Bypass. To enhance the potential benefits of the Yolo Bypass for various fish species, the Fremont Weir is assumed to be notched to provide increased seasonal floodplain inundation in all of the alternatives simulated for this consultation. For this alternative, it is assumed that an opening in the existing weir and operable gates are constructed at invert elevation 14 feet along with two smaller openings and operable gates at invert elevation 18 feet.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity and Delta-Mendota Canal/California Aqueduct Intertie Capacity

The Jones Pumping Plant consists of six pumps including one rated at 800 cfs, two at 850 cfs, and three at 950 cfs. Maximum pumping capacity is assumed to be 4,600 cfs with the 400 cfs Delta Mendota Canal (DMC) – California Aqueduct Intertie that became operational in July 2012.

SWP Banks Pumping Plant Capacity

SWP Banks pumping plant has an installed capacity of about 10,300 cfs. The SWP water rights for diversions specify a maximum of 10,300 cfs, but the U. S. Army Corps of Engineers (ACOE) permit for SWP Banks Pumping Plant allows a maximum pumping of 6,680 cfs. With additional diversions depending on Vernalis flows the total diversion can go up to 10,300 cfs during December 15 – March 15. Additional capacity of 500 cfs (pumping limit up to 7,180 cfs) is allowed in July – September to limit the SWP water supply impacts of Spring Delta export reduction actions.

San Luis Reservoir

The No Action Alternative reflects the current size of San Luis Reservoir and does not address the crest raise actions per the B.F. Sisk Dam Safety of Dams (SOD) Modification Project ROD (Reclamation, 2019). San Luis reservoir storage is split into two pools, split between the CVP and SWP with 972 TAF and 1067 TAF capacities respectively CCWD Intakes

The Contra Costa Canal originates at Rock Slough, about four miles southeast of Oakley, and terminates after 47.7 miles at Martinez Reservoir. Historically, diversions at the unscreened Rock Slough facility (Contra Costa Canal Pumping Plant No. 1) have ranged from about 50 to 250 cfs. The canal and associated facilities are part of the CVP; but are operated and maintained by the Contra Costa Water District (CCWD). CCWD also operates a diversion on Old River and the Alternative Intake Project (AIP), the new drinking water intake at Victoria Canal, about 2.5 miles east of Contra Costa Water District's (CCWD) intake on the Old River. CCWD can divert water to the Los Vaqueros Reservoir to store good quality water when available and supply to its customers.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under the No Action Alternative are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

The SWRCB Water Quality Control Plan (WQCP) and other applicable water rights decisions, as well as other agreements are important factors in determining the operations of both the Central Valley Project (CVP) and the State Water Project (SWP). The December 1994 Accord committed the CVP and SWP to a set of Delta habitat protective objectives that were incorporated into the 1995 WQCP and later, were implemented by D-1641. Significant elements in D-1641 include X2 standards, export/inflow (E/I) ratios, Delta water quality standards, real-time Delta Cross Channel operation, and flow and water quality standards for the San Joaquin River at Vernalis.

Coordinated Operations Agreement (COA)

The CVP and SWP use a common water supply in the Central Valley of California. Reclamation and DWR have built water conservation and water delivery facilities in the Central Valley in order to deliver water supplies to project contractors. The water rights of the projects are conditioned by the SWRCB to protect the beneficial uses of water within each respective project and jointly for the protection of beneficial uses in the Sacramento Valley and the Sacramento-San Joaquin Delta Estuary. The agencies coordinate and operate the CVP and SWP to meet the joint water right requirements in the Delta.

The Coordinated Operations Agreement (COA), signed in 1986, defines the project facilities and their water supplies, sets forth procedures for coordination of operations, identifies formulas for sharing joint responsibilities for meeting Delta standards as they existed in SWRCB Decision 1485 (D-1485), 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.

Reclamation and DWR re-negotiated COA in 2018 and this ROC on LTO includes the amended COA, which stipulates a change in responsibility for making storage withdrawals to meet in-basin use (as noted in Table 1) and a change in export capacity when exports are constrained (Table 2).

Table 1. Sharing of Responsibility for Meeting In-basin Use

	CVP	SWP
W	80%	20%
AN	80%	20%
BN	75%	25%
D	65%	35%
C	60%	40%

Table 2. Sharing of Applicable Export Capacity When Exports are Constrained

	CVP	SWP
Balanced Water Conditions	65%	35%
Excess Water Conditions	60%	40%

CVPIA (b)(2) Assumptions

The Central Valley Project Improvement Act (CVPIA) 3406(b)(2) water allocation, management, and related actions (B2) are not modeled in this alternative.

Continued CALFED Agreements

The Environmental Water Account (EWA) was established in 2000 by the CALFED Record of Decision (ROD). The EWA was initially identified as a 4-year cooperative effort intended to operate from 2001 through 2004 but was extended through 2007 by agreement between the EWA agencies. It is uncertain, however, whether the EWA will be in place in the future and what actions and assets it may include. Because of this uncertainty, the EWA has not been included in the current CalSim 3 implementation.

One element of the EWA available assets is the Lower Yuba River Accord (LYRA) Component 1 water. Despite the absence of the EWA in CalSim 3, the LYRA Component 1 water is assumed to be transferred to South of Delta (SOD) State Water Project (SWP) contractors to reduce the impact of Spring export limits. An additional 500 cfs of capacity is permitted at Banks Pumping Plant from July through September to export this transferred water.

Temporary Urgency Change Petitions (TUCPs)

Reclamation and DWR may request a TUCP to meet public health and safety needs when dry conditions prevent meeting D-1641. Reclamation and DWR would not apply for TUCPs to preserve storage in upstream reservoirs beyond water required to maintain public health and safety. It is assumed that the following relaxations of D-1641 criteria will be triggered by low Shasta storage and/or Sacramento Index value:

- Season: February – April:
 - 4,000 cfs NDOI required in lieu of Spring X2 standards;
- Season: May – September:
- Emmaton EC standard moved to Threemile Slough
 - 4,000 cfs NDOI required in lieu of X2 in May
 - 3,000 cfs NDOI standard applied in June – September

When TUCPs are active, Delta exports are limited to Health and Safety.

Water Transfers and Wheeling

Lower Yuba River Accord (LYRA)

Acquisitions of Component 1 water under the Lower Yuba River Accord, and use of 500 cfs dedicated capacity at Banks PP during July – September, are assumed to be used to reduce as much of the impact of the Apr – May Delta export actions on SWP contractors as possible.

Phase 8 Transfers

Phase 8 transfers are not included in the No Action Alternative simulation.

Short-term or Temporary Water Transfers

Short term or temporary transfers such as Sacramento Valley acquisitions conveyed through Banks PP are not included in the No Action Alternative simulation.

Cross Valley Canal Wheeling and Joint Point of Diversion

Cross Valley Canal (CVC) wheeling is modeled up to a maximum of 128 TAF per year. Joint Point of Diversion (JPOD) is operated per the CALFED ROD, where only Delta surplus can be wheeled under JPOD. No CVC or JPOD wheeling is allowed in months when there is an ITP export cut.

Contra Costa Wheeling through Freeport

Through existing agreements and consistent with CCWD's CVP water service contract, CCWD may wheel 3.2 TAF of water through the East Bay Municipal Utility District (EBMUD) share of the Freeport Regional Water Authority (FRWA) Intake Facility each year. Wheeled water is conveyed to CCWD via the FRWA pipeline, Folsom South Canal, Mokelumne Aqueduct, and finally the CCWD-EBMUD intertie. EBMUD diversions take priority over CCWD wheeling.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

Minimum Flow below Lewiston Dam

Trinity EIS Preferred Alternative which includes variable annual instream flows for the Trinity River based on the forecasted hydrology according to the Trinity River Restoration Program Water Year type, ranging from 369 TAF in critically dry years to 815 TAF in extremely wet years. Additional 50 TAF of releases under the Long-Term Plan to Protect Adult Salmon in the Lower Klamath River during August-September in all but Wet years.

Trinity Reservoir end-of-September Minimum Storage

Trinity EIS Preferred Alternative, modeled as 600 TAF, as able.

Trinity Import

The No Action Alternative assumes that the CVP can import water from Trinity. Imports consider Trinity and Shasta storage and required Trinity release. The No Action Alternative targets the highest imports in June through August.

Clear Creek

Reclamation operates Clear Creek flows in accordance with the 1960 Memorandum of Agreement (MOA) with CDFW, and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Reclamation operates to a minimum baseflow in Clear Creek of 200 cfs from October through May, and 150 cfs from June through September in all Sacramento Valley (40-30-30) Index Water Year types except Critical year types. In Critical years, Clear Creek base flows are 150 cfs in all months.

In addition, Reclamation creates additional flows for both channel maintenance and spring attraction flows. Channel maintenance releases are 10 TAF in February of BN, AN, and Wet years. Spring attraction flows are supported by 10 TAF of releases in June of non-critical years, and a 3-day 900 cfs pulse release in June in critical years.

Sacramento River

Shasta Lake End-of-September Minimum Storage

NMFS 2004 Winter-run BO (1,900 TAF in non-critical dry years), which is not explicitly modeled but is met when hydrologically feasible).

Minimum Flow Below Keswick Dam

Order 90-5 set the minimum flow below Keswick Dam from September through February to be 3,250 cfs in all critically dry years as defined in the 1960 water rights agreement between the Bureau of Reclamation and Department of Fish and Game. Order 90-5 also requires operations at Shasta Dam, Keswick Dam, and Spring Creek Power Plant to meet temperature objectives, which is modeled in CalSim as a 3,250 cfs release in all months.

Reclamation tries to stabilize fall flows below Keswick to reduce redd dewatering and rebuild coldwater pool. In CalSim, this is implemented as a target Keswick release in October through February based on Shasta end-of-September storage:

Table 3. Keswick Release Target October Through February

Shasta End-of-September	Keswick Release Target
<2.2 MAF	3,250 cfs
2.2-2.8 MAF	4,000 cfs
2.8-3.2 MAF	4,500 cfs
>3.2 MAF	5,000 cfs

The rice decomposition smoothing action is implemented through review of the demands to reduce large peaks.

A Spring Pulse flow of up to 150 TAF is released in March and April if it is expected that the release will not impact Shasta's ability to fill to at least 4.1 MAF by the end of April. Flood control releases can contribute to the 150 TAF pulse volume.

Flow Objective at Wilkins Slough

Flow objective at Wilkins Slough based on month, CVP allocation, and Shasta storage condition.

Minimum Flow Near Rio Vista

The minimum flow standard at Rio Vista is a September through December minimum flow of 3,000-4,500 cfs based on month and Sacramento Valley (40-30-30) Index Water Year type from D-1641.

Voluntary Agreements

None

Feather River

Minimum Flow Below Thermalito

Minimum flows below Thermalito Diversion Dam (low flow channel) are based on the 2006 Settlement Agreement which targets 700 cfs April 1 through September 9 and 800 cfs September 10 through March 31. Minimum flows below Thermalito Afterbay outlet (high flow channel) range from 750-1,750 cfs based on the 1983 DWR and CDFW agreement.

Voluntary Agreements

None

American River

Folsom Dam Flood Control

Folsom operates to flood control rules per the 2018 revision of the Water Control Manual for Folsom Dam and Lake, which incorporates the auxiliary spillway and forecast-informed decision making.

Minimum Flow Below Nimbus Dam

Minimum flow below Nimbus Dam is determined by the 2017 American River Modified Flow Management Standard.

Minimum Flow At H Street

The No Action Alternative applies D-893 at H Street, which is modeled as 250 cfs between January 1 and September 15 or 500 cfs at other times, with some reductions allowed in years where April through November inflows to Folsom are projected to be less than 600 TAF.

Voluntary Agreements

None

Stanislaus River

Minimum Flow Below Goodwin Dam

New Melones minimum flows below Goodwin are per the Stepped Release Plan (SRP). These flows are patterned to provide fall attraction flows in October and outmigration pulse flows in spring months (April 15 through May 15 in all years), and total up to 185.3 TAF to 483.7 TAF annually depending on the San Joaquin Valley (60-20-20) Index Water Year type (Table 4, Table 5, and Table 6).

Table 4. Annual SRP Flow Allocation

San Joaquin Valley (60-20-20) Index Water Year type	SRP Flows (TAF)
Critical	185.3
Dry	234.1
Below Normal	346.7
Above Normal	346.7
Wet	483.7

Table 5. Monthly “Base” SRP Flows Based on the Annual SRP Volume

Annual SRP Flow Volume (TAF)	Monthly SRP Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-14	May 16-31	Jun.	Jul.	Aug.	Sep.
185.3	577.4	200	200	212.9	214.3	200	200	150	150	150	150	150
234.1	635.5	200	200	219.4	221.4	200	500	284.4	200	200	200	200
346.7	774.2	200	200	225.8	228.6	200	1,471.4	1,031.3	363.3	250	250	250
483.7	796.8	200	200	232.3	235.7	1,521	1,614.3	1,200	940	300	300	300

Table 6. April 15 through May 15 “Pulse” Flows for Fishery Purposes Based on the Annual Fishery Volume

Annual SRP Flow Volume (TAF)	SRP Pulse Flows (cfs)	
	April 15-30	May 1-15
185.3	687.5	666.7
234.1	1,000	1,000
346.7	1,625	1,466.7
483.7	1,212.5	1,933.3

Minimum Dissolved Oxygen

Releases are made to the Stanislaus River below Goodwin Dam to meet the D-1422 dissolved oxygen content objective. Surrogate flows representing releases for dissolved oxygen requirement in CalSim are presented in Table 7. These flows are met through releases from New Melones without any annual volumetric limit but are only released if not met by other releases.

Table 7. Surrogate Flows Representing Releases for Dissolved Oxygen

	Surrogate Flow (TAF)
Jan.	0.0
Feb.	0.0
Mar.	0.0
Apr.	0.0
May	0.0
Jun.	15.2
Jul.	16.3
Aug.	17.4
Sep.	14.8
Oct.	0.0
Nov.	0.0
Dec.	0.0

Water Supply

Water supply refers to deliveries from New Melones to water rights holders (Oakdale Irrigation District [ID] and South San Joaquin ID) and CVP eastside contractors (Stockton East Water District [WD] and Central San Joaquin Water Control District [WCD]).

Water is provided to Oakdale ID and South San Joaquin ID in accordance with their 1988 Settlement Agreement with Reclamation (up to 600 TAF based on hydrologic conditions), limited by consumptive use. The conservation account of up to 200 TAF storage capacity defined under this agreement is not modeled in CalSim 3.

Annual allocations for Stockton East WD and Central San Joaquin WCD are determined using the San Joaquin Valley (60-20-20) Index Water Year type (Table 8) and are distributed using monthly patterns.

Table 8. Annual allocations for Stockton East WD and Central San Joaquin WCD

San Joaquin Valley (60-20-20) Index Water Year type	CVP Contractor Allocation (TAF)
Critical	0
Dry	49
Below Normal, Above Normal, and Wet	155

San Joaquin River

San Joaquin River Restoration Program

San Joaquin River Restoration Program releases per the Restoration Flow Guidelines. Restoration Flow requirements are implemented at Friant Dam and in the proposed Mendota Pool Bypass.

Recapture of Restoration Flows is simulated at Patterson Irrigation District, Banta Carbona Irrigation District, West Stanislaus Irrigation District, and in the Delta.

Maximum Salinity Near Vernalis

New Melones contribution per the SRP.

Minimum Flow Near Vernalis

New Melones contribution per the SRP.

Voluntary Agreements

None

Sacramento-San Joaquin Delta

SWRCB D-1641

All Delta outflow requirements per SWRCB D-1641 are included in the No Action Alternative simulation. However, not all salinity requirements are included as CalSim 3 is not capable of predicting salinities in the Delta. Instead, empirically based equations and models are used to relate interior salinity conditions with the flow conditions. DWR's Artificial Neural Network (ANN) trained for salinity is used to predict and interpret salinity conditions at the Collinsville, Emmaton, Jersey Point, and Rock Slough stations. Emmaton and Jersey Point standards are for protecting water quality conditions for agricultural use in the western Delta and they are in effect from April 1 to August 15. The EC requirement at Emmaton varies from 0.45 mmhos/cm to 2.78 mmhos/cm, depending on the Sacramento Valley (40-30-30) Index Water Year type. The EC requirement at Jersey Point varies from 0.45 to 2.20 mmhos/cm, depending on the water year type. The Rock Slough standard is for protecting water quality conditions for M&I use for water exported through the Contra Costa Canal. It is a year-round standard that requires a certain number of days in a year with chloride concentration less than 150 mg/L. The number of days requirement is dependent upon the water year type. The standard at Jersey Point is extended beyond the April through August D-1641 standard, to include September through January to help manage central Delta salinity and the Rock Slough water quality standard.

Delta Smelt Summer-Fall Habitat Action

SWP provides an additional 100 TAF volume of water to supplement Delta outflow in summer or fall months of a Sacramento Valley (40-30-30) Index wet or above normal year. This action is modeled with 100 TAF of additional outflow in August of wet and above normal years.

Combined Old and Middle River Flows

Projects operate to an OMR index no more negative than a 14-day moving average of -5,000 CFS between January 1 and May 31st except for the following conditions:

- **Integrated Early Winter Pulse Protection (“First Flush”):** After December 1 and through January 31, when 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 indicates a high risk of migration and dispersal into areas at high risk of future entrainment, but not be required if ripe or spent female Delta Smelt are collected in monitoring surveys, Reclamation and DWR propose to operate to OMR index of negative 2,000 CFS for 14 days. The Sacramento River Index (SACRI) is used to determine first flush conditions (SACRI greater than or equal to 20,000 CFS).
- **Turbidity Bridge Avoidance:** January and February in any Sacramento (40-30-30) Index Water Year type, if first flush occurred in December and if the turbidity trigger is reached (SACRI greater than or equal to 20,000 CFS), Projects operate to OMR Index of negative 2,000 CFS for five days.
- **WIIN Act Storm-Related OMR Flexibility:** It is assumed that there may be storm-related OMR management flexibility in January and February. In all water year types, it is assumed that this action is triggered under the following conditions which dynamically determined in CalSim: the Delta is in excess conditions, X2 < 81 km, SACRI < 20,000 cfs, and Qwest > +1,000 cfs. Each condition is determined based on the monthly timestep in CalSim.
- **Species-specific cumulative salvage or loss threshold:** Since salvage or loss cannot be directly modeled in CalSim, historic salvage data at the fish facilities at Banks and Jones Pumping Plants and fish catch data at Chipps Island trawl during water years 2010-2022 were analyzed. Historic salvage data provides the potential timing of triggering the 50% and 75% levels of the proposed single year loss thresholds. The Chipps Island catch data provides the migration timing and estimates for when the 95% of Winter-Run and Steelhead have migrated out of the Delta, which is the proposed offramp for the real-time OMR management for these species. Based on this historic data, the modeling used an OMR index of negative 3,500 CFS in a portion of each month from January through May.

South Delta Exports (Banks and Jones PP)

Exports at Jones and Banks Pumping Plant are restricted to their permitted capacities per SWRCB D-1641 requirements.

Under D-1641 the combined export of the CVP Tracy Pumping Plant and SWP Banks Pumping Plant is limited to a percentage of Delta inflow. The percentage ranges from 35 to 45 percent during February depending on the January eight river index and is 35 percent during March through June months. For the rest of the months 65 percent of the Delta inflow is allowed to be exported.

D-1641 also limits combined exports April 15 – May 15 to the maximum of 1500 cfs or flow in the San Joaquin River at Vernalis.

Additional 500 cfs SWP pumping is allowed during the July through September period.

A minimum health and safety pumping of 1,500 cfs is assumed from January through June.

Spring Outflow Requirement

Under the ITP, the SWP operates to the San Joaquin River Inflow to Export Ratio (SJR IE). The maximum allowable SWP export is 600 cfs or 40% of the total export under SJR IE in April and May. The ratio varies by the San Joaquin Valley (60-20-20) Water Year type (Table 9). SJR IE does not apply when Delta outflow is greater than 44,500 cfs.

Table 9. SJR IE Ratio by San Joaquin Valley (60-20-20) Water Year Type

San Joaquin Valley (60-20-20) Water Year type	Total Export:Vernalis Flow
Wet and Above Normal	4:1
Below Normal	3:1
Dry	2:1
Critical	1:1

Suisun Marsh Salinity Control Gates

Operate to meet D-1641 water quality standards October through May.

Summer/Fall Delta Smelt habitat action operates for 60 days June through October of Sacramento Valley (40-30-30) Index Wet, Above Normal, and Below Normal years. Additional SWP ITP action in Dry years, where the gate will operate for 30 days if the previous year was Below Normal or 60 days if the previous year was Above Normal or Wet and there was sufficient carryover.

Delta Cross Channel Gate Operation

Gate operations per Multi-Year Study Program.

The nuances of this operation cannot be modeled in the monthly CalSim timestep, so gate closures represented in the model reflect actions under the NMFS 2009 BO Action 4.1.2 along with D-1641.

D-1641 calls for gates to be closed for 45 out of 92 days November through January, every day February through May 20, and 14 out of 26 days May 21 through June 15. CalSim assumptions for these criteria close the gates for 10 days in November, 15 days in December, 20 days in January, all days in May, and 4 days in June.

Additional gate closures to represent the NMFS BO are triggered in October and November by indications that daily flow at Wilkins Slough would exceed 7,500 cfs, corresponding to a high risk of fish presence. Gates are modeled as fully closed in December and January.

Reclamation determines the timing and duration of actual gate closures after discussion with USFWS, CDFW, and NMFS.

X2

The D-1641 February through June X2 criteria is included in the No Action Alternative simulation.

Delta outflow to manage X2 in the fall months following Sacramento Valley (40-30-30) Index wet and above normal years targets maintaining an average X2 for September and October no greater (more eastward) than 80 kilometers. This criteria is modeled with transitional flows in the last half of August.

Voluntary Agreements

None

Temporary Urgency Change Petition Representation

Some D-1641 criteria is relaxed under severe water supply conditions, determined by a combination of Sac River Index and Shasta storage. Water quality standards at Emmaton are modified to represent moving the standard upstream to Three-Mile Slough, X2 requirements are suspended, and Net Delta Outflow Index standards are relaxed by 1,000 cfs in summer months. When TUCP's are triggered, Delta exports are limited to health and safety levels.

Systemwide Operational Rules

CVP Water Allocation

CalSim includes allocation logic for determining deliveries to north-of-Delta and south-of-Delta CVP contractors. The delivery logic uses runoff forecast information, which incorporates uncertainty in the hydrology, and a rule curve which relates water supply to the allocation. Water supply is defined by forecasted inflow and Spring reservoir storage. Allocation is first determined in March and updated in April and May as runoff forecasts become more certain. South of Delta CVP allocation can be affected by export potential, which is represented in a rule curve based on the Sac River Index.

CVP Settlement Contractors, Exchange Contractors, and Refuges receive 100% allocation in all except for Shasta Critical Years. In Shasta Critical Years, the Settlement Contractors and the Refuges are given a 75% allocation and Exchange contractors are given a 77% allocation.

CVP water service contracts are determined based on water supply (except the East Side contractors which are determined in CalSim by the San Joaquin 60-20-20 Index). CVP agriculture allocations are 0-100% and CVP municipal and industrial allocations are 50-100%.

SWP Water Allocation

CalSim includes allocation logic for determining deliveries to north-of-Delta and south-of-Delta SWP contractors. The delivery logic uses runoff forecast information, which incorporates uncertainty in the hydrology, and standardized rule curves (i.e. Water Supply Index versus Demand Index Curve). The rule curves relate forecasted water supplies to deliverable “demand,” and then use deliverable “demand” to assign subsequent delivery levels to estimate the water available for delivery and carryover storage. Updates of delivery levels occur monthly from January 1 through May 1 for the SWP as runoff forecasts become more certain. The south-of-Delta SWP delivery is determined based on water supply parameters and operational constraints.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

The tidal boundary condition at Martinez is based on an adjusted astronomical tide normalized for sea level rise (Ateljevich and Yu, 2007).

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative.

Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from CalSim 3.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model; however, the fish barrier located at the Head of Old River is not included in the model.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (Reclamation, 2008).

Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31. Head of Old River Barrier would not be installed.

Suisun Marsh Salinity Control Gate

The radial gates in the Suisun Marsh Salinity Control Gate Structure are assumed to be tidally operating based on the operational time series outputs from CalSim 3.

When operating, gates open when upstream water level is 0.3 ft above downstream water level. Gates close when current is less than -0.1 fps. When not operating, gates are held open.

HEC-5Q

The following is a description of the assumptions listed in Appendix F Modeling Section 1-2 Callouts Tables.

Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CalSim 3 output.

Shasta Temperature Management

Shasta temperature control device (TCD) operated to "2019 tiers" as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CalSim 3 output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output.

Exploratory 1 – Run of River Scenario

This section presents the assumptions used in developing the CalSim 3, DSM2 and HEC-5Q simulations of the Exploratory 1 (EXP1) Run of River Scenario considered for the LTO.

The EXP1 scenario includes projected climate change and sea level rise assumptions corresponding to 2022 median ± 15 and 15cm sea level rise (SLR). Changes in climate results in the changes in the reservoir and tributary inflows included in CalSim 3. The sea level rise changes result in changes to salinity conditions in the Delta. The climate change and sea level rise assumptions are described in detail Appendix F Attachment 1-1 Climate Change.

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 Callouts Tables.

Hydrology

Inflows/Supplies

Same as No Action Alternative.

Level of Development

Same as No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

CalSim 3 uses applied water demands, determined by CalSimHydro, based on the level of development average 2004-2013 land use. Urban demands are based on 2020 Urban Water Management Plans. Demand units are classified as CVP project, SWP project, local project or non-project. CVP and SWP demands are separated into different classes based on the contract type.

Deliveries are limited by water rights and/or project contract obligations, as applicable.

For the EXP1 scenario, for the Sacramento Valley, CVP Settlement contractors may divert as possible, up to full contract amounts, given hydrologic conditions without CVP facility operations or hydraulic conditions consideration. No deliveries to CVP M&I or Ag service contractors. Deliveries to refuges are made as possible, up to Level 1 supply needs, given hydrologic conditions, without CVP facility operations or hydraulic conditions consideration. Deliveries to senior water rights are made as possible, given hydrologic conditions, without CVP facility operations or hydraulic conditions consideration. For the San Joaquin River, no deliveries to Friant Unit CVP M&I or Ag service contractors. Deliveries to water rights, CVP Exchange contractors, and refuges (up to Level 1) are made as possible, up to full contract amount, through San Joaquin River diversions, given hydrologic conditions, without CVP facility operations or hydraulic conditions consideration. For the Stanislaus River deliveries to water rights are made as possible given hydrologic conditions, without CVP facility operations or hydraulic conditions consideration. No deliveries to Stanislaus Unit CVP M&I or Ag service contractors. For the Delta, no diversions at Jones PP are included. Deliveries to CCWD water rights are made as possible given Delta hydrologic conditions without CVP facility operations; no deliveries to CVP M&I or Ag service contractors.

For the EXP1 scenario, for the Feather River, deliveries to SWP FRSA contractors are made as possible, up to full contract amounts, given hydrologic conditions, without SWP facility operations or hydraulic conditions consideration. No deliveries to SWP M&I service contractors. Deliveries to senior water rights are made as possible, given hydrologic conditions, without SWP facility operations or hydraulic conditions consideration. For the Delta, no diversions at Banks PP are included. No deliveries to SWP M&I or Ag service contractors.

Facilities

For the EXP1 scenario, existing facilities are operated only to maintain facility integrity. CalSim3 is a monthly timestep model and therefore results do not reflect reasonable storage or flow release conditions for sub-monthly flood events whenever storage is less than full capacity for the month.

For the EXP1 scenario, storage facilities, Trinity Lake, Shasta Lake, Lake Oroville, Folsom Lake, Millerton Lake and New Melones Reservoir are operated to dead pool capacity. Inflows are passed through the facilities, subject to all other regulations and operation assumption callouts for this scenario. Stored water is released as quickly as possible, and releases are not limited to release capacity, however, they are limited by downstream channel capacity. Reregulating reservoirs Whiskeytown Lake, Keswick Reservoir, Thermalito Complex and Lake Natoma are similarly operated to dead pool capacity and releases not limited to release capacity.

For the EXP1 scenario, diversion and conveyance facilities, Clear Creek Tunnel, Spring Creek Tunnel, Red Bluff Pumping Plant, Tehama-Colusa Canal, and Folsom South Canal are not operated. Other diversion and conveyance facilities are operated given hydrologic conditions, for water right diverters, without CVP or SWP facility operations or hydraulic conditions consideration. These include Hamilton City Pump Station, Glenn-Colusa Canal and other diversions for Sacramento River Settlement Contractors and Refuge Level 1 water supply needs, Thermalito Complex and other diversions for Feather River Service Area Settlement Contractors, and American River PCWA Pump Station, Freeport Regional Water Project and City of Stockton Delta Water Supply Project and other diversions for water right diverters.

The Delta serves as a natural system of channels to transport river flows and reservoir storage to the CVP and SWP facilities in the south Delta, which export water to the projects' contractors through two pumping plants: CVP's C.W. Jones Pumping Plant and SWP's Harvey O. Banks Pumping Plant. Jones and Banks Pumping Plants supply water to agricultural and urban users throughout parts of the San Joaquin Valley, South Lahontan, Southern California, Central Coast, and South San Francisco Bay Area regions. The Contra Costa Canal and the North Bay Aqueduct supply water to users in the northeastern San Francisco Bay and Napa Valley areas.

For the EXP1 scenario, there is no pumping included for CVP or SWP facilities at Jones and Banks Pumping Plants, no operation of Delta Mendota Canal, California Aqueduct or South Bay Aqueduct and there is no storage operation at San Luis Reservoir or any other aqueduct storage facilities. For North Bay Aqueduct, there are no deliveries to SWP service contracts; only diversions under the Fairfield, Vacaville, and Benecia Settlement Agreement. For CCWD, there is no pumping to store in Los Vaqueros Reservoir and no CVP M&I contract diversions; only water right diversions for direct use by CCWD are included.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under EXP1 are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

For the EXP1 scenario, SWRCB D-1641 and its various components are not included.

Coordinated Operations Agreement (COA)

For the EXP1 scenario, COA and its various components are not included.

Water Transfers and Wheeling

For the EXP1 scenario, water transfers and wheeling options of any kind are not included.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

For the EXP1 scenario, Trinity Lake is operated to dead pool and regulations on the Trinity River are not included.

Minimum Flow below Lewiston Dam

None.

Trinity Reservoir end-of-September Minimum Storage

No target.

Trinity Import

None.

Clear Creek

For the EXP1 scenario, Whiskeytown Reservoir is operated to dead pool and regulations on Clear Creek are not included.

Sacramento River

For the EXP1 scenario, Shasta Lake is operated to dead pool and regulations on the Sacramento River are not included.

Shasta Lake End-of-September Minimum Storage

No target.

Minimum Flow Below Keswick Dam

None.

Flow Objective at Wilkins Slough

None.

Minimum Flow Near Rio Vista

None.

Voluntary Agreements

None.

Feather River

For the EXP1 scenario, Lake Oroville is operated to dead pool and regulations on the Feather River are not included.

Minimum Flow Below Thermalito

None.

Voluntary Agreements

None.

American River

For the EXP1 scenario, Folsom Lake is operated to dead pool and regulations on the American River are not included.

Folsom Dam Flood Control

Same as No Action Alternative.

Minimum Flow Below Nimbus Dam

None.

Minimum Flow At H Street

None.

Voluntary Agreements

None.

Stanislaus River

For the EXP1 scenario, New Melones Reservoir is operated to dead pool and regulations on the Stanislaus River and the San Joaquin River at Vernalis are not included.

Minimum Flow Below Goodwin Dam

None.

Minimum Dissolved Oxygen

None.

San Joaquin River

For the EXP1 scenario, Millerton Lake is operated to dead pool and regulations on the San Joaquin River are not included. The channel capacity for the San Joaquin River from Friant Dam to the Mendota Pool has been increased to 2,600 cfs to accommodate flows to meet diversions to Exchange Contractors and Refuge Level 1 water supply needs given hydrologic conditions without operation of CVP facilities.

San Joaquin River Restoration Program

None.

Maximum Salinity Near Vernalis

None.

Minimum Flow Near Vernalis

None.

Voluntary Agreements

None.

Sacramento-San Joaquin Delta**SWRCB D-1641**

For the EXP1 scenario, requirements are not included.

Delta Smelt Summer-Fall Habitat Action

None.

Combined Old and Middle River Flows

None.

South Delta Exports (Banks and Jones PP)

For the EXP1 scenario, Delta export pumping is not included.

Spring Outflow Requirement

For the EXP1 scenario, SWP ITP requirements are not included.

Suisun Marsh Salinity Control Gates

For the EXP1 scenario, SWRCB D-1641, LTO or SWP ITP requirements are not included.

The SMSCG gates are not operated.

Delta Cross Channel Gate Operation

For the EXP1 scenario, SWRCB D-1641, LTO or SWP ITP requirements are not included.

The Delta Cross Channel gates are always closed.

X2

For the EXP1 scenario, Spring and Fall X2 operations are not included.

Voluntary Agreements

None.

Temporary Urgency Change Petition Representation

None.

Systemwide Operational Rules***CVP Water Allocation***

For the EXP1 scenario, CVP Settlement Contractors and Exchange Contractors allocations are set to 100% of contracts in all years except for Shasta Critical Years. In Shasta Critical Years, the Settlement Contractors are set to 75% allocation and Exchange contractors are set to 77% allocation. Refuge allocations are set based on Level 1 water supply needs using the same allocation levels as Settlement Contractors. Settlement, Exchange and Refuge deliveries are provided subject to given hydrologic conditions at the point of diversion for each, without use of CVP facilities. Exchange contractors deliveries are diverted only from the San Joaquin River (not from the Delta Mendota Canal).

For the EXP1 scenario, CVP Municipal and Industrial and Agriculture water service contractor allocations are set to zero and deliveries are not included.

SWP Water Allocation

For the EXP1 scenario, Feather River Settlement Contractors allocations are set according to contract specific terms. Deliveries are provided subject to given hydrologic conditions at the point of diversion, without use of SWP facilities.

For the EXP1 scenario, SWP Municipal and Industrial and Agriculture water service contractor allocations are set to zero and deliveries are not included.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

Same as No Action Alternative

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the EXP1.

Facilities

Delta Cross Channel

For the EXP1 scenario, the Delta Cross Channel gates are always closed.

South Delta Temporary Barriers

For the EXP1 scenario, the South Delta Temporary Barriers are not included.

Clifton Court Forebay Gates

For the EXP1 scenario, the Clifton Court Forebay Gates are always open.

Suisun March Salinity Control Gate

For the EXP1 scenario, the Suisun March Salinity Control Gate is always open.

HEC-5Q

The following is a description of the assumptions listed in Appendix F Modeling Section 1-2 Callouts Tables.

Sacramento-Trinity Rivers

Shasta Temperature Management

For the EXP1 scenario, due to Shasta Lake being operated to dead pool, temperature management is conducted to the 90-5 logic, modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates, with additional modifications to account for numerical error.

Trinity Temperature Management

For the EXP1 scenario, due to Trinity Lake being operated to dead pool, temperature management is not included.

American River

Folsom Temperature Management

For the EXP1 scenario, due to Folsom Lake being operated to dead pool, temperature management is conducted to the 2009 NMFS BiOp Appendix 2D logic, modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates, with additional modifications to account for numerical error.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output, with additional modifications to account for numerical error from operating the reservoirs at dead pool.

Exploratory 3 – Obligated Releases Scenario

This section presents the assumptions used in developing the CalSim 3, DSM2 and HEC-5Q simulations of the Exploratory 3 (EXP3) Obligated Releases Scenario considered for the LTO.

The EXP3 scenario includes the same projected climate change and sea level rise assumptions as the EXP1 scenario.

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 Callouts Tables.

Hydrology

Inflows/Supplies

Same as No Action Alternative.

Level of Development

Same as No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as the EXP1 scenario.

Deliveries are limited by water rights and/or project contract obligations, as applicable.

For the EXP3 scenario, for the Sacramento Valley, CVP Settlement contractors may divert up to full contract amounts, including diverting releases provided by CVP facility operations. No deliveries to CVP M&I or Ag service contractors. Deliveries to refuges are made up to firm Level 2 supply needs, including diverting releases provided by CVP facility operations. Deliveries to senior water rights are included. For the San Joaquin River, no deliveries to Friant Unit CVP M&I or Ag service contractors. Deliveries to water rights, CVP Exchange contractors, and refuges (up to firm Level 2) are made up to full contract amount, through San Joaquin River diversions, including diverting releases provided by CVP facility operations. For the Stanislaus River deliveries to water rights are included. No deliveries to Stanislaus Unit CVP M&I or Ag service contractors. For the Delta, no diversions at Jones PP are included. Deliveries to CCWD water rights are included; no deliveries to CVP M&I or Ag service contractors.

For the EXP3 scenario, for the Feather River, deliveries to SWP FRSA contractors are included, up to full contract amounts, including diverting releases provided by SWP facility operations. No deliveries to SWP M&I service contractors. Deliveries to senior water rights are included. For the Delta, no diversions at Banks PP are included. No deliveries to SWP M&I or Ag service contractors.

Facilities

For the EXP3 scenario, existing facilities are operated to store water and release stored water for non-discretionary obligations, subject to all other regulations and operation assumption callouts for this scenario. Non-discretionary obligations include Settlement contractors, senior water rights and other non-project diversions, SWRCB D-1641 and other regulatory requirements listed in the assumptions callouts for this scenario.

For the EXP3 scenario, storage facilities, Trinity Lake, Shasta Lake, Lake Oroville, Folsom Lake, Millerton Lake and New Melones Reservoir are operated to store water and release stored water for non-discretionary obligations, subject to all other regulations and operations assumptions callouts for this scenario. dead pool capacity. Releases are limited to release capacity and limited by downstream channel capacity. Reregulating reservoirs Whiskeytown Lake, Keswick Reservoir, Thermalito Complex and Lake Natoma are operated to existing capacity and releases are limited to release capacity.

For the EXP3 scenario, diversion and conveyance facilities, Clear Creek Tunnel, Spring Creek Tunnel, Red Bluff Pumping Plant, Tehama-Colusa Canal, and Folsom South Canal are not operated. Other diversion and conveyance facilities are operated for water right diverters. These include Hamilton City Pump Station, Glenn-Colusa Canal and other diversions for Sacramento River Settlement Contractors and Refuge firm Level 2 water supply needs, Thermalito Complex and other diversions for Feather River Service Area Settlement Contractors, and American River PCWA Pump Station, Freeport Regional Water Project and City of Stockton Delta Water Supply Project and other diversions for water right diverters.

The Delta serves as a natural system of channels to transport river flows and reservoir storage to the CVP and SWP facilities in the south Delta, which export water to the projects' contractors through two pumping plants: CVP's C.W. Jones Pumping Plant and SWP's Harvey O. Banks Pumping Plant. Jones and Banks Pumping Plants supply water to agricultural and urban users throughout parts of the San Joaquin Valley, South Lahontan, Southern California, Central Coast, and South San Francisco Bay Area regions. The Contra Costa Canal and the North Bay Aqueduct supply water to users in the northeastern San Francisco Bay and Napa Valley areas.

For the EXP3 scenario, same as for the EXP1 scenario, there is no pumping included for CVP or SWP facilities at Jones and Banks Pumping Plants, no operation of Delta Mendota Canal, California Aqueduct or South Bay Aqueduct and there is no storage operation at San Luis Reservoir or any other aqueduct storage facilities. For North Bay Aqueduct, there are no deliveries to SWP service contracts; only diversions under the Fairfield, Vacaville, and Benecia Settlement Agreement. For CCWD, there is no pumping to store in Los Vaqueros Reservoir and no CVP M&I contract diversions; only water right diversions for direct use by CCWD are included.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under EXP3 are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as No Action Alternative.

Coordinated Operations Agreement (COA)

Same as No Action Alternative.

Water Transfers and Wheeling

Same as EXP1.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

Same as EXP1.

Minimum Flow below Lewiston Dam

Same as EXP1.

Trinity Reservoir end-of-September Minimum Storage

Same as EXP1.

Trinity Import

Same as EXP1.

Clear Creek

For the EXP3 scenario, Whiskeytown Reservoir is operated to store water and regulations on Clear Creek are included.

Reclamation operates Clear Creek flows in accordance with the 1960 Memorandum of Agreement (MOA) with CDFW, and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Reclamation operates to a minimum baseflow in Clear Creek of 200 cfs from October through May, and 150 cfs from June through September in all Sacramento Valley (40-30-30) Index Water Year types except Critical year types. In Critical years, Clear Creek base flows are 150 cfs in all months.

In addition, Reclamation creates additional flows for both channel maintenance and spring attraction flows. Channel maintenance releases are 10 TAF in February of BN, AN, and Wet years. Spring attraction flows are supported by 10 TAF of releases in June of non-critical years, and a 3-day 900 cfs pulse release in June in critical years.

Sacramento River

For the EXP3 scenario, Shasta Lake is operated to store water and release stored water for non-discretionary obligations and regulations on the Sacramento River are included.

Shasta Lake End-of-September Minimum Storage

Same as EXP1.

Minimum Flow Below Keswick Dam

For the EXP3 scenario, Order 90-5 set the minimum flow below Keswick Dam from September through February to be 3,250 cfs in all but critically dry years. Order 90-5 also requires operations at Shasta Dam, Keswick Dam, and Spring Creek Power Plant to meet temperature objectives, which is modeled in CalSim as a 3,250 cfs release in all months.

Flow Objective at Wilkins Slough

For the EXP3 scenario, the flow objective at Wilkins Slough is set at 3,250 cfs.

Minimum Flow Near Rio Vista

Same as No Action Alternative.

Voluntary Agreements

None.

Feather River

For the EXP3 scenario, Lake Oroville is operated to store water and release stored water for non-discretionary obligations and regulations on the Feather River are included.

Minimum Flow Below Thermalito

For the EXP3 scenario, the minimum flows below Thermalito Diversion Dam (low flow channel) are based on the 2006 Settlement Agreement which targets 700 cfs April 1 through September 9 and 800 cfs September 10 through March 31. Minimum flows below Thermalito Afterbay outlet (high flow channel) range from 750-1,750 cfs based on the 1983 DWR and CDFW agreement.

Voluntary Agreements

None.

American River

For the EXP3 scenario, Folsom Lake is operated to store water and release stored water for non-discretionary obligations and regulations on the American River are included.

Folsom Dam Flood Control

Same as No Action Alternative.

Minimum Flow Below Nimbus Dam

Same as EXP1.

Minimum Flow At H Street

Same as No Action Alternative.

Voluntary Agreements

None.

Stanislaus River

For the EXP3 scenario, New Melones Reservoir is operated to store water and release stored water for non-discretionary obligations and regulations on the Stanislaus River and the San Joaquin River at Vernalis are included.

Minimum Flow Below Goodwin Dam

Same as No Action Alternative.

Minimum Dissolved Oxygen

Same as No Action Alternative.

San Joaquin River

For the EXP3 scenario, Millerton Lake is operated to store water and release stored water for non-discretionary obligations and regulations on the San Joaquin River are included. The channel capacity for the San Joaquin River from Friant Dam to the Mendota Pool has been increased to 2,600 cfs to accommodate flows to meet diversions to Exchange Contractors and Refuge firm Level 2 water supply needs.

San Joaquin River Restoration Program

Same as EXP1.

Maximum Salinity Near Vernalis

Same as EXP1.

Minimum Flow Near Vernalis

Same as EXP1.

Voluntary Agreements

None.

Sacramento-San Joaquin Delta**SWRCB D-1641**

Same as No Action Alternative.

Delta Smelt Summer-Fall Habitat Action

Same as EXP1.

Combined Old and Middle River Flows

Same as EXP1.

South Delta Exports (Banks and Jones PP)

Same as EXP1.

Spring Outflow Requirement

Same as EXP1.

Suisun Marsh Salinity Control Gates

Same as EXP1.

Delta Cross Channel Gate Operation

Same as EXP1.

X2

For the EXP3 scenario, SWRCB D-1641 Spring X2 flows are included, however Fall X2 operations are not included.

Voluntary Agreements

None.

Temporary Urgency Change Petition Representation

None.

Systemwide Operational Rules

CVP Water Allocation

For the EXP3 scenario, CVP Settlement Contractors and Exchange Contractors allocations are set to 100% of contracts in all years except for Shasta Critical Years. In Shasta Critical Years, the Settlement Contractors are set to 75% allocation and Exchange contractors are set to 77% allocation. Refuge allocations are set based on firm Level 2 water supply needs using the same allocation levels as Settlement Contractors. Settlement, Exchange and Refuge deliveries are included and met with releases from CVP facilities as needed. Exchange contractors deliveries are diverted only from the San Joaquin River (not from the Delta Mendota Canal) and met with releases from CVP facilities as needed.

For the EXP3 scenario, same as for the EXP1 scenario, CVP Municipal and Industrial and Agriculture water service contractor allocations are set to zero and deliveries are not included.

SWP Water Allocation

For the EXP3 scenario, Feather River Settlement Contractors allocations are set according to contract specific terms. Deliveries and met with releases from SWP facilities as needed.

For the EXP3 scenario, same as for the EXP1 scenario, SWP Municipal and Industrial and Agriculture water service contractor allocations are set to zero and deliveries are not included.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

Same as No Action Alternative

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the EXP3.

Facilities

Delta Cross Channel

Same as EXP1.

South Delta Temporary Barriers

Same as EXP1.

Clifton Court Forebay Gates

Same as EXP1.

Suisun March Salinity Control Gate

Same as EXP1.

HEC-5Q

Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CalSim 3 output.

Shasta Temperature Management

Shasta temperature control device (TCD) operated to 90-5 logic as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CalSim 3 output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output.

Alternative 2 v1 – Multi-Agency Consensus

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 Callouts Tables.

Hydrology

Inflows/Supplies

Same as No Action Alternative.

Level of Development

Same as No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as No Action Alternative.

Facilities

Same as Alternative 1.

Fremont Weir

Same as No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity and Delta-Mendota Canal/California Aqueduct Intertie Capacity

Same as Alternative 1.

SWP Banks Pumping Plant Capacity

Same as No Action Alternative.

San Luis Reservoir

Same as Alternative 1.

CCWD Intakes

Same as No Action Alternative.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under Alternative 2 are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as No Action Alternative

Coordinated Operations Agreement (COA)

COA is modified from the No Action Alternative to account for reductions to the Sacramento River Settlement Contractors in Bin 3B years to encourage the conserved water to remain in Shasta storage.

CVPIA (b)(2) Assumptions

Same as No Action Alternative.

Continued CALFED Agreements

Same as No Action Alternative.

Water Transfers and Wheeling

Lower Yuba River Accord (LYRA)

Same as No Action Alternative.

Phase 8 Transfers

Same as No Action Alternative.

Short-term or Temporary Water Transfers

Same as No Action Alternative.

Cross Valley Canal Wheeling and Joint Point of Diversion

Same as No Action Alternative.

Contra Costa Wheeling through Freeport

Same as No Action Alternative.

Temporary Urgency Change Petitions (TUCPs)

Not assumed in Alternative 2v1.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

Minimum Flow below Lewiston Dam

Same as No Action Alternative.

Trinity Reservoir end-of-September Minimum Storage

Same as No Action Alternative.

Trinity Import

Same as No Action Alternative.

Clear Creek

Reclamation proposes to release Clear Creek flows in a variable hydrograph in all except Sacramento Valley (40-30-30) Index Critical year-types (Table 10). In Critical year-types, releases from Whiskeytown Dam target 150 cfs in all months.

In addition, Reclamation proposes to create pulse flows for channel maintenance, spring attraction flows, and to meet other physical and biological objectives. These pulses are modeled as 5 TAF in May and June in all except Critical year-types. In Critical year-types a 5 TAF pulse flow is modeled in May.

Table 10. Clear Creek Seasonal Variable Hydrograph Monthly Minimum Flows, Except Sacramento Valley (40-30-30) Index Critical Years

	Flow (cfs)
Oct	168
Nov	221
Dec	269
Jan	295
Feb	286
Mar	271
Apr	234
May	185
Jun	136
Jul	106
Aug	114
Sep	134

Sacramento River

Shasta Lake End-of-September Minimum Storage

Shasta is operated using the Water Temperature and Storage Framework approach which establishes management “Bins”.

The Bin is determined February through May based on estimated Shasta fill and carryover, forecasted inflow, projected delivery, and projected regulatory cost. The May Bin estimate endures through September.

- Bin 1A – End of April (EOA) estimate > 3.7 MAF and End of September (EOS) estimate > 3.0 MAF. Under Bin 1A normal operations occur.
- Bin 1B – EOA estimate > 3.7 MAF and EOS estimate > 2.4 MAF. Under Bin 1B, a factor is applied to the reservoir balancing goals to prioritize Shasta storage if possible.
- Bin 2A – EOA estimate > 3.0 MAF and EOS estimate > 2.2 MAF. Under Bin 2A, a factor is applied to the reservoir balancing goals to prioritize Shasta storage if possible, and additional cuts to CVP Service Contract allocations are based on the estimated and target carryover.
- Bin 2B – EOA estimate > 3.0 MAF and EOS estimate > 2.0 MAF. Under Bin 2B, additional cuts to CVP Service Contract allocations are based on the estimated and target carryover.
- Bin 3A – EOA estimate > 3.0 MAF and EOS estimate < 2.0 MAF, or EOA estimate < 3.0 MAF and EOS estimate > 2.0 MAF, or EOA estimate < 3.0 MAF and EOS estimate < 2.0 MAF and October through April Shasta inflow > 2.5 MAF. Under Bin 3A, additional cuts are made to CVP Agriculture allocation and CVP Municipal and Industrial allocation can be cut down to Public Health and Safety (25% allocation) based on the estimated and target carryover.
- Bin 3B – EOA estimate > 3.0 MAF and EOS estimate < 2.0 MAF and October through April Shasta Inflow < 2.5 MAF. Under Bin 3B, CVP Agriculture Service allocation is 0% and CVP Municipal and Industrial Service allocation is 25%. Sacramento River Settlement Contractor (SRSC) allocation is reduced by up to 500 TAF (modeled by allocations as low as 47%). CVP North of Delta Refuge is given the same allocation as SRSC. Up to 280 TAF of reduced delivery to SRSC and Refuge demands is tracked in a storage account in Shasta. Reductions in storage withdrawal are tracked and used to adjust the COA balance.

A decision tree for determining Shasta Management Bin is shown below in Figure 1:

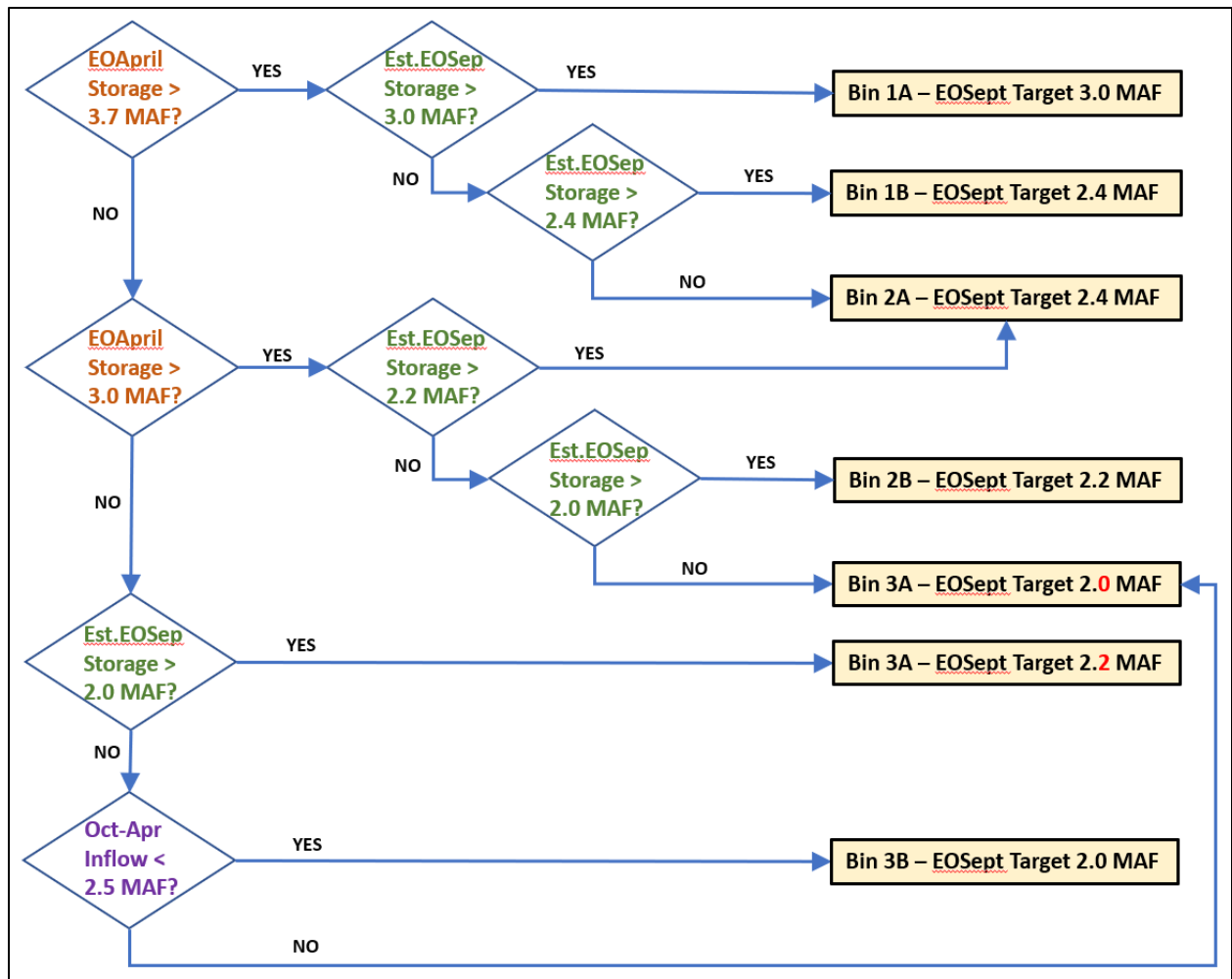


Figure 1. Decision Tree for Shasta Management Bin

Minimum Flow Below Keswick Dam

Same as No Action Alternative.

Flow Objective at Wilkins Slough

Same as No Action Alternative.

Minimum Flow Near Rio Vista

Same as No Action Alternative.

Voluntary Agreements

None

Feather River

Minimum Flow Below Thermalito

Same as No Action Alternative.

Voluntary Agreements

None

American River**Folsom Dam Flood Control**

Same as No Action Alternative.

Minimum Flow Below Nimbus Dam

Minimum flow below Nimbus Dam is determined by the 2017 American River Modified Flow Management Standard but using the 90 percent forecast exceedance for unimpaired inflows to Folsom and the Sacramento Valley (40-30-30) Index.

Minimum Flow At H Street

Same as No Action Alternative

Voluntary Agreements

None

Stanislaus River**Minimum Flow Below Goodwin Dam**

New Melones minimum flows below Goodwin are per the modified Stepped Release Plan (SRP). These flows are patterned to provide fall attraction flows in October and outmigration pulse flows in spring months (April 15 through May 15 in all years) and total up to 188.8 TAF to 492.6 TAF annually depending on the San Joaquin 60-20-20 Index using the 90 percent forecast exceedance (Table 11, Table 12, and Table 13).

In Shasta Bin 3B years, if May New Melones storage is above 1.4 MAF and the EOS Shasta storage estimate is below 1,225 TAF, the minimum flow at Goodwin is increased to 1,500 cfs in June through August to support Delta Outflow.

Table 11. Annual SRP Flow Allocation

San Joaquin Valley (60-20-20) Index Water Year type	SRP Flows (TAF)
Critical	188.8
Dry	239.5
Below Normal	352.9
Above Normal	352.9
Wet	492.6

Table 12. Monthly “Base” SRP Flows Based on the Annual SRP Volume

Annual SRP Flow Volume (TAF)	Monthly SRP Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-14	May 16-31	Jun.	Jul.	Aug.	Sep.
188.8	577.4	200	200	200	292.9	200	200	150	150	150	150	150
239.5	635.5	200	200	200	339.3	200	500	284.4	200	200	200	200
352.9	774.2	200	200	200	385.7	200	1,471.4	1,031.3	363.3	250	250	250
492.6	796.8	200	200	200	432.1	1,521	1,614.3	1,200	940	300	300	300

Table 13. April 15 through May 15 “Pulse” Flows for Fishery Purposes Based on the Annual Fishery Volume

Annual SRP Flow Volume (TAF)	SRP Pulse Flows (cfs)	
	April 15-30	May 1-15
185.3	687.5	666.7
234.1	1,000	1,000
346.7	1,625	1,466.7
483.7	1,212.5	1,933.3

Minimum Dissolved Oxygen

Same as No Action Alternative.

Water Supply

Same as No Action Alternative.

San Joaquin River

San Joaquin River Restoration Program

Same as No Action Alternative.

Maximum Salinity Near Vernalis

Same as No Action Alternative.

Minimum Flow Near Vernalis

Same as No Action Alternative.

Voluntary Agreements

None

Sacramento-San Joaquin Delta

SWRCB D-1641

Same as No Action Alternative.

Delta Smelt Summer-Fall Habitat Action

Not included.

Combined Old and Middle River Flows

Projects operate to an OMR index no more negative than a 14-day moving average of -5,000 CFS between January 1 and June 30th except for the following conditions:

- Integrated Early Winter Pulse Protection (“First Flush”): After December 1 and through January 31, when 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 indicates a high risk of migration and dispersal into areas at high risk of future entrainment, but not be required if ripe or spent female Delta Smelt are collected in monitoring surveys, Reclamation and DWR propose to operate to OMR index of negative 2,000 CFS for 14 days. The model index of SACRI is used to determine first flush conditions (SACRI greater than or equal to 20,000 CFS). This action is offramped when flows at Rio Vista are greater than 55,000 cfs OR flows at Vernalis are greater than 8,000 cfs.
- Turbidity Bridge Avoidance: January through March in any Sacramento (40-30-30) Index Water Year type, if first flush has already occurred and if the turbidity trigger is reached (SACRI greater than or equal to 20,000 CFS), Projects operate to OMR Index of negative 2,000 CFS for ten days.
- WIIN Act Storm-Related OMR Flexibility: It is assumed that there may be storm-related OMR management flexibility in January and February. In all wateryear types, it is assumed that this action is triggered under the following conditions which dynamically determined in CalSim: the Delta is in excess conditions, X2 < 81 km, SACRI < 20,000 cfs, and QWest > +1,000 cfs. Each condition is determined based on the monthly timestep in CalSim.
- Species-specific cumulative salvage or loss threshold: Since salvage or loss cannot be directly modeled in CalSim, historic salvage data at the fish facilities at Banks and Jones Pumping Plants and other triggers for these actions were analyzed for the 2010 – 2022 period. Based on this historic data and water year type, the modeling used an OMR index of negative 3,500 CFS in a portion of each January through June.

South Delta Exports (Banks and Jones PP)

Same as No Action Alternative.

Spring Outflow Requirement

No additional actions.

Suisun Marsh Salinity Control Gates

Operate to meet D-1641 water quality standards October through May.

Summer/Fall Delta Smelt habitat action operates for 60 days June through October of Sacramento Valley (40-30-30) Index Above Normal, Below Normal, and Dry years following Wet or Above Normal years and 30 days in Dry years following Below Normal years using a 7 on, 7 off schedule.

Delta Cross Channel Gate Operation

Same as No Action Alternative.

X2

Same as No Action Alternative.

Voluntary Agreements

None.

Temporary Urgency Change Petition Representation

TUCP's are not included.

Systemwide Operational Rules

CVP Water Allocation

Similar to No Action Alternative with additional cuts as detailed in Shasta Lake End-of-September Minimum Storage.

SWP Water Allocation

Same as No Action Alternative.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

Same as No Action Alternative

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative.

Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from CalSim 3.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model; however, the fish barrier located at the Head of Old River is not included in the model.

Clifton Court Forebay Gates

Same as No Action Alternative.

Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31. Head of Old River Barrier would not be installed.

Suisun Marsh Salinity Control Gate

The radial gates in the Suisun Marsh Salinity Control Gate Structure are assumed to be tidally operating based on the operational time series outputs from CalSim 3.

When operating, gates open when upstream water level is 0.3 ft above downstream water level. Gates close when current is less than -0.1 fps. When not operating, gates are held open.

HEC-5Q

The following is a description of the assumptions listed in Appendix F Modeling Section 1-2 Callouts Tables.

Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CalSim 3 output.

Shasta Temperature Management

Shasta temperature control device (TCD) operated to "mixed" as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CalSim 3 output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output.

Alternative 2 v2 – Multi-Agency Consensus (Early Implementation Voluntary Agreements)

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 Callouts Tables.

Hydrology

Inflows/Supplies

Same as No Action Alternative.

Level of Development

Same as No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as No Action Alternative.

Facilities

Same as Alternative 1.

Fremont Weir

Same as No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity and Delta-Mendota Canal/California Aqueduct Intertie Capacity

Same as Alternative 1.

SWP Banks Pumping Plant Capacity

Same as No Action Alternative.

San Luis Reservoir

Same as Alternative 1.

CCWD Intakes

Same as No Action Alternative.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under Alternative 2 v2 are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as No Action Alternative

Coordinated Operations Agreement (COA)

Same as Alternative 2 v1.

CVPIA (b)(2) Assumptions

Same as No Action Alternative.

Continued CALFED Agreements

Same as No Action Alternative.

Temporary Urgency Change Petitions (TUCPs)

Not assumed in Alternative 2v2.

Water Transfers and Wheeling

Lower Yuba River Accord (LYRA)

Same as No Action Alternative.

Phase 8 Transfers

Same as No Action Alternative.

Short-term or Temporary Water Transfers

Same as No Action Alternative.

Cross Valley Canal Wheeling and Joint Point of Diversion

Same as No Action Alternative.

Contra Costa Wheeling through Freeport

Same as No Action Alternative.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

Minimum Flow below Lewiston Dam

Same as No Action Alternative.

Trinity Reservoir end-of-September Minimum Storage

Same as No Action Alternative.

Trinity Import

Same as No Action Alternative.

Clear Creek

Same as Alternative 2 v1.

Sacramento River

Shasta Lake End-of-September Minimum Storage

Same as Alternative 2 v1.

Minimum Flow Below Keswick Dam

Same as Alternative 2 v1.

Flow Objective at Wilkins Slough

Same as No Action Alternative.

Minimum Flow Near Rio Vista

Same as No Action Alternative.

Voluntary Agreements

None

Feather River

Minimum Flow Below Thermalito

Same as No Action Alternative.

Voluntary Agreements

None

American River

Folsom Dam Flood Control

Same as No Action Alternative.

Minimum Flow Below Nimbus Dam

Same as Alternative 2 v1.

Minimum Flow At H Street

Same as No Action Alternative

Voluntary Agreements

None

Stanislaus River

Minimum Flow Below Goodwin Dam

Same as Alternative 2 v1.

Minimum Dissolved Oxygen

Same as No Action Alternative.

Water Supply

Same as No Action Alternative.

San Joaquin River

San Joaquin River Restoration Program

Same as No Action Alternative.

Maximum Salinity Near Vernalis

Same as No Action Alternative.

Minimum Flow Near Vernalis

Same as No Action Alternative.

Voluntary Agreements

None

Sacramento-San Joaquin Delta

SWRCB D-1641

Same as No Action Alternative.

Delta Smelt Summer-Fall Habitat Action

Same as Alternative 2 v1.

Combined Old and Middle River Flows

Same as Alternative 2 v1.

South Delta Exports (Banks and Jones PP)

Same as No Action Alternative, but also includes CVP and SWP export cuts under the Delta VA during March-May (see Voluntary Agreement section below).

Spring Outflow Requirement

Same as Alternative 2 v1, with additional outflow provided by the Delta VA (see Voluntary Agreement section below).

Suisun Marsh Salinity Control Gates

Same as Alternative 2 v1.

Delta Cross Channel Gate Operation

Same as No Action Alternative.

X2

Same as No Action Alternative.

Voluntary Agreements

Delta VA implemented to provide additional outflow March-May through export cuts. Export cut amounts are defined according to the Sacramento Valley (40-30-30) Index Water Year type and resulting flows are protected as Delta outflow. Total export cuts include SOD PWA water purchase program amounts. Cut amounts are shown in the two tables below. The CVP makes export cuts and also cuts corresponding deliveries. The SWP cuts exports but no explicit delivery cuts are made in the model.

Table 14. CVP export cuts and corresponding delivery cuts

Sacramento Valley (40-30-30) Index WY type	Export cuts (taf)	General delivery cuts (taf) - distributed between all CVP SOD Ag contractors	PWA Purchase CVP SOD (taf) - distributed between all CVP SOD Ag contractors	PWA Purchase Add CVP SOD (taf), applied to Del Puerto only, minimum of amount below and Del Puerto Ag allocation	PWA Purchase WWD SOD (taf), applied to Westlands WD only, minimum of amount below and 31.185 * CVP SOD Ag allocation
W	27	0	0	0	27
AN	147	87.5	35	5	19.5
BN	107	62.5	24.5	5	15
D	86	62.5	12.5	5	6
C	3	0	0	0	3

Table 15. SWP export cuts

Sacramento Valley (40-30-30) Index WY type	Export cuts (taf)
W	0
AN	117.5
BN	92.5
D	92.5
C	0

The timing and volume of export cuts under the Delta VA are determined according to the following criteria:

- Water year types are determined using 90% exceedance forecast in March-April, and 50% exceedance forecast in May.
- All CVP export cuts begin March 10th and continue through May or until the annual requirement is fully met.
- SWP AN year export cuts begin March 22nd and continue through May or until the annual requirement is fully met.

- SWP BN/D year export cuts begin March 11th and continue through May or until annual requirement is fully met.
- No export cuts when in Balanced and IBU conditions
- SWP export cut maximum applied in March: 50 taf in AN/BN/D years
- No export cuts when in Balanced In-Basin Use (IBU) conditions
- Export cuts restricted to CVP or SWP volume of Unstored Water for Export (UWFE)
- Export cuts restricted to volume of exports above minimum H&S exports. This is 900 cfs (for CVP) and 600 cfs (for SWP)
- Export cuts restricted to volume in CVP or SWP San Luis above dead pool

Systemwide Operational Rules

CVP Water Allocation

Same as Alternative 2 v1.

SWP Water Allocation

Same as No Action Alternative.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

Same as No Action Alternative

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative.

Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from CalSim 3.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model; however, the fish barrier located at the Head of Old River is not included in the model.

Clifton Court Forebay Gates

Same as No Action Alternative.

Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31. Head of Old River Barrier would not be installed.

Suisun Marsh Salinity Control Gate

The radial gates in the Suisun Marsh Salinity Control Gate Structure are assumed to be tidally operating based on the operational time series outputs from CalSim 3.

When operating, gates open when upstream water level is 0.3 ft above downstream water level. Gates close when current is less than -0.1 fps. When not operating, gates are held open.

HEC-5Q

The following is a description of the assumptions listed in Appendix F Modeling Section 1-2 Callouts Tables.

Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CalSim 3 output.

Shasta Temperature Management

Shasta temperature control device (TCD) operated to "mixed" as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CalSim 3 output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output.

Alternative 2 v3 – Multi-Agency Consensus (All Voluntary Agreements)

CalSim 3

The following is description of the assumptions tabulated in Appendix F Section 1-2 Callouts Tables.

Hydrology

Inflows/Supplies

Same as No Action Alternative.

Level of Development

Same as No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as No Action Alternative.

Facilities

Same as Alternative 1.

Fremont Weir

Same as No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity and Delta-Mendota Canal/California Aqueduct Intertie Capacity

Same as Alternative 1.

SWP Banks Pumping Plant Capacity

Same as No Action Alternative.

San Luis Reservoir

Same as Alternative 1.

CCWD Intakes

Same as No Action Alternative.

Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under Alternative 2 v2 are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as No Action Alternative

Coordinated Operations Agreement (COA)

Same as Alternative 2 v1.

CVPIA (b)(2) Assumptions

Same as No Action Alternative.

Continued CALFED Agreements

Same as No Action Alternative.

Temporary Urgency Change Petitions (TUCPs)

Not assumed in Alternative 2 v3.

Water Transfers and Wheeling

Lower Yuba River Accord (LYRA)

Same as No Action Alternative.

Phase 8 Transfers

Same as No Action Alternative.

Short-term or Temporary Water Transfers

Same as No Action Alternative.

Cross Valley Canal Wheeling and Joint Point of Diversion

Same as No Action Alternative.

Contra Costa Wheeling through Freeport

Same as No Action Alternative.

Specific Regulatory Assumptions and Site-Specific Operations Criteria

Trinity River

Minimum Flow below Lewiston Dam

Same as No Action Alternative.

Trinity Reservoir end-of-September Minimum Storage

Same as No Action Alternative.

Trinity Import

Same as No Action Alternative.

Clear Creek

Same as Alternative 2 v1.

Sacramento River

Shasta Lake End-of-September Minimum Storage

Same as Alternative 2 v1.

Minimum Flow Below Keswick Dam

Same as Alternative 2 v1.

Flow Objective at Wilkins Slough

Same as No Action Alternative.

Minimum Flow Near Rio Vista

Same as No Action Alternative.

Voluntary Agreements

Sacramento VA implemented according to the following assumptions:

- Water for pulse flows is generated through 25,000 acres of land fallowing in the Sacramento Basin.
- Pulse flows are protected through the Delta.

- Pulse amounts are determined using 50% exceedance of forecasted Sacramento Valley (40-30-30) Index Water Year type in April.
 - In AN/BN years, 95 taf pulse release split between April and May.
 - In Dry years, water saved from land fallowing is stored in an account in Shasta, then released as a pulse in the following year split between April-May. Account storage is water savings that can be backed up into Shasta, reduced by the volume that spills. Spills of this VA water occur only after all Proposed Action account water has spilled. If the following year is an AN/BN year then the pulse is 95 taf + any Dry year carryover.
- Water savings from land fallowing occurs throughout irrigation season. Water is either released for the VA pulse directly (April-May in AN/BN years) or backed up into Shasta. In months where water cannot be backed up, water is exported at Jones if possible, or routed out the Delta.

Putah Creek VA is implemented providing additional flow of 6 taf in November-May in all but Sacramento Valley (40-30-30) Index Water Year type Wet years through reservoir reoperation. Not protected through Delta.

Feather River

Minimum Flow Below Thermalito

Same as No Action Alternative.

Voluntary Agreements

Feather VA implemented according to the following assumptions:

- Water for pulse flows is generated through 10,000 acres of land fallowing in the Feather River Basin.
- Pulse flows are protected through the Delta.
- Pulse amounts are determined using 50% exceedance of forecasted Sacramento Valley (40-30-30) Index Water Year type in April.
- Pulse releases of 60 taf in AN/BN/D years
- Pulse release split between April and May, but flow releases can continue later in year depending on timing of spills

Yuba VA implemented providing additional flow of 50 taf in April-June in Sacramento Valley (40-30-30) Index Water Year type AN/BN/D years, provided through reservoir reoperation and protected through Delta. Timeseries of flows provided by Yuba Water Agency.

American River

Folsom Dam Flood Control

Same as No Action Alternative.

Minimum Flow Below Nimbus Dam

Same as Alternative 2 v1.

Minimum Flow At H Street

Same as No Action Alternative

Voluntary Agreements

American VA implemented according to the following assumptions:

- Pulse flows provided in March-May in all but Sacramento Valley (40-30-30) Index Water Year type Wet years.
- Pulse flows are protected through the Delta.
- Pulse volumes are as follows:
 - 10 taf in AN/BN years provided through reservoir operation (7 taf from Hell Hole Reservoir and 3 taf from Caples Reservoir)
 - 30 taf in Dry and Critical years provided through groundwater substitution by Carmichael Water District, City of Roseville, City of Sacramento, Golden State Water Company, and Sacramento County Groundwater Agency
 - 10 taf in Dry years provided through reservoir reoperation (5 taf from Hell Hole Reservoir) and groundwater substitution (5 taf from same agencies as above)

Stanislaus River**Minimum Flow Below Goodwin Dam**

Same as Alternative 2 v1.

Minimum Dissolved Oxygen

Same as No Action Alternative.

Water Supply

Same as No Action Alternative.

San Joaquin River**San Joaquin River Restoration Program**

Same as No Action Alternative.

Maximum Salinity Near Vernalis

Same as No Action Alternative.

Minimum Flow Near Vernalis

Same as No Action Alternative.

Voluntary Agreements

Friant VA implemented according to the following assumptions:

- 50 taf flow contribution in San Joaquin River Restoration Program Dry, Normal-Dry, and Normal-Wet years during February-May
- Flows are protected through the Delta
- Friant flood releases and restoration flows can contribute to meeting the VA.
- If necessary, recapture is reduced so that restoration flows can go to outflow. Delta recapture is foregone first, and Lower San Joaquin River recapture second (only if needed)
- Restoration flows can be recaptured whether or not Friant is spilling, and hence foregone under the same conditions
- Recapture can be foregone up to a maximum of 50% during the period of February through May. If 50% is not sufficient to meet the 50 taf flow goal, then no more contribution is required.

Sacramento-San Joaquin Delta

SWRCB D-1641

Same as No Action Alternative.

Delta Smelt Summer-Fall Habitat Action

Same as Alternative 2 v1.

Combined Old and Middle River Flows

Same as Alternative 2 v1.

South Delta Exports (Banks and Jones PP)

Same as Alternative 2 v2.

Spring Outflow Requirement

Same as Alternative 2 v1, with additional flows provide by the Delta VA, Sacramento VA, Feather VA, American VA, Mokelumne VA, Yuba VA, Friant VA, and Putah Creek VA.

Suisun Marsh Salinity Control Gates

Same as Alternative 2 v1.

Delta Cross Channel Gate Operation

Same as No Action Alternative.

X2

Same as No Action Alternative.

Voluntary Agreements

Delta VA implemented as in Alternative 2 v2

Mokelumne VA implemented to provide additional flow of 45 taf in AN years, 20 taf in BN years, 10 taf in D years, based on Mokelumne JSA Water Year type. 79% of water released in March-May and 21% in October. Water provided through reservoir reoperation. Not protected through Delta.

Systemwide Operational Rules

CVP Water Allocation

Same as Alternative 2 v1.

SWP Water Allocation

Same as No Action Alternative.

DSM2

The following is a description of the assumptions tabulated in Appendix F: Modeling Section 1-2 Callouts Tables.

River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim 3.

Tidal Boundary

Same as No Action Alternative

Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich, 2001), as modified to account for the salinity changes related to the sea level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea level rise at Year 2030.

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim 3.

Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative.

Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from CalSim 3.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model; however, the fish barrier located at the Head of Old River is not included in the model.

Clifton Court Forebay Gates

Same as No Action Alternative.

Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31. Head of Old River Barrier would not be installed.

Suisun Marsh Salinity Control Gate

The radial gates in the Suisun Marsh Salinity Control Gate Structure are assumed to be tidally operating based on the operational time series outputs from CalSim 3.

When operating, gates open when upstream water level is 0.3 ft above downstream water level. Gates close when current is less than -0.1 fps. When not operating, gates are held open.

HEC-5Q

The following is a description of the assumptions listed in Appendix F Modeling Section 1-2 Callouts Tables.

Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CalSim 3 output.

Shasta Temperature Management

Shasta temperature control device (TCD) operated to "mixed" as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CalSim 3 output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D modeled as described in Appendix F: Modeling Attachment 1-3, Model Updates.

Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CalSim 3 output.

References

- Ateljevich, E. 2001. *Chapter 10: Planning tide at the Martinez boundary. Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 22nd Annual Progress Report to the State Water Resources Control Board.*
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