Appendix 5A, Section B

CalSim II and DSM2 Modeling Simulations and Assumptions

This section summarizes the modeling simulations and assumptions for the No Action Alternative, Second Basis of Comparison, and other alternatives in this Environmental Impact Statement (EIS). Appendix 5A, Section B, is organized as follows:

- Introduction
- Assumptions for the No Action Alternative and Second Basis of Comparison Model Simulations
  - No Action Alternative
  - Second Basis of Comparison
- Assumptions for Alternatives Model Simulations
  - Alternative 3
  - Alternative 5
  - Summary of Alternatives Assumptions
- Timeframe of Evaluation
- No Action Alternative and Second Basis of Comparison Assumptions Tables
  - CalSim II Assumptions
  - (DSM2 Assumptions
- American River Demands
- Delivery Specifications
- U.S. Fish and Wildlife Service (USFWS) Reasonable and Prudent Alternative (RPA) Implementation
- National Marine Fisheries Service (NMFS) RPA Implementation
- References

5A.1 Introduction

As described in Appendix 5A, Section A, modeling was prepared for evaluation of the alternatives considered in this EIS. This section describes the assumptions for the CalSim II and DSM2 modeling of the No Action Alternative, Second Basis of Comparison, and other alternatives.

The following model simulations were prepared as the basis for evaluating the impacts of the other alternatives at 2030 projected conditions:

- No Action Alternative

- Second Basis of Comparison

The following model simulations of alternatives were prepared:

- Alternative 1 – Same as the Second Basis of Comparison
- Alternative 2 – Only operational components of the No Action Alternative (same modeling assumptions as the No Action Alternative)
- Alternative 3 –Discussed further in this section
- Alternative 4 – Similar to Second Basis of Comparison with actions to improve aquatic resource conditions (same modeling assumptions as the Second Basis of Comparison)
- Alternative 5 – Discussed further in this section

The No Action Alternative and Second Basis of Comparison assumptions were developed by the Bureau of Reclamation (Reclamation). Alternative 2 assumptions were defined in the Notice of Intent. Assumptions for Alternatives 3, 4, and 5 were developed in consideration of comments received during the scoping process.

The No Action Alternative and Second Basis of Comparison models were developed by Reclamation. Other alternatives were simulated using these two CalSim II simulations and implementing changes in assumptions from either the No Action Alternative or the Second Basis of Comparison.

Alternative 1 and Alternative 4 modeling assumptions are the same as the Second Basis of Comparison, and Alternative 2 modeling assumptions are the same as the No Action Alternative; therefore, the assumptions for those alternatives will not be discussed separately in this document.

CalSim II and DSM2 model representation of the RPAs in the 2008 USFWS and 2009 NMFS Biological Opinions (BOs) is consistent with the model representation developed in 2009 through a coordinated process with the Federal and state agencies.

5A.2 Assumptions for the No Action Alternative and the Second Basis of Comparison Model Simulations

This section presents the assumptions used in developing the CalSim II and DSM2 model simulations of the No Action Alternative and the Second Basis of Comparison for use in the EIS evaluation.

The assumptions were selected to satisfy National Environmental Policy Act requirements. The basis for these assumptions is described in Chapter 3, Description of Alternatives. Assumptions that were applied to the CalSim II and DSM2 modeling are included in the following section.

The No Action Alternative assumptions represent the continuation of existing policy and management direction at Year 2030 and include implementation of water operations components of the RPA actions specified in the 2008 USFWS BO and 2009 NMFS BO.

The Second Basis of Comparison was developed due to the identified need during scoping comments for a basis of comparison that would occur without the RPAs. The Second Basis of Comparison assumptions do not include most of the RPAs. They do, however, include actions that are constructed (e.g., Red Bluff Pumping Plant), implemented (e.g., Suisun Marsh Habitat Management, Preservation, and Restoration Plan), or legislatively mandated (e.g., San Joaquin River Restoration Plan), and those that have undergone a substantial degree of progress (e.g., Yolo Bypass Salmonid Habitat Restoration and Fish Passage).

The detailed assumptions used in developing CalSim II and DSM2 simulations of the No Action Alternative and Second Basis of Comparison are included in Section 5A.B.5. Additional information is provided in the table footnotes of each table. Table entries and footnotes make reference to supporting appendix sections and other documents.

5A.2.1 No Action Alternative

The No Action Alternative was developed assuming projected Year 2030 conditions. The No Action Alternative assumptions include existing facilities and ongoing programs that existed as of March 28, 2012, publication date of the Notice of Intent. The No Action Alternative assumptions also include facilities and programs that received approvals and permits by March 2012 because those programs were consistent with the existing management direction of the Notice of Intent. The No Action Alternative models do 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 the Year 2030. Climate change results in the changes in the reservoir and tributary inflows included in CalSim II. The sea-level rise changes result in modified flow salinity relationships in the Delta. The climate change and sea-level rise assumptions at Year 2030 are described in detail in Section 5A.B.4. The CalSim II simulation for the No Action Alternative does not consider any adaptation measures that would result in managing the Central Valley Project (CVP) and State Water Project (SWP) system in a different manner than it is managed 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 the EIS.

5A.2.1.1 CalSim II Assumptions for the No Action Alternative Hydrology

Inflows/Supplies

The CalSim II model includes the historical hydrology projected to Year 2030 under the climate change and with projected 2020 modifications for operations upstream of the rim reservoirs.

Level of Development

CalSim II uses a hydrology that is the result of an analysis of agricultural and urban land use and population estimates. The assumptions used for Sacramento Valley land use result from aggregation of historical survey and projected data developed for the California Water Plan Update (Bulletin 160-98). Generally, land-use projections are based on Year 2020 estimates (hydrology serial number 2020D09E); however, the San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation. Where appropriate, Year 2020 projections of demands associated with water rights and CVP and SWP water service contracts have been included. Specifically, projections of full buildout are used to describe the American River region demands for water rights and CVP contract supplies, and California Aqueduct and the Delta Mendota Canal CVP and SWP contractor demands are set to full contract amounts.

Demands, Water Rights, and CVP and SWP Contracts

CalSim II demand inputs are preprocessed monthly time series for a specified level of development (e.g., 2020) and according to hydrologic conditions. Demands 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. A description of various demands and classifications included in CalSim II is provided in the 2008 Operations Criteria and Plan (OCAP) Biological Assessment (BA) Appendix D (Reclamation 2008a).

Table 5A.B.1 below includes the summary of the CVP and SWP project demands in thousand acre feet (TAF) included under the No Action Alternative. A detailed description of American River demands assumed under the No Action Alternative is provided in Section 5A.B.7. For SWP entitlement contractors, full Table A demands are assumed every year. The demand assumptions are not modified for changes in climate conditions.

The detailed listing of CVP and SWP contract amounts and other water rights assumptions for the No Action Alternative are included in the delivery specification tables in Section 5A.B.9.

Table 5A.B.1 Summary of CVP and SWP Demands (TAF/Year) under No Action Alternative

Project Contractor Type	North-of-the-Delta	South-of-the-Delta
CVP Contractors		
Settlement/Exchange	2,194	840
Water Service Contracts	935	2,101
Agriculture	378	1,937
M&I	557	164
Refuges	189	281
SWP Contractors		
Feather River Service Area	983	–
Table A	114	4,055
Agriculture	0	1,017
M&I	114	3,038

Notes:
Urban demands noted above are for full buildout conditions.
M&I = municipal and industrial

5A.2.1.1.1 Facilities

CalSim II 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 Section 5A.B.5.

CalSim II also represents the flood control weirs such as the Fremont Weir located along the Sacramento River at the upstream end of the Yolo Bypass. Rating curves for the existing weir are used to model the spills over the Fremont Weir. In addition, the No Action Alternative CalSim II model assumes an operable weir notch for the Fremont Weir as modeled in Alternative 4 in the Bay Delta Conservation Plan (BDCP) Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (DWR, Reclamation, USFWS, and NMFS 2013).

The No Action Alternative also includes the Freeport Regional Water Project, located along the Sacramento River near Freeport and the City of Stockton Delta Water Supply Project (30 million gallon/day [mgd] capacity).

A brief description of the key export facilities that are located in the Delta and included under the No Action Alternative run 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. The 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 the EIS. It is assumed that an opening in the existing weir and operable gates are constructed at elevation 17.5 feet along with a smaller opening and operable gates at elevation 11.5 feet. Derivation of the rating curve for the elevation 17.5-feet opening used in the CalSim II model is described in Section 5A.B.4 of this appendix. The modeling approach used in CalSim II model to estimate the Fremont Weir spills using the daily patterned Sacramento River flow at Verona is provided in Section 5A.3.3

CVP C.W. Bill Jones Pumping Plant (Tracy Pumping Plant) Capacity

The Jones Pumping Plant consists of six pumps, including one rated at 800 cubic feet/second (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 10,668 cfs (two units of 375 cfs, five units of 1,130 cfs, and four units of 1,067 cfs). The SWP water rights for diversions specify a maximum of 10,350 cfs, but the U.S. Army Corps of Engineers (USACE) 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 8,500 cfs from December 15 to March 15. Additional capacity of 500 cfs (pumping limit up to 7,180 cfs) is allowed to reduce impact of NMFS BO Action 4.2.1 on the SWP.

Contra Costa Water District (CCWD) Intakes

The Contra Costa Canal originates at Rock Slough (about 4 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 CCWD's 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.

5A.2.1.1.2 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.

Decision 1641 (D-1641) Operations

The State Water Resources Control Board (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 CVP and 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 Decision 1641 (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 San Joaquin flow standards.

Coordinated Operation Agreement (COA)

The CVP and SWP use a common water supply in the Central Valley of California. Reclamation and California Department of Water Resources (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 Operation 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.

Central Valley Project Improvement Act (CVPIA) (b)(2) Assumptions

The previous 2008 OCAP BA modeling included a dynamic representation of Central Valley Project Improvement Act (CVPIA) 3406(b)(2) water allocation, management, and related actions (B2). The selection of discretionary actions for use of B2 water in each year was based on a May 2003 U.S. Department of the Interior (the Department) policy decision. The use of B2 water is assumed to continue in conjunction with the USFWS and NMFS BO RPA actions. The CalSim II implementation used for modeling for the EIS does not dynamically account for the use of (b)(2) water, but rather assumes predetermined USFWS BO upstream fish objectives for Clear Creek, Sacramento River below Keswick Dam, and American River below Nimbus Dam, and a pulse period exports limit. Other (b)(2) actions are assumed to be accommodated by USFWS and NMFS BO RPA actions for the American River, Stanislaus River, and Delta export restrictions.

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 II implementation.

One element of the EWA available assets is the Lower Yuba River Accord (LYRA) Component 1 water. In the absence of the EWA and implementation in CalSim II, the LYRA Component 1 water is assumed to be transferred to south-of-Delta SWP contractors to help mitigate the impact of the NMFS BO on SWP exports during April and May. An additional 500 cfs of capacity is permitted at Banks Pumping Plant from July through September to export this transferred water.

USFWS BO Actions

The USFWS BO was released on December 15, 2008, in response to Reclamation's request for formal consultation with the USFWS on the coordinated operations of the CVP and SWP in California. To develop CalSim II modeling assumptions for the RPA documented in this BO, DWR led a series of meetings that involved members of fisheries and project agencies. This group has prepared the assumptions and CalSim II implementations to represent the RPA in the No Action Alternative CalSim II simulation. The following actions of the USFWS BO RPA have been included in the No Action Alternative CalSim II simulations:

- Action 1: Adult Delta Smelt migration and entrainment (RPA Component 1, Action 1 – First Flush)
- Action 2: Adult Delta Smelt migration and entrainment (RPA Component 1, Action 2)
- Action 3: Entrainment protection of larval and juvenile Delta Smelt (RPA Component 2)
- Action 4: Estuarine habitat during Fall (RPA Component 3)
- Action 5: Temporary spring Head of Old River barrier (HORB) and the Temporary Barrier Project (RPA Component 2)

A detailed description of the assumptions that have been used to model each action is included in the technical memorandum "Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies," prepared by an interagency working group under the direction of the lead agencies. Reference information for this technical memorandum is included in Section 5A.B.10.

NMFS BO Salmon Actions

The NMFS Salmon BO on long-term operations of the CVP and SWP was released on June 4, 2009. To develop CalSim II modeling assumptions for the RPAs documented in this BO, DWR led a series of meetings that involved members of fisheries and project agencies. This group has prepared the assumptions and CalSim II implementations to represent the RPA in the No Action Alternative CalSim II simulations for future planning studies. The following NMFS BO RPAs have been included in the No Action Alternative CalSim II simulations:

- Action I.1.1: Clear Creek spring attraction flows
- Action I.4: Wilkins Slough operations
- Action II.1: Lower American River flow management
- Action III.1.4: Stanislaus River flows below Goodwin Dam
- Action IV.1.2: Delta Cross Channel gate operations
- Action IV.2.1: San Joaquin River flow requirements at Vernalis and Delta export restrictions
- Action IV.2.3: Old and Middle River flow management

For Action I.2.1, which calls for a percentage of years that meet certain specified end-of-September and end-of-April storage and temperature criteria resulting from the operation of Lake Shasta, no specific CalSim II modeling code is implemented to simulate the performance measures identified.

A detailed description of the assumptions that have been used to model each action is included in the technical memorandum "Representation of National Marine Fisheries Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies," prepared by an interagency working group under the direction of the lead agencies. This technical memorandum is included in the Section 5A.B.9.

Water Transfers

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 Pumping Plant from July to September are assumed to be used to reduce as much of the impact of the April to 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 Pumping Plant are not included in the No Action Alternative simulation.

5A.2.1.1.3 Specific Regulatory Assumptions

Lower American Flow Management

The American River Flow Management Standard (ARFMS) is included in the No Action Alternative, the Second Basis of Comparison, and all other alternatives in the EIS (Reclamation 2006).

Delta Outflow (Flow and Salinity)

SWRCB D-1641:

All flow-based Delta outflow requirements per SWRCB D-1641 are included in the No Action Alternative simulation. Similarly, for the February through June period, the X2 standard is included in the No Action Alternative simulation.

USFWS BO (December 2008) Action 4:

USFWS BO Action 4 requires additional Delta outflow to manage X2 in the fall months following Wet and Above Normal years to maintain an average X2 for September and October no greater (more eastward) than 74 kilometers following Wet years and 81 kilometers following Above Normal years. In November, the inflow to CVP and SWP reservoirs in the Sacramento Basin should be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall X2 target. This action is included in the No Action Alternative.

Combined Old and Middle River Flows

USFWS BO restricts south Delta pumping to preserve certain Old and Middle River (OMR) flows in three of its Actions: Action 1 to protect pre-spawning adult Delta Smelt from entrainment during the first flush, Action 2 to protect pre-spawning adults from entrainment and from adverse hydrodynamic conditions, and Action 3 to protect larval Delta Smelt from entrainment. CalSim II simulates these actions to a limited extent.

A brief description of USFWS BO Actions 1 through 3 implementations in CalSim II is as follows: Action 1 is onset based on a turbidity trigger that takes place during or after December. This action requires limit on exports so that the average daily OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent of the monthly criteria). Action 1 ends after 14 days of duration or when Action 3 is triggered based on a temperature criterion. Action 2 starts immediately after Action 1 and requires a range of net daily OMR flows to be no more negative than -1,250 to -5,000 cfs (with a 5-day running average within 25 percent of the monthly criteria). Action 2 continues until Action 3 is triggered. Action 3 also requires net daily OMR flow to be no more negative than -1,250 to -5,000 cfs based on a 14-day running average (with a simultaneous 5-day running average within 25 percent). Although the range is similar to Action 2, the Action implementation is different. Action 3 continues until June 30, or when water temperature reaches a certain threshold. A more detailed description of the implementation of these actions is provided in Section 5A.B.8.

NMFS BO Action 4.2.3 requires OMR flow management to protect emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers from entrainment into south Delta channels and at the export facilities in the south Delta. This action requires reducing exports from January 1 through June 15 to limit negative OMR flows to -2,500 to -5,000 cfs. CalSim II assumes OMR flows required in NMFS BO are covered by OMR flow requirements developed for Actions 1 through 3 of the USFWS BO as described in Section 5A.B.8.

South Delta Export-San Joaquin River Inflow Ratio

NMFS BO Action 4.2.1 requires exports to be capped at a certain fraction of San Joaquin River flow at Vernalis during April and May while maintaining a health and safety pumping of 1,500 cfs.

Exports at the South Delta Intakes

Exports at Jones and Banks Pumping Plant are restricted to their permitted capacities per SWRCB D-1641 requirements. In addition, the south Delta exports are subject to Vernalis flow-based export limits during April and May as required by Action 4.2.1. An additional 500 cfs pumping is allowed to reduce the impact of NMFS BO Action 4.2.1 on SWP during the July through September period.

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 35 percent during the months of March through June. For the rest of the months, 65 percent of the Delta inflow is allowed to be exported.

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

Delta Water Quality

The No Action Alternative simulation includes SWRCB D-1641 salinity requirements. However, not all salinity requirements are included as CalSim II 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) is used to predict and interpret salinity conditions at the Emmaton, Jersey Point, Rock Slough, and Collinsville 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 electrical conductivity (EC) requirement at Emmaton varies from 0.45 millimhos per centimeter (mmhos/cm) to 2.78 mmhos/cm, depending on the 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 municipal and industrial (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 milligrams per liter. The number of days requirement is dependent upon the water year type. The Collinsville standard is applied during October through May months to protect water quality conditions for migrating

fish species, and it varies between 12.5 mmhos/cm in May and 19.0 mmhos/cm in October.

The sea-level rise change assumed at the Year 2030 results in a modified flow-salinity relationship in the Delta. An ANN, which is capable of emulating DSM2 results under the 15-cm sea-level rise condition at the Year 2030 is used to simulate the flow-salinity relationship in CalSim II simulation for the No Action Alternative.

San Joaquin River Restoration Program

Friant Dam releases required by the San Joaquin River Restoration Program are included in the No Action Alternative, the Second Basis of Comparison, and all other alternatives. A more detailed description of the San Joaquin River Restoration Program is presented in Appendix 3A, "No Action Alternative: Central Valley Project and State Water Project Operations".

5A.2.1.1.4 Operations Criteria

Fremont Weir Operations

To provide seasonal floodplain inundation in the Yolo Bypass, the 17.5- and the 11.5-foot elevation gates are opened between December 1 and March 31. This may extend to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts in the bypass. As a simplification for modeling, the gates are assumed opened until April 30 in all years. The gates are operated to limit maximum spill to 6,000 cfs until the Sacramento River stage reaches the existing Fremont Weir crest elevation. When the river stage is at or above the existing Fremont Weir crest elevation, the notch gates are assumed to be closed. While desired inundation period is on the order of 30 to 45 days, gates are not managed to limit to this range; instead, the duration of the event is governed by the Sacramento River flow conditions. To provide greater opportunity for the fish in the bypass to migrate upstream into the Sacramento River, the 11.5-foot elevation gate is assumed to be open for an extended period between September 15 and June 30. As a simplification for modeling, the period of operation for this gate is assumed to be September 1 to June 30. The spills through the 11.5-foot elevation gate are limited to 100 cfs.

Delta Cross Channel Gate Operations

SWRCB D-1641 Delta Cross Channel (DCC) standards provide for closure of the DCC gates for fisheries protection at certain times of the year. From November through January, the DCC may be closed for up to 45 days. From February 1 through May 20, the gates are closed every day. The gates may also be closed for 14 days during the May 21 through June 15 time period. Reclamation determines the timing and duration of the closures after discussion with USFWS, California Department of Fish and Wildlife (DFW), and NMFS.

NMFS BO Action 4.1.2 requires gates to be operated as described in the BO based on the presence of salmonids and water quality from October 1 through December 14; gates should be closed from December 15 to January 31, except short-term operations to maintain water quality. CalSim II includes the NMFS

BO DCC gate operations in addition to the D-1641 gate operations. When the daily flows in the Sacramento River at Wilkins Slough exceed 7,500 cfs (flow assumed to flush salmon into the Delta), DCC is closed for a certain number of days in a month as described in Section B-11. From October 1 to December 14, if the flow trigger condition is such that additional days of DCC gates closure is called for, however water quality conditions are a concern and the DCC gates remain open, then Delta exports are limited to 2,000 cfs for each day in question.

Allocation Decisions

CalSim II includes allocation logic for determining deliveries to north-of-Delta and south-of-Delta CVP and 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 and March 1 through May 1 for the CVP as runoff forecasts become more certain. The south-of-Delta SWP delivery is determined based on water supply parameters and operational constraints. The CVP system wide delivery and south-of-Delta delivery are determined similarly upon water supply parameters and operational constraints with specific consideration for export constraints.

San Luis Operations

CalSim II sets targets for San Luis storage each month that are dependent on the current South-of-Delta allocation and upstream reservoir storage. When upstream reservoir storage is high, allocations and San Luis fill targets are increased. During a prolonged drought when upstream storage is low, allocations and fill targets are correspondingly low. For the No Action Alternative simulation, the San Luis rule curve is managed to minimize situations in which shortages may occur due to lack of storage or exports.

New Melones Operations

In addition to flood control, New Melones is operated for four different purposes: fishery flows, water quality, Bay-Delta flow, and water supply.

Fishery

In the No Action Alternative simulation, fishery flows refer to flow requirements of the 2009 NMFS BO Action III.1.3. 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 98.9 TAF to 589.5 TAF annually depending on the hydrological conditions based on the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.2 through 5A.B.4).

Table 5A.B.2 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Flows (TAF)
0 to 1,399.9	185.3
1,400 to 1,999.9	234.1
2,000 to 2,499.9	346.7
2,500 to 2,999.9	483.7
≥ 3,000	589.5

Table 5A.B.3 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-15	May 16–31	June	July	Aug.	Sept.
98.9	110	200	200	125	125	125	250	250	0	0	0	0
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
589.5	841.9	300	300	358.1	364.3	1,648.4	2,442.9	1,725	1,100	429	400	400

Table 5A.B.4 April 15 through May 15 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Fishery Pulse Flows (CFS)	
	April 15-30	May 1-15
185.3	687.5	666.7
234.1	1,000.0	1,000.0
346.7	1,625.0	1,466.7
483.7	1,212.5	1,933.3
589.5	925.0	2,206.7

Water Quality

Water quality releases include releases to meet the SWRCB D-1641 salinity objectives at Vernalis and the Decision 1422 (D-1422) dissolved oxygen objectives at Ripon.

The Vernalis water quality requirement (SWRCB D-1641) is an EC requirement of 700 and 1000 mmhos/cm for the irrigation (April through August) and non-irrigation (September through March) seasons, respectively.

Additional releases are made to the Stanislaus River below Goodwin Dam if necessary, to meet the D-1422 dissolved oxygen content objective. Surrogate flows representing releases for dissolved oxygen requirement in CalSim II are presented in Table 5A.B.5. The surrogate flows are reduced for critical years where New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) is less than 940 TAF. These flows are met through releases from New Melones without any annual volumetric limit.

Table 5A.B.5 Surrogate Flows for D1422 DO Requirement at Vernalis (TAF)

	Non-Critical Years	Critical Years
January	0.0	0.0
February	0.0	0.0
March	0.0	0.0
April	0.0	0.0
May	0.0	0.0
June	15.2	11.9
July	16.3	12.3
August	17.4	12.3
September	14.8	11.9
October	0.0	0.0
November	0.0	0.0
December	0.0	0.0

Bay-Delta Flows

Bay-Delta flow requirements are defined by D-1641 flow requirements at Vernalis (not including pulse flows during the April 15 through May 16 period). These flows are met through releases from New Melones without any annual volumetric limit.

D-1641 requires the flow at Vernalis to be maintained during the February through June period. The flow requirement is based on the required location of X2 and the San Joaquin Valley water year hydrologic classification (60-20-20 Index), as summarized in Table 5A.B.6.

Table 5A.B.6 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Flow Required if X2 is West of Chipps Island	Flow required if X2 is East of Chipps Island
Wet	3,420	2,130
Above Normal	3,420	2,130
Below Normal	2,280	1,420
Dry	2,280	1,420
Critical	1,140	710

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 II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.7) and are distributed throughout 1 year using monthly patterns.

Table 5A.B.7 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	0
1,400 to 1,800	49
>1,800	155

5A.2.1.2 DSM2 Assumptions for No Action Alternative

5A.2.1.2.1 River Flows

For the No Action Alternative DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim II.

5A.2.1.2.2 Tidal Boundary

For the No Action Alternative, the tidal boundary condition at Martinez is based on an adjusted astronomical tide normalized for sea-level rise (Ateljevich and Yu 2007) and is modified to account for the sea-level rise using the correlations derived based on three-dimensional (UnTRIM) modeling of the Bay-Delta with sea-level rise at Year 2030.

5A.2.1.2.3 Water Quality

Martinez EC

For the No Action Alternative, 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 II 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 No Action Alternative DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim II.

5A.2.1.2.4 Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative simulation. The DSM2 model and grid developed as part of the 2009 recalibration effort (CH2M HILL 2009) was used for the No Action Alternative modeling.

5A.2.1.2.5 Facilities

Delta Cross Channel

DCC 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 II.

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. The fish barrier located at the Head of Old River is also 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 2008b).

5A.2.1.2.6 Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. Head of Old River Barrier is assumed to be only installed from September 16 to November 30 and is not installed in the spring months, based on the USFWS BO Action 5. 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.

Montezuma Salinity Control Gate

The radial gates in the Montezuma Slough Salinity Control Gate Structure are assumed to be tidally operating from October through February each year to minimize propagation of high salinity conditions into the interior Delta.

5A.2.2 Second Basis of Comparison

The Second Basis of Comparison was developed assuming projected Year 2030 conditions. The Second Basis of Comparison assumptions include CVP and SWP operations prior to the RPAs, except for the ones that are constructed (e.g., Red Bluff Pumping Plant), implemented, legislatively mandated (e.g., San Joaquin River Restoration Plan), or that have undergone a substantial degree of progress (e.g., Yolo Bypass Salmonid Habitat and Fish Passage). Similar to the No Action Alternative, the Second Basis of Comparison models do not include any potential future habitat restoration areas due to the uncertainty of system effects depending on potential locations of such areas within the Delta.

The Second Basis of Comparison includes projected climate change and sea-level rise assumptions corresponding to the Year 2030. Change in climate results in the changes in the reservoir and tributary inflows are included in CalSim II. The sea-level rise changes result in modified flow-salinity relationships in the Delta. The climate change and sea-level rise assumptions at Year 2030 are described in detail in Section 5A.B.2. CalSim II simulation of the Second Basis of Comparison 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 the EIS.

5A.2.2.1 CalSim II Assumptions for Second Basis of Comparison

5A.2.2.1.1 Hydrology

Inflows/Supplies

Consistent with the No Action Alternative simulation.

Level of Development

Consistent with the No Action Alternative simulation.

Demands, Water Rights, CVP and SWP Contracts

Consistent with the No Action Alternative simulation.

5A.2.2.1.2 Facilities

Facilities assumptions under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

Fremont Weir

Consistent with the No Action Alternative simulation.

CVP C.W. Bill Jones Pumping Plant (Tracy Pumping Plant) Capacity

Consistent with the No Action Alternative simulation.

SWP Banks Pumping Plant (Banks Pumping Plant) Capacity

Consistent with the No Action Alternative simulation.

CCWD Intakes

Consistent with the No Action Alternative simulation.

5A.2.2.1.3 Regulatory Standards

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

D-1641 Operations

D-1641 Operations simulated under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

Significant elements of D-1641 include X2 standards, E/I) ratios, Delta water quality standards, real-time Delta Cross Channel operation, and San Joaquin flow standards.

Coordinated Operation Agreement (COA)

Consistent with the No Action Alternative simulation.

CVPIA (b)(2) Assumptions

Consistent with the No Action Alternative simulation.

Continued CALFED Agreements

Consistent with the No Action Alternative simulation.

USFWS BO Actions

The 2008 USFWS BO RPAs are not implemented under the Second Basis of Comparison.

NMFS BO Actions

The 2009 NMFS BO RPAs are not implemented under the Second Basis of Comparison.

Water Transfers

Water transfers assumptions simulated under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

5A.2.2.1.4 Specific Regulatory Assumptions

Lower American Flow Management

Consistent with the No Action Alternative simulation.

Delta Outflow (Flow and Salinity)

SWRCB D-1641

Consistent with the No Action Alternative simulation.

USFWS BO (December 2008) Action 4

USFWS BO Action 4 is not included under the Second Basis of Comparison.

Combined Old and Middle River Flows

No requirement for minimum combined Old and Middle River flows is included in the Second Basis of Comparison.

South Delta Export-San Joaquin River Inflow Ratio

NMFS BO Action 4.2.1 requires exports to be capped at a certain fraction of San Joaquin River flow at Vernalis during April and May while maintaining a health and safety pumping of 1,500 cfs.

Exports at the South Delta Intakes

The Second Basis of Comparison, similar to the No Action Alternative, includes export restrictions at Jones and Banks Pumping Plant 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 percent 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.

Further limitations on south Delta exports due to NMFS BO Action 4.2.1 are not included under the Second Basis of Comparison.

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

Delta Water Quality

Consistent with the No Action Alternative simulation.

The sea-level rise change assumed at the Year 2030 results in a modified flow-salinity relationship in the Delta. An ANN, which is capable of emulating the DSM2 model results under the 15-cm sea-level rise condition at the Year 2030, is used to simulate the flow-salinity relationship in CalSim II simulation for the Second Basis of Comparison.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.2.2.1.5 Operations Criteria

Fremont Weir Operations

Consistent with the No Action Alternative simulation.

Delta Cross Channel Gate Operations

SWRCB D-1641 DCC standards provide for closure of the DCC gates for fisheries protection at certain times of the year. From November through January, the DCC may be closed for up to 45 days. From February 1 through May 20, the gates are closed. The gates may also be closed for 14 days during the May 21 through June 15 time period. Reclamation determines the timing and duration of the closures after discussion with USFWS, California Department of Fish and Wildlife (DFW), and NMFS.

The NMFS BO Action 4.1.2 that specifies DCC operations is not included in the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for allocation decisions under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis operations under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

New Melones Operations

In addition to flood control, New Melones is operated for four different purposes: fishery flows, water quality, Bay-Delta flow, and water supply.

Fishery

Because the Second Basis of Comparison represents regulatory environment prior to the 2008 USFWS and 2009 NMFS BOs, fishery flows in this simulation refer to flow requirements of the 1997 New Melones Interim Plan of Operations (IPO). These flows include an outmigration pulse flow in April and May. Total annual volume dedicated to fishery flows vary from 0 to 467 TAF depending on the hydrologic conditions defined by the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.8 through 5A.B.10).

Table 5A.B.8 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Flows (TAF)
0	0
1,400	98
2,000	125
2,500	345
3,000	467
6,000	467

Table 5A.B.9 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-15	May 16–31	June	July	Aug.	Sept.
98.4	110	200	200	125	125	125	250	250	0	0	0	0
243.3	200	250	250	250	250	250	300	300	200	200	200	200
253.8	250	275	275	275	275	275	300	300	200	200	200	200
310.3	250	300	300	300	300	300	900	900	250	250	250	250
410.2	350	350	350	350	350	350	1,500	1,500	800	300	300	300
466.8	350	400	400	400	400	400	1,500	1,500	1,500	300	300	300

Table 5A.B.10 April 15 through May 15 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Fishery Pulse Flows (CFS) April 15 – May 15
0	0
98	500
125	1,500
345	1,500
467	1,500
467	1,500

Water Quality

Consistent with the No Action Alternative simulation.

Bay-Delta Flows

Consistent with the No Action Alternative simulation.

Water Supply

Consistent with the No Action Alternative simulation.

Water Supply-CVP Eastside Contractors

Consistent with the No Action Alternative simulation.

5A.2.2.2 DSM2 Assumptions for Second Basis of Comparison

5A.2.2.2.1 River Flows

Consistent with the No Action Alternative simulation.

5A.2.2.2.2 Tidal Boundary

Consistent with the No Action Alternative simulation.

5A.2.2.2.3 Water Quality

Martinez EC

Consistent with the No Action Alternative simulation.

Vernalis EC

Consistent with the No Action Alternative simulation.

5A.2.2.2.4 Morphological Changes

Consistent with the No Action Alternative simulation.

5A.2.2.2.5 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 II. DCC gate operations in Second Basis of Comparison are different than those in the No Action Alternative simulation as described previously in this section.

South Delta Temporary Barriers

South Delta Temporary Barriers are included similar to the No Action Alternative. However, the operation of the HORB is different in the Second Basis of Comparison as explained in the following section.

Clifton Court Forebay Gates

Consistent with the No Action Alternative simulation.

5A.2.2.2.6 Operations Criteria

South Delta Temporary Barriers

Similar to the No Action Alternative simulation with the exception that the USFWS BO Action 5 is not included in the Second Basis of Comparison. Therefore, HORB is installed in spring months (April 1 through May 31) in addition to fall months (September 16 through November 30).

Montezuma Salinity Control Gate

Consistent with the No Action Alternative simulation.

5A.3 Assumptions for Alternatives Model Simulations

This section describes the CalSim II and DSM2 modeling assumptions for the Alternatives 3 and 5. Alternative 3 is generally consistent with the Second Basis of Comparison, and Alternative 5 is generally consistent with the No Action Alternative. Assumptions that are different from the Second Basis of Comparison for Alternative 3 and from the No Action Alternative for Alternative 5 are described in detail below. Other assumptions that are consistent with the respective basis of comparison, are provided in short form for completeness.

5A.3.1 Alternative 3

Alternative 3 model assumptions generally follow the Second Basis of Comparison simulation with the exception of the Old and Middle River Flows requirement, and a different set of assumptions for the New Melones operation that are based on the Oakdale ID's 2012 proposal [OID et al. 2012]. Alternative 3 includes other assumptions that are not modeled such as predation control, trap and haul fish passage, trap at head of Old River and barge to Chipps Island, and ocean harvest limits for Central Valley Chinook Salmon. Detailed descriptions of Alternative 3 assumptions are described in the Chapter 3, Description of Alternatives.

Alternative 3 CalSim II and DSM2 assumptions that are different from the Second Basis of comparison are described below.

5A.3.1.1 CalSim II Assumptions for Alternative 3

5A.3.1.1.1 Demands, Water Rights, CVP and SWP Contracts

Similar to the Second Basis of Comparison and the No Action Alternative.

5A.3.1.1.2 Facilities

Fremont Weir

Consistent with the Second Basis of Comparison and the No Action Alternative.

Banks Pumping Plant Capacity

Consistent with the Second Basis of Comparison and the No Action Alternative.

Jones Pumping Plant Capacity

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.1.1.3 Regulatory Standards

Delta Outflow Index (Flow and Salinity)

SWRCB D-1641

Consistent with the Second Basis of Comparison and the No Action Alternative.

USFWS BO Action 4

Consistent with the Second Basis of Comparison.

Combined Old and Middle River Flows

The combined Old and Middle River (OMR) flow criteria are based on concepts addressed in the 2008 USFWS and 2009 NMFS BOs related to adaptive restrictions for temperature, turbidity, salinity, and presence of Delta Smelt. The OMR flow criteria in the Alternative 3 are similar to those of the No Action Alternative, with the exception of the following changes:

- Action 1 that protects the pre-spawning adult Delta Smelt from entrainment is modified to limit exports such that the average daily OMR flow is no more negative than -3,500 cfs for a total duration of 14 days, with a 5-day running average no more negative than 4,375 cfs (within 25 percent of the monthly criteria).
- Action 2 that protects adult Delta Smelt within the Delta from entrainment is modified to limit exports so that the average daily OMR flow is no more negative than -3,500 or -7,500 cfs depending on the previous month's ending X2 location (-3,500 cfs if X2 is east of Roe Island, or -7,500 cfs if X2 is west of Roe Island), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -4,375 cfs if X2 is east of Roe Island, or -9,375 cfs if X2 is west of Roe Island).
- Action 3 that protects larval and juvenile Delta Smelt from entrainment is modified to limit exports so that the average daily OMR flow is no more negative than -1,250, 3,500, or 7,500 cfs, depending on the previous month's ending X2 location (-1,250 cfs if X2 is east of Chipps Island, -7,500 cfs if X2 is west of Roe Island, or -3,500 cfs if X2 is between Chipps and Roe Island,

inclusively), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -1,562 cfs if X2 is east of Chipps Island, -9,375 cfs if X2 is west of Roe Island, or -4,375 cfs if X2 is between Chipps and Roe Island).

- Temporal off-ramp for Action 3 is assumed to occur no later than June 15 (changed from June 30).
- An off-ramp based on QWest (westerly flow on the San Joaquin River past Jersey Point calculated as a combination of San Joaquin River at Blind Point, Three Mile Slough and Dutch Slough) is assumed. If Qwest is greater than 12,000 cfs, then the Action 3 is discontinued. Because Action 2 is defined to occur between Actions 1 and 3, the Qwest off ramp also results in discontinuation of Action 2 if it happens before Action 3 is triggered. In monthly CalSim II modeling, the previous month's QWest value is used for determining the off-ramp, therefore if the off-ramp occurs within the previous month, RPA Actions in that previous month are assumed to continue until the end of the month.

South Delta Export-San Joaquin River Inflow Ratio

Consistent with the Second Basis of Comparison.

Exports at the South Delta Intakes

The south Delta exports in Alternative 3 are operated per SWRCB D-1641. Similar to the Second Basis of comparison, the combined export of the CVP Tracy Pumping Plant and SWP Banks Pumping Plant is limited to a percentage of the total Delta inflow, based on the export-inflow ratio specified under D-1641.

Delta Water Quality

Alternative 3 includes SWRCB D-1641 salinity requirements consistent with the Second Basis of Comparison and the No Action Alternative.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.3.1.1.4 Operations Criteria

Fremont Weir Operations

Consistent with the Second Basis of Comparison and the No Action Alternative.

Delta Cross Channel Gate Operations

Consistent with the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for determining the allocations in the Alternative 3 CalSim II simulation are similar to the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis operations under the Alternative 3 are consistent with the No Action Alternative and the Second Basis of Comparison simulations.

New Melones Operations

In addition to flood control, New Melones is operated for four different purposes: fishery flows, water quality, Bay-Delta flow, and water supply.

Fishery

In the Alternative 3 simulation, fishery flows are modeled per Oakdale Irrigation District's 2012 proposal (OID et al. 2012). These flows include an outmigration pulse flow from April 1 through May 15. Total annual volume dedicated to fishery flows vary from 174 to 318 TAF depending on the hydrologic conditions defined by the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.11 through 5A.B.13).

Table 5A.B.11 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Base Flows (TAF)
0 to 1,800	174
1,801 to 2,500	235
>2,500	318

Table 5A.B.12 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
235	252	300	300	150	173	200	200	200	200	200	200	200
318	300	300	300	300	300	300	1,500	850	200	200	200	200

Table 5A.B.13 April 1 through May 31 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

New Melones Water Supply Forecast (TAF)	Fishery Pulse Flows (CFS) April 1–May 31
0 to 1,800	750
1,801 to 2,500	1,500
>2,500	1,500

Water Quality

No D-1641 water quality releases are assumed in Alternative 3.

D-1422 dissolved oxygen compliance point is moved to the Orange Blossom Bridge under the Alternative 3. However, for modeling purposes, surrogate flows in CalSim II are assumed to be the same as those to meet the Ripon compliance point (surrogate flows consistent with the Second Basis of Comparison and the No Action Alternative).

Bay-Delta Flows

No D-1641 Bay-Delta flow requirements are assumed under the Alternative 3.

Water Supply

Water supply refers to deliveries from New Melones to water rights holders (Oakdale ID and South San Joaquin ID) and CVP eastside contractors (Stockton East WD and Central San Joaquin 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 II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.14) and are distributed throughout 1 year using monthly patterns.

Table 5A.B.14 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	10
1,400 to 1,800	59
>1,800	155

5A.3.1.2 DSM2 Assumptions for Alternative 3

5A.3.1.2.1 Tidal Boundary

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.1.2.2 Water Quality

Martinez EC

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.1.2.3 Morphological Changes

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.1.2.4 Facilities

South Delta Temporary Barriers

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.1.2.5 Operations Criteria

South Delta Temporary Barriers

Consistent with the No Action Alternative, South Delta Temporary Barriers are operated based on San Joaquin flow conditions. Head of Old River Barrier is assumed to be only installed from September 16 to November 30 and is not installed in the spring months, based on the USFWS BO Action 5. 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.

Montezuma Salinity Control Gate

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.3.2 Alternative 5

Alternative 5 model assumptions generally follow the No Action Alternative simulation with the exception of more positive Old and Middle River Flows requirement in April and May, and D 1641 pulse flows at Vernalis. Detailed descriptions of Alternative 5 assumptions are described in Chapter 3, Description of Alternatives.

Alternative 5 CalSim II and DSM2 assumptions that are different from the No Action Alternative are described below.

5A.3.2.1 CalSim II Assumptions for Alternative 5

5A.3.2.1.1 Demands, Water Rights, CVP and SWP Contracts

Similar to the Second Basis of Comparison and the No Action Alternative.

5A.3.2.1.2 Facilities

Fremont Weir

Consistent with the No Action Alternative and the Second Basis of Comparison.

Banks Pumping Plant Capacity

Consistent with the No Action Alternative and the Second Basis of Comparison.

Jones Pumping Plant Capacity

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.3.2.1.3 Regulatory Standards

Delta Outflow Index (Flow and Salinity)

SWRCB D-1641

All flow-based Delta outflow requirements included in SWRCB D-1641 are consistent with the No Action Alternative. Similarly, for the February through June period, the X2 standard is included consistent with the No Action Alternative.

USFWS BO Action 4

USFWS BO Action 4 requires additional Delta outflow to manage X2 in the fall months following the Wet and Above Normal years. This action is included in Alternative 5. The assumptions for this action under Alternative 5 are consistent with the No Action Alternative.

Combined Old and Middle River Flows

The Alternative 5 OMR flow requirement is similar to the No Action Alternative with the exception of positive OMR flows in April and May in all years.

South Delta Export-San Joaquin River Inflow Ratio

Consistent with the No Action Alternative.

Exports at the South Delta Intakes

Similar to the No Action Alternative, with the exception that the minimum health and safety pumping of 1,500 cfs is not assumed for the months of April and May under Alternative 5.

Delta Water Quality

Consistent with the No Action Alternative and the Second Basis of Comparison.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.3.2.1.4 Operations Criteria

Fremont Weir Operations

Consistent with the No Action Alternative and the Second Basis of Comparison.

Delta Cross Channel Gate Operations

Consistent with the No Action Alternative and the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for allocation decisions under Alternative 5 are consistent with the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis Operations under Alternative 5 are consistent with the No Action Alternative simulation.

New Melones Operations

New Melones operations assumed in Alternative 5 is similar to the No Action Alternative with the exception of D-1641 Vernalis pulse flows.

Fishery

Similar to the No Action Alternative simulation, fishery flows refer to flow requirements of the 2009 NMFS BO Action III.1.3 under Alternative 5.

Water Quality

Consistent with the No Action Alternative.

Bay-Delta Flows

Bay-Delta flow requirements are defined by D-1641 flow requirements at Vernalis (not including pulse flows during the April 15 through May 16 period). These flows are met through releases from New Melones without any annual volumetric limit.

D-1641 requires flows at Vernalis to be maintained during the February through June period and is based on the required location of X2 and the San Joaquin Valley water year hydrologic classification (60-20-20 Index) as summarized in Table 5A.B.15.

Table 5A.B.15 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Flow Required if X2 is West of Chipps Island	Flow required if X2 is East of Chipps Island
Wet	3,420	2,130
Above Normal	3,420	2,130
Below Normal	2,280	1,420
Dry	2,280	1,420
Critical	1,140	710

In addition to the D-1641 "base" flows, D-1641 pulse flows for the April 15 through May 15 period are also simulated under Alternative 5 (Table 5A.B.16).

Table 5A.B.16 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Pulse Flow Required if X2 is West of Chipps Island	Pulse Flow required if X2 is East of Chipps Island
Wet	8,620	7,330
Above Normal	7,020	5,730
Below Normal	5,480	4,620
Dry	4,880	4,020
Critical	3,540	3,110

Water Supply

Water supply refers to deliveries from New Melones to water rights holders (Oakdale ID and South San Joaquin ID) and CVP eastside contractors (Stockton East WD and Central San Joaquin 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 II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.17), and are distributed throughout 1 year using monthly patterns.

Table 5A.B.17 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	0
1,400 to 1,800	49
>1,800	155

5A.3.2.2 DSM2 Assumptions for Alternative 5

5A.3.2.2.1 Tidal Boundary

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.3.2.2.2 Water Quality

Martinez EC

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.3.2.2.3 Morphological Changes

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.3.2.2.4 Facilities

South Delta Temporary Barriers

Consistent with the No Action Alternative.

5A.3.2.2.5 Operations Criteria

South Delta Temporary Barriers

Consistent with the No Action Alternative and the Second Basis of Comparison.

Montezuma Salinity Control Gate

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.3.3 Summary of Alternatives Assumptions

A summary table of the EIS alternatives' assumptions is provided below for quick reference (Table 5A.B.18).

1 **Table 5A.B.18 EIS Alternatives CalSim II Model Key Modeling Assumptions Summary**

		No Action Alternative and Alternative 2	Alternatives 1 and 4 and Second Basis of Comparison	Alternative 3	Alternative 5
USFWS BO RPAs	Action 1 – First Flush	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Represented
	Action 2 – Adult Protection OMR	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Represented
	Action 3 – Juvenile Protection OMR	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Modified to be operationally more restrictive
	Action 4 – Fall X2	Represented	Not Represented	Not Represented	Represented
	Action 5 – Spring HORB	Represented	Not Represented	Represented	Represented
NMFS BO RPAs	I.1.1 – Clear Creek Spring Attraction	Represented	Not Represented	Not Represented	Represented
	I.3.1, I.3.2, I.3.3 – Red Bluff Ops	Represented	Represented	Represented	Represented
	I.7 – Yolo Bypass Modification	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic
	III.1.3 – Goodwin Flow Schedule	Represented per Appendix 2E Table	Fishery Flows from 1997 IPO	Fishery Flows from OID/SSJID Plan (2012)	Represented per Appendix 2E Table

		No Action Alternative and Alternative 2	Alternatives 1 and 4 and Second Basis of Comparison	Alternative 3	Alternative 5
NMFS BO RPAs	IV.1.2 – DCC Ops	Represented per RPA	Represented per D-1641	Represented per D-1641	Represented per RPA
	IV.2.1 – I/E Ratio	Represented	Not Represented	Not Represented	Represented
	IV.2.3 – OMR	See USFWS Actions 1-3	See USFWS Actions 1-3	See USFWS Actions 1-3	See USFWS Actions 1-3
Spring Delta Outflow		D-1641	D-1641	D-1641	Increased from D-1641 due to OMR Action in April and May
Releases from Goodwin	Fishery Flows	NMFS RPA III.1.3 (Appendix 2E)	Fishery Flows from 1997 Interim Plan of Operations	Fishery Flows from OID/SSJID Proposal (2012)	NMFS RPA III.1.3 (Appendix 2E)
	Vernalis Base Flow	D-1641 – no cap	D-1641 – no cap	N/A	D-1641 – no cap
	Vernalis Pulse Flow	N/A	N/A	N/A	D-1641 – no cap
	Vernalis Salinity	D-1641—no cap	D-1641—no cap	N/A	D-1641 – no cap
	Dissolved Oxygen	D-1641 standard at Ripon	D-1641 standard at Ripon	D-1641 standard at Orange Blossom Bridge (no model changes)	D-1641 standard at Ripon
OID/SSJID Deliveries		1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account
CVP Contractor Allocations		Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF

5A.4 Timeframe of Evaluation

The No Action Alternative, the Second Basis of Comparison, and the other alternatives are simulated at Year 2030 conditions. Changes in climate conditions and sea level (15-cm rise) were assumed at Year 2030 and are consistent within all alternatives.

Using this approach, the climate scenario was derived based on sampling of the ensemble of global climate model projections rather than one single realization or a handful of individual realizations. The Q5 scenario that represents the central tendency of the climate projections was selected for the EIS analysis.

Simulation of climate change and sea-level rise effects in CalSim II modeling of the alternatives is accomplished by:

- Incorporating the modified CalSim II inputs reflecting climate change for parameters including, inflows, water year types, runoff forecasts, and Delta water temperature.
- Incorporating modified ANNs to reflect the flow-salinity response under sea level change.

Simulation of the tidal marsh restoration areas and sea-level rise effects in DSM2 modeling of the alternatives is accomplished by:

- Incorporating consistent grid changes identified in corroboration simulation into the DSM2 model for the sea-level rise condition.
- Modifying the downstream stage and EC boundary conditions at Martinez in the DSM2 model using the appropriate regression equation for the 15-cm sea-level rise. The adjusted astronomical tide specified at Martinez in the alternatives is modified using the correlations shown in Table 5A.B.19. The Martinez EC boundary condition resulting from the G-model is modified using the correlations specified in the Table 5A.B.19.

Table 5A.B.19 Correlation to Transform Baseline Martinez Stage and EC for use in alternatives DSM2 Simulations at Year 2030

Scenario	Martinez Stage (feet NGVD 29)		Martinez EC (µS/cm)	
	Correlation	Lag (min)	Correlation	Lag (min)
Year 2030 (15cm SLR)	Y = 1.0033*X + .47	-1	Y = 0.9954* X + 556.3	0

Notes:

X = Baseline Martinez stage or EC

Y = Alternative Martinez stage or EC

5A.5 No Action Alternative and Second Basis of Comparison Callout Tables

5A.5.1 CalSim II Assumptions

This subsection provides a summary of the CalSim II assumptions for the No Action Alternative and the Second Basis of Comparison (Table 5A.B.20).

5A.5.2 DSM2 Assumptions

This subsection provides a summary of the DSM2 assumptions for the No Action Alternative and the Second Basis of Comparison (Table 5A.B.21).

5A.6 American River Demands

This section includes the information in the "Bay Delta Conservation Plan EIR/EIS Project—CalSim II Baselines Models—American River Assumptions," dated February 17, 2010.

5A.6.1 Introduction

The following is a summary of the assumptions that are EIS alternatives. For specific diversion-related assumptions, see the following section.

- American River Flow Management is included, as required by the June 2009 NMFS Biological Opinion Action II.1.
- Water rights and CVP demands are assumed at a full buildout condition with CVP contracts at full contract amounts
- Placer County Water Agency (PCWA) Pump Station is included at full demand
- Freeport Regional Water Project (FRWP) is included at full demand (East Bay Municipal Utility District (EBMUD) CVP contracts and SCWA CVP contract and new appropriative water rights and water acquisitions as modeled in the FRWP EIS/R)
  - Sacramento River Water Reliability Project is not included
  - Sacramento Area Water Forum is not included (dry year "wedge" reductions and mitigation water releases are not included)

5A.6.2 Summary of Demands

The Table 5A.B.22 below summarizes the water rights, CVP contract amounts, and demand amounts for each diverter in the American River system in the No Action Alternative and the Second Basis of Comparison.

1 **Table 5A.B.20 CalSim II Inputs – Assumptions**

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Planning horizon[a]	Year 2030	Same
Demarcation date[a]	March 2012	Same
Period of simulation	82 years (1922-2003)	Same
HYDROLOGY		
Inflows/Supplies	Historical with modifications for operations upstream of rim reservoirs and with changed climate at Year 2030	Same
Level of development	Projected 2030 level[c]	Same
DEMANDS, WATER RIGHTS, CVP and SWP CONTRACTS		
Sacramento River Region (excluding American River)		
CVP[d]	Land-use based, full buildout of contract amounts	Same
SWP (FRSA)[e]	Land-use based, limited by contract amounts	Same
Non-project	Land-use based, limited by water rights and SWRCB Decisions for Existing Facilities	Same
Antioch Water Works	Pre-1914 water right	Same
Federal refuges[f]	Firm Level 2 water needs	Same
Sacramento River Region—American River[g]		
Water rights	Year 2025, full water rights	Same
CVP	Year 2025, full contracts, including Freeport Regional Water Project	Same
San Joaquin River Region[h]		
Friant Unit	Limited by contract amounts, based on current allocation policy	Same
Lower Basin	Land-use based, based on district level operations and constraints	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Stanislaus River[i]	Land-use based, Revised Operations Plan[t] and NMFS BO (June 2009) Actions III.1.2 and III.1.3[v]	Land-use based, Revised Operations Plan[t]
San Francisco Bay, Central Coast, Tulare Lake and South Coast Regions (CVP and SWP project facilities)		
CVP[d]	Demand based on contract amounts	Same
CCWD[j]	195 TAF/year CVP contract supply and water rights	Same
SWP[e,k]	Demand based on Table A amounts	Same
Article 56	Based on 2001-2008 contractor requests	Same
Article 21	MWD demand up to 200 TAF/month from December to March subject to conveyance capacity, Kern County Water Agency demand up to 180 TAF/month, and other contractor demands up to 34 TAF/month in all months, subject to conveyance capacity	Same
North Bay Aqueduct (NBA)	77 TAF/yr demand under SWP contracts, up to 43.7 cfs of excess flow under Fairfield, Vacaville, and Benecia Settlement Agreement	Same
Federal refuges[f]	Firm Level 2 water needs	Same
FACILITIES		
Systemwide	Existing facilities	Same
Sacramento River Region		
Shasta Lake	Existing, 4,552 TAF capacity	Same
Red Bluff Diversion Dam	Diversion dam operated with gates out all year, NMFS BO (June 2009) Action I.3.1[v]; assume permanent facilities in place	Same
Colusa Basin	Existing conveyance and storage facilities	Same
Upper American River[g,l]	PCWA American River Pump Station	Same
Lower Sacramento River	Freeport Regional Water Project[n]	Same
San Joaquin River Region		
Millerton Lake (Friant Dam)	Existing, 520 TAF capacity	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Lower San Joaquin River	City of Stockton Delta Water Supply Project, 30-mgd capacity	Same
Delta Region		
SWP Banks Pumping Plant (South Delta)	Physical capacity is 10,300 cfs but 6,680 cfs permitted capacity in all months up to 8,500 cfs during Dec. 15 through Mar. 15 depending on Vernalis flow conditions[o]; additional capacity of 500 cfs (up to 7,180 cfs) allowed for July through Sept. for reducing impact of NMFS BO (June 2009) Action IV.2.1 Phase II[v] on SWP[w]	Physical capacity is 10,300 cfs but 6,680 cfs permitted capacity in all months up to 8,500 cfs during Dec. 15 through Mar. 15 depending on Vernalis flow conditions[o]; additional capacity of 500 cfs (up to 7,180 cfs) allowed for July through Sept. for reducing impact of B2 Actions.
CVP C.W. Bill Jones Pumping Plant (Tracy Pumping Plant)	Permit capacity is 4,600 cfs in all months (allowed for by the Delta-Mendota Canal-California Aqueduct Intertie)	Same
Upper Delta-Mendota Canal Capacity	Existing plus 400 cfs Delta-Mendota Canal-California Aqueduct Intertie	Same
CCWD Intakes	Los Vaqueros existing storage capacity, 100 TAF, existing pump locations, AIP included[p]	Same
San Francisco Bay Region		
South Bay Aqueduct (SBA)	SBA rehabilitation, 430 cfs capacity from junction with California Aqueduct to Zone 7 Water Agency diversion point	Same
South Coast Region		
California Aqueduct East Branch	Existing capacity	Same
REGULATORY STANDARDS		
North Coast Region		
Trinity River		
Minimum flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/year)	Same
Trinity Reservoir end-of-September minimum storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Sacramento River Region		
Clear Creek		
Minimum flow below Whiskeytown Dam	Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS, predetermined CVPIA 3406(b)(2) flows[q], and NMFS BO (June 2009) Action I.1.1[v]	Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS, predetermined CVPIA 3406(b)(2) flows[q]
Upper Sacramento River		
Shasta Lake end-of-September minimum storage	NMFS 2004 Winter-run Biological Opinion, (1900 TAF in non-critically dry years), and NMFS BO (June 2009) Action I.2.1[v]	NMFS 2004 Winter-run Biological Opinion, (1900 TAF in non-critically dry years)
Minimum flow below Keswick Dam	SWRCB WR 90-5, predetermined CVPIA 3406(b)(2) flows[q], and NMFS BO (June 2009) Action I.2.2[v]	SWRCB WR 90-5, predetermined CVPIA 3406(b)(2) flows[q]
Feather River		
Minimum flow below Thermalito Diversion Dam	2006 Settlement Agreement (700/800 cfs)	Same
Minimum flow below Thermalito Afterbay outlet	1983 DWR, DFW Agreement (750-1,700 cfs)	Same
Yuba River		
Minimum flow below Daguerre Point Dam	D-1644 Operations (Lower Yuba River Accord)[r]	Same
American River		
Minimum flow below Nimbus Dam	American River Flow Management[s] as required by NMFS BO (June 2009) Action II.1[v]	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same
Lower Sacramento River		
Minimum flow near Rio Vista	SWRCB D-1641	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
San Joaquin River Region		
Mokelumne River		
Minimum flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100-325 cfs)	Same
Minimum flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25-300 cfs)	Same
Stanislaus River		
Minimum flow below Goodwin Dam	1987 Reclamation, DFW agreement, and flows required for NMFS BO (June 2009) Action III.1.2 and III.1.3[v]	1987 Reclamation, DFW agreement
Minimum dissolved oxygen	SWRCB D-1422	Same
Merced River		
Minimum flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180-220 cfs, Nov.-Mar.), and Cowell Agreement	Same
Minimum flow at Shaffer Bridge	FERC 2179 (25-100 cfs)	Same
Tuolumne River		
Minimum flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94-301 TAF/yr)	Same
San Joaquin River		
San Joaquin River below Friant Dam/ Mendota Pool	San Joaquin River Restoration-full flows, not constrained by current canal capacity[u]	Same
Maximum salinity near Vernalis	SWRCB D-1641	Same
Minimum flow near Vernalis	SWRCB D-1641, and NMFS BO (June 2009) Action IV.2.1[v]	SWRCB D-1641
Sacramento River – San Joaquin Delta Region		
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641 and USFWS BO (Dec. 2008) Action 4	SWRCB D-1641

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Delta Cross Channel gate operation	SRWCB D-1641 with additional days closed from Oct. 1 – Jan. 31 based on NMFS BO (June 2009) Action IV.1.2[v] (closed during flushing flows from Oct. 1 – Dec. 14 unless adverse water quality conditions)	SRWCB D-1641
South Delta exports (Jones Pumping Plant and Banks Pumping Plant)	SWRCB D-1641, Vernalis flow-based export limits Apr. 1 – May 31 as required by NMFS BO (June 2009) Action IV.2.1[v] (additional 500 cfs allowed for July – Sept. For reducing impact on SWP)[w]	SWRCB D-1641 (additional 500 cfs allowed for July – Sept. For reducing impact of B2 Actions)
Combined Flow in OMR	USFWS BO (Dec. 2008) Actions 1 through 3 and NMFS BO (June 2009) Action IV.2.3[v]	None
OPERATIONS CRITERIA: RIVER-SPECIFIC		
Sacramento River Region		
Upper Sacramento River		
Flow objective for navigation (Wilkins Slough)	NMFS BO (June 2009) Action I.4[v]; 3,500 – 5,000 cfs based on CVP water supply condition	Same
American River		
Folsom Dam flood control	Variable 400/670 flood control diagram (without outlet modifications)	Same
Feather River		
Flow at Mouth of Feather River (above Verona)	Maintain DFW/DWR flow target of 2,800 cfs for Apr. through Sept. dependent on Oroville inflow and FRSA allocation	Same
San Joaquin River Region		
Stanislaus River		
Flow below Goodwin Dam[i]	Revised Operations Plan[t] and NMFS BO (June 2009) Action III.1.2 and III.1.3[v]	Revised Operations Plan[t]
San Joaquin River		
Salinity at Vernalis	Grasslands Bypass Project (full implementation)	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
OPERATIONS CRITERIA: SYSTEMWIDE		
CVP water allocation		
Settlement/Exchange	100 percent (75 percent in Shasta critical years)	Same
Refuges	100 percent (75 percent in Shasta critical years)	Same
Agriculture Service	100 percent-0 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	100 percent-0 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641
Municipal & Industrial Service	100 percent-50 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	100 percent-50 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641
SWP water allocation		
North of Delta (FRSA)	Contract specific	Same
South of Delta (including North Bay Aqueduct)	Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are additionally limited due to D-1641 and USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are additionally limited due to D-1641
CVP-SWP coordinated operations		
Sharing of responsibility for in-basin-use	1986 Coordinated Operations Agreement (FRWP EBMUD and 2/3 of the North Bay Aqueduct diversions considered as Delta Export; 1/3 of the North Bay Aqueduct diversion as in-basin-use)	Same
Sharing of surplus flows	1986 Coordinated Operations Agreement	Same
Sharing of total allowable export capacity for project-specific priority pumping	Equal sharing of export capacity under SWRCB D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	Equal sharing of export capacity under SWRCB D-1641

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Water transfers	Acquisitions by SWP contractors are wheeled at priority in Banks Pumping Plant over non-SWP users; LYRA included for SWP contractors[w]	Same
Sharing of total allowable export capacity for lesser priority and wheeling-related pumping	Cross Valley Canal wheeling (max of 128 TAF/year), CALFED ROD defined Joint Point of Diversion (JPOD)	Same
San Luis Reservoir	San Luis Reservoir is allowed to operate to a minimum storage of 100 TAF	Same
CVPIA 3406(b)(2)[v,q]		
Policy Decision	Per May 2003 Department Decision:	Same
Allocation	800 TAF, 700 TAF in 40-30-30 dry years, and 600 TAF in 40-30-30 critical years as a function of Ag allocation	Same
Actions	Predetermined upstream fish flow objectives below Whiskeytown and Keswick Dams, non-discretionary NMFS BO (June 2009) actions for the American and Stanislaus Rivers, and NMFS BO (June 2009) and USFWS BO (Dec. 2008) actions leading to export restrictions[v]	Predetermined upstream fish flow objectives below Whiskeytown and Keswick Dams
Accounting	Releases for non-discretionary USFWS BO (Dec. 2008) and NMFS BO (June 2009)[v] actions may or may not always be deemed (b)(2) actions; in general, it is anticipated that, accounting of these actions using (b)(2) metrics, the sum would exceed the (b)(2) allocation in many years; therefore no additional actions are considered and no accounting logic is included in the model [q]	No accounting logic is included in the model

	No Action Alternative Assumption	Second Basis of Comparison Assumption
WATER MANAGEMENT ACTIONS		
Water Transfer Supplies (long-term programs)		
Lower Yuba River Accord[w]	Yuba River acquisitions for reducing impact of NMFS BO export restrictions[v] on SWP	Yuba River acquisitions
Phase 8	None	None
Water Transfers (short-term or temporary programs)		
Sacramento Valley acquisitions conveyed through Banks Pumping Plant[x]	Post-analysis of available capacity	Post-analysis of available capacity

Notes:

a. These assumptions were developed under the direction of the DWR and Reclamation in 2010. Only operational components of 2008 USFWS and 2009 NMFS BOs as of demarcation date of No Action Alternative and the No action Alternative assumptions are included. Restoration of at least 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh required by the 2008 USFWS BO and restoration of at least 17,000 to 20,000 acres of floodplain rearing habitat for juvenile winter-run and spring-run Chinook Salmon and Central Valley Steelhead in the Yolo Bypass and/or suitable areas of the lower Sacramento River required by the NMFS 2009 BO are not included in the No Action Alternative assumptions because environmental documents of projects regarding these actions were not completed as of the publication date of the Notice of Preparation/Notice of Intent (February 13, 2009).

b. The Sacramento Valley hydrology used in the No Action Alternative CalSim II model reflects nominal 2005 land-use assumptions. The nominal 2005 land use was determined by interpolation between the 1995 and projected 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects 2005 land-use assumptions developed by Reclamation. Existing-level projected land-use assumptions are being coordinated with the California Water Plan Update for future models.

c. The Sacramento Valley hydrology used in the No Action Alternative CalSim II model reflects 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation. Development of Future-level projected land-use assumptions are being coordinated with the California Water Plan Update for future models.

d. CVP contract amounts have been updated according to existing and amended contracts as appropriate. Assumptions regarding CVP agricultural and M&I service contracts and Settlement Contract amounts are documented in the Delivery Specifications attachments.

e. SWP contract amounts have been updated as appropriate based on recent Table A transfers/agreements. Assumptions regarding SWP agricultural and M&I contract amounts are documented in the Delivery Specifications attachments.

f. Water needs for Federal refuges have been reviewed and updated as appropriate. Assumptions regarding firm Level 2 refuge water needs are documented in the Delivery Specifications attachments. Refuge Level 4 (and incremental Level 4) water is not analyzed.

g. Assumptions regarding American River water rights and CVP contracts are documented in the Delivery Specifications attachments. The Sacramento Area Water Forum agreement, its dry year diversion reductions, Middle Fork Project operations and "mitigation" water is not included.

h. The new CalSim II representation of the San Joaquin River has been included in this model package (CalSim II San Joaquin River Model, Reclamation, 2005). Updates to the San Joaquin River have been included since the preliminary model release in August 2005. The model reflects the difficulties of ongoing groundwater overdraft problems. The 2030 level of development representation of the San Joaquin River Basin does not make any attempt to offer solutions to groundwater overdraft problems. In addition a dynamic groundwater simulation is not yet developed for the San Joaquin River Valley. Groundwater extraction/recharge and stream-groundwater interaction are static assumptions and may not accurately reflect a response to simulated actions. These limitations should be considered in the analysis of results.

i. The CalSim II model representation for the Stanislaus River does not necessarily represent Reclamation's current or future operational policies. A suitable plan for supporting flows has not been developed for NMFS BO (June 2009) Action 3.1.3.

j. The actual amount diverted is operated in conjunction with supplies from the Los Vaqueros project. The existing Los Vaqueros storage capacity is 100 TAF. Associated water rights for Delta excess flows are included.

k. Under No Action Alternative, it is assumed that SWP Contractors demand for Table A allocations vary from 3.0 to 4.1 million acre-feet (MAF)/year. Under the No Action Alternative, it is assumed that SWP Contractors can take delivery of all Table A allocations and Article 21 supplies. Article 56 provisions are assumed and allow for SWP Contractors to manage storage and delivery conditions such that full Table A allocations can be delivered. Article 21 deliveries are limited in Wet years under the assumption that demand is decreased in these conditions. Article 21 deliveries for the NBA are dependent on excess conditions only, all other Article 21 deliveries also require that San Luis Reservoir be at capacity and that Banks Pumping Plant and the California Aqueduct have available capacity to divert from the Delta for direct delivery.

l. PCWA American River pumping facility upstream of Folsom Lake is included in both the Existing and No Action Alternative No Action Alternative. The diversion is assumed to be 35.5 TAF/Yr.

m. footnote removed

n. footnote removed

o. Current USACE permit for Banks Pumping Plant allows for an average diversion rate of 6,680 cfs in all months. Diversion rate can increase up to 1/3 of the rate of San Joaquin River flow at Vernalis from Dec. 15th to Mar. 15th, up to a maximum diversion of 8,500 cfs, if Vernalis flow exceeds 1,000 cfs.

p. The CCWD AIP is an intake at Victoria Canal that operates as an alternate Delta diversion for Los Vaqueros Reservoir. This assumption is consistent with the future no-project condition defined by the Los Vaqueros Enlargement study team.

q. CVPIA (b)(2) fish actions are not dynamically determined in the CalSim II model, nor is (b)(2) accounting done in the model. Since the USFWS BO and NMFS BO were issued, the Department has exercised its discretion to use (b)(2) in the delta by

accounting some or all of the export reductions required under those biological opinions as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other delta actions will be limited to covering the CVP's VAMP export reductions. Similarly, since the USFWS BO and NMFS BO were issued, the Department has exercised its discretion to use (b)(2) upstream by accounting some or all of the release augmentations (relative to the hypothetical (b)(2) base case) below Whiskeytown, Nimbus, and Goodwin as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other upstream actions will be limited to covering Sacramento releases, in the fall and winter. For modeling purposes, predetermined time series of minimum instream flow requirements are specified. The time series are based on the Aug. 2008 BA Study 7.0 and Study 8.0 simulations which did include dynamically determined (b)(2) actions.

r. D-1644 and the Lower Yuba River Accord is assumed to be implemented for Existing and No Action Alternative No Action Alternative. The Yuba River is not dynamically modeled in CalSim II. Yuba River hydrology and availability of water acquisitions under the Lower Yuba River Accord are based on modeling performed and provided by the Lower Yuba River Accord EIS/EIR study team.

s. Under Existing Conditions, the flow components of the proposed American River Flow Management are as required by the NMFS BO (June 4, 2009).

t. The model operates the Stanislaus River using a 1997 Interim Plan of Operation-like structure, i.e., allocating water for Stockton East Water District and CSJWCD, Vernalis water quality dilution, and Vernalis D-1641 flow requirements based on the New Melones Index. Oakdale Irrigation District and South San Joaquin Irrigation District allocations are based on their 1988 agreement and Ripon DO requirements are represented by a static set of minimum instream flow requirements during June thru Sept. Instream flow requirements for fish below Goodwin are based on NMFS BO Action III.1.2. NMFS BO Action IV.2.1's flow component is not assumed to be in effect.

u. SJR Restoration Water Year 2010 Interim Flows Project are assumed, but are *not input into the models; operation not regularly defined at this time*

v. In cooperation with Reclamation, National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife, the Department of Water Resources has developed assumptions for implementation of the USFWS BO (Dec. 15, 2008) and NMFS BO (June 4, 2009) in CalSim II.

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

x. Only acquisitions of Lower Yuba River Accord Component 1 water are included.

Table 5A.B.21 DSM2 Assumptions

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Period of simulation	82 years (1922-2003)[a,b]	Same
REGIONAL SUPPLIES		
Boundary flows	Monthly time series from CalSim II output (alternatives provide different flows and exports)[c]	Same
REGIONAL DEMANDS AND CONTRACTS		
Ag flows (DICU)	2005 Level, DWR Bulletin 160-98[d]	2020 Level, DWR Bulletin 160-98[d]
TIDAL BOUNDARY		
Martinez stage	15-minute adjusted astronomical tide[a]	Same
WATER QUALITY		
Vernalis EC	Monthly time series from CalSim II output[e]	Monthly time series from CalSim II output[e]
Agricultural Return EC	Municipal Water Quality Investigation Program analysis	Same
Martinez EC	Monthly net Delta Outflow from CalSim II output and G-model[f]	Monthly net Delta Outflow from CalSim II output and G-model[f]
MORPHOLOGICAL CHANGES		
Mokelumne River	None	None
San Joaquin River	None	None
Middle River	None	None
Dutch Slough Restoration Project	None	None

	No Action Alternative Assumption	Second Basis of Comparison Assumption
FACILITIES		
Contra Costa Water District Delta Intakes	Rock Slough Pumping Plant, Old River at Highway 4 Intake	Rock Slough Pumping Plant, Old River at Highway 4 Intake and Alternate Improvement Project Intake on Victoria Canal
South Delta barriers	Temporary Barriers Program	Same
Two Gate Program	None	None
Franks Tract Program	None	None
SPECIFIC PROJECTS		
Water Supply Intake Projects		
Freeport Regional Water Project	None	Monthly output from CalSim II
Stockton Delta Water Supply Project	None	Monthly output from CalSim II
Antioch Water Works	Monthly output from CalSim II	Monthly output from CalSim II
Sanitary and Agricultural Discharge Projects		
Veale Tract Drainage Relocation	The Veale Tract Water Quality Improvement Project, funded by CALFED, relocates the agricultural drainage outlet that was relocated from Rock Slough channel to the southern end of Veale Tract, on Indian Slough[k]	Same
OPERATIONS CRITERIA		
Delta Cross Channel	Monthly time series of number of days open from CalSim II output	Monthly time series of number of days open from CalSim II output
Clifton Court Forebay	Priority 3, gate operations synchronized with incoming tide to minimize impacts to low water levels in nearby channels	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
South Delta barriers	Temporary Barriers Project operated based on San Joaquin River flow time series from CalSim II output; HORB is assumed only installed[l] Sept. 16 through Nov. 30; agricultural barriers on OMR are assumed to be installed starting from May 16 and on Grant Line Canal from June 1; all three barriers are allowed to be operated until November 30; May 16 to May 31; the tidal gates are assumed to be tied open for the barriers on Old and Middle Rivers[m].	Temporary Barriers Project operated based on San Joaquin River flow time series from CalSim II output; HORB is assumed installed[l] April 1 through May 31 and Sept. 16 through Nov. 30; agricultural barriers on OMR are assumed to be installed starting from May 16 and on Grant Line Canal from June 1; all three barriers are allowed to be operated until November 30; May 16 to May 31; the tidal gates are assumed to be tied open for the barriers on ORM[m]

Notes:

a. A new adjusted astronomical tide for use in DSM2 planning studies has been developed by DWR's Bay Delta Office Modeling Support Branch Delta Modeling Section in cooperation with the Common Assumptions workgroup. This tide is based on a more extensive observed dataset and covers the entire 82-year period of record.

b. The 16-year period of record is the simulation period for which DSM2 has been commonly used for impacts analysis in many previous projects, and includes varied water year types.

c. Although monthly CalSim II output was used as the DSM2-HYDRO input, the Sacramento and San Joaquin rivers were interpolated to daily values in order to smooth the transition from high to low and low to high flows. DSM2 then uses the daily flow values along with a 15-minute adjusted astronomical tide to simulate effect of the spring and neap tides.

d. The Delta Island Consumptive Use (DICU) model is used to calculate diversions and return flows for all Delta islands based on the level of development assumed. The nominal 2005 Delta region hydrology land use was determined by interpolation between the 1995 and projected 2020 land-use assumptions associated with Bulletin 160-98.

e. CalSim II calculates monthly EC for the San Joaquin River, which was then converted to daily EC using the monthly EC and flow for the San Joaquin River. Fixed concentrations of 150, 175, and 125 µmhos/cm were assumed for the Sacramento River, Yolo Bypass, and eastside streams, respectively.

f. Net Delta outflow based on the CalSim II flows was used with an updated G-model to calculate Martinez EC. Under changed climate conditions, Martinez EC is modified to account for the sea-level rise at early (15 cm) and late (45 cm) long-term phases (Year 2060).

g. footnote removed.

h. footnote removed.

i. footnote removed.

j. footnote removed.

k. Information was obtained based on the information from the draft final "Delta Region Drinking Water Quality Management Plan" dated June 2005 prepared under the CALFED Water Quality Program and a presentation by David Briggs at SWRCB public workshop for periodic review. The presentation "Compliance Location at Contra Costa Canal at Pumping Plant #1 – Addressing Local Degradation" notes that the Veale Tract drainage relocation project will be operational in June 2005. The DICU drainage currently simulated at node 204 is moved to node 202 in DSM2.

l. Based on the USFWS BO Action 5, HORB is assumed to be not installed in April or May; therefore HORB is only installed in the fall, as shown.

m. Based on the USFWS BO Action 5 and the project description provided in the page 119.

Table 5A.B.22 American River Diversions Assumed in the No Action Alternative and Second Basis of Comparison

	Diversion Location	No Action Alternative and Second Basis of Comparison (TAF/yr)		
		CVP M&I[a] Contracts (maximum[a])	Water Rights (maximum)	Diversion Limit (maximum capacity)
Placer County Water Agency	Auburn Dam Site	–	65.0	65.0
Total		**0**	**65.0**	**65.0**
Sacramento Suburban Water District[b]	Folsom Reservoir	–	0	0
City of Folsom – includes P.L. 101-514		7	27	34
Folsom Prison		–	5	5
San Juan Water District (Placer County)		–	25	25
San Juan Water District (Sac County) – includes P.L. 101-514	Folsom Reservoir	24.2	33	57.2
El Dorado Irrigation District		7.55	17	24.55
City of Roseville		32	30	62.0
Placer County Water Agency		35	–	35
El Dorado County – P.L.101-514		15	–	15
Total		**120.8**	**137.0**	**257.8**

	Diversion Location	No Action Alternative and Second Basis of Comparison (TAF/yr)		
		CVP M&I[a] Contracts (maximum[a])	Water Rights (maximum)	Diversion Limit (maximum capacity)
So. Cal WC/Arden Cordova WC	Folsom South Canal	–	5	5
California Parks and Recreation		5	–	5
SMUD		30	15	45
Canal Losses		–	1	1
Total		**35**	**21**	**56**
City of Sacramento[c]	Lower American River	–	225.6	225.6
Carmichael Water District		–	12	12
Total		**0**	**237.6**	**237.6**
Total American River Diversions		**155.8**	**460.6**	**616.4**
Sacramento River Diversions				
City of Sacramento	Lower Sacramento River	–	86.19	86.19
Sacramento County Water Agency		30	–	30
Sacramento County Water Agency—P.L. 101-514		15	–	15
Sacramento County Water Agency—water rights and acquisitions		–	Varies[d], average 32.58	Varies[d], average 32.58
East Bay Municipal Utilities District		133	–	Varies[e], average 8.2
Total Sacramento River Diversions		**178**	**118.8**	**172.0**
Total		**333.8**	**579.4**	**788.4**

l Notes:

a. When the CVP Contract quantity exceeds the quantity of the Diversion Limit minus the Water Right (if any), the diversion modeled is the quantity allocated to the CVP Contract (based on the CVP contract quantity shown times the CVP M&I allocation percentage) plus the Water Right (if any), but with the sum limited to the quantity of the Diversion Limit

b. Diversion is only allowed if and when Mar-Nov Folsom Unimpaired Inflow (FUI) exceeds 1,600 TAF

c. When the Hodge single dry year criteria is triggered, Mar-Nov FUI falls below 400 TAF, diversion on the American River is limited to 50 TAF/yr; based on monthly Hodge flow limits assumed for the American, diversion on the Sacramento River may be increased to 223 TAF due to reductions of diversions on American River

d. SCWA targets 68 TAF of surface water supplies annually. The portion unmet by CVP contract water is assumed to come from two sources:

   (1) Delta “excess” water- averages 16.5 TAF annually, but varies according to availability. SCWA is assumed to divert excess flow when it is available, and when there is available pumping capacity.

   (2) “Other” water- derived from transfers and/or other appropriated water, averaging 14.8 TAF annually but varying according remaining unmet demand.

e. EBMUD CVP diversions are governed by the Amendatory Contract, stipulating:

   (1) 133 TAF maximum diversion in any given year

   (2) 165 TAF maximum diversion amount over any 3 year period

   (3) Diversions allowed only when EBMUD total storage drops below 500 TAF

   (4) 155 cfs maximum diversion rate

5A.7 Delivery Specifications

This section lists the CVP and SWP contract amounts and other water rights assumptions used in the EIS No Action Alternative and No Action Alternative CalSim II simulations (Tables 5A.B.23 through 5A.B.27).

5A.8 USFWS RPA Implementation

The information included in this section is consistent with what was provided to and agreed upon by the lead agencies in the technical memorandum, "Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies" on February 10, 2010 (updated May 18, 2010).

5A.8.1 Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies

The USFWS BO was released on December 15, 2008. To develop CalSim II modeling assumptions for the RPA in the BO, DWR led a series of meetings that involved members of fisheries and project agencies. The purpose for establishing this group was to prepare the assumptions and CalSim II implementations to represent the RPAs in Existing and Future Condition CalSim II simulations for future planning studies.

This memorandum summarizes the approach that resulted from these meetings and the modeling assumptions that were laid out by the group. The scope of this memorandum is limited to the December 15, 2008 BO. Unless otherwise indicated, all descriptive information of the RPAs is taken from Appendix B of the BO.

Table 5A.B.28 lists the participants that contributed to the meetings and information summarized in this document.

The RPAs in the USFWS BO are based on physical and biological phenomena that do not lend themselves to simulations using a monthly time step. Much scientific and modeling judgment has been employed to represent the implementation of the RPAs. The group believes the logic put into CalSim II represents the RPAs as best as possible at this time, given the scientific understanding of environmental factors enumerated in the BO and the limited historical data for some of these factors.

Table 5A.B.23 Delta – Future Conditions

CVP/ SWP Contractor	Geographic Location	Water Right (TAF/yr)	SWP Table A Amount (TAF)		SWP Article 21 Demand (TAF/mon)	CVP Water Service Contracts (TAF/yr)	
			Ag	M&I		AG	M&I
North Delta							
City of Vallejo	City of Vallejo	–	–	–	–	–	16.0
CCWD*	Contra Costa County	–	–	–	–	–	195.0
Napa County FC&WCD	North Bay Aqueduct	–	–	29.03	1.0	–	–
Solano County WA	North Bay Aqueduct	–	–	47.51	1.0	–	–
Fairfield, Vacaville, and Benicia Agreement	North Bay Aqueduct	31.60	–	–	–	–	–
City of Antioch	City of Antioch	18.0	–	–	–	–	–
Total North Delta		**49.6**	**0.0**	**76.5**	**2.0**	**0.0**	**211.0**
South Delta							
Delta Water Supply Project	City of Stockton	32.4	–	–	–	–	–
Total South Delta		**32.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total		**82.0**	**0.0**	**76.5**	**2.0**	**0.0**	**211.0**

1 **Table 5A.B.24 CVP North-of-the-Delta – Future Conditions**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Anderson Cottonwood ID	Sacramento River Redding Subbasin	–	–	128.0	–	–
Clear Creek C.S.D.		13.8	1.5	–	–	–
Bella Vista WD		22.1	2.4	–	–	–
Shasta C.S.D.		–	1.0	–	–	–
Sac R. Misc. Users		–	–	3.4	–	–
Redding, City of		–	–	21.0	–	–
City of Shasta Lake		2.5	0.3	–	–	–
Mountain Gate C.S.D.			0.4	–	–	–
Shasta County Water Agency		0.5	0.5	–	–	–
Redding, City of/Buckeye		–	6.1	–	–	–
Total		**38.9**	**12.2**	**152.4**		**0.0**
Corning WD	Corning Canal	23.0	–	–	–	–
Proberta WD		3.5	–	–	–	–
Thomes Creek WD		6.4	–	–	–	–
Total		**32.9**	**0.0**	**0.0**	–	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Kirkwood WD	Tehama-Colusa Canal	2.1	–	–	–	–
Glide WD		10.5	–	–	–	–
Kanawha WD		45.0	–	–	–	–
Orland-Artois WD		53.0	–	–	–	–
Colusa, County of		20.0	–	–	–	–
Colusa County WD		62.2	–	–	–	–
Davis WD		4.0	–	–	–	–
Dunnigan WD		19.0	–	–	–	–
La Grande WD		5.0	–	–	–	–
Westside WD		65.0	–	–	–	–
Total		**285.8**	**0.0**	**0.0**	–	**0.0**
Sac. R. Misc. Users	Sacramento River	–	–	1.5	–	–
Glenn Colusa ID	Glenn-Colusa Canal	–	–	441.5	–	–
		–	–	383.5	–	–
Sacramento NWR		–	–	–	–	53.4
Delevan NWR		–	–	–	–	24.0
Colusa NWR		–	–	–	–	28.8

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Colusa Drain M.W.C.	Colusa Basin Drain	–	–	7.7	–	–
		–	–	62.3	–	–
Total		**0.0**	**0.0**	**895.0**	–	**106.2**
Princeton-Cordova-Glenn ID	Sacramento River	–	–	67.8	–	–
Provident ID		–	–	54.7	–	–
Maxwell ID		–	–	1.8	–	–
		–	–	16.2	–	–
Sycamore Family Trust		–	–	31.8	–	–
Roberts Ditch IC		–	–	4.4	–	–
Sac R. Misc. Users[b]		–	–	4.9	–	–
		–	–	9.5	–	–
Total		**0.0**	**0.0**	**191.2**	–	**0.0**
Reclamation District 108	Sacramento River	–	–	12.9	–	–
		–	–	219.1	–	–
River Garden Farms		–	–	29.8	–	–
Meridian Farms WC		–	–	35.0	–	–
Pelger Mutual WC		–	–	8.9	–	–
Reclamation District 1004		–	–	71.4	–	–
Carter MWC		–	–	4.7	–	–
Sutter MWC		–	–	226.0	–	–
Tisdale Irrigation & Drainage Co.		–	–	9.9	–	–

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Sac R. Misc. Users		–	–	103.4	–	–
		–	–	0.9	–	–
Feather River WD export		20.0	–	–	–	–
Total		**20.0**	**0.0**	**722.1**	–	**0.0**
Sutter NWR	Sutter bypass water for Sutter NWR	–	–	–	–	25.9
Gray Lodge WMA	Feather River	–	–	–	–	41.4
Butte Sink Duck Clubs		–	–	–	–	15.9
Total		**0.0**	**0.0**	**0.0**		**83.2**
Sac. R. Misc. Users	Sacramento River	–	–	56.8	–	–
City of West Sacramento		–	–	23.6	–	–
Davis-Woodland Water Supply Project		DSA 65	–	–	–	–
Total		**0.0**	**0.0**	**80.4**	–	**0.0**
Sac R. Misc. Users	Lower Sacramento River	–	–	4.8	–	–
Natomas Central MWC		–	–	120.2	–	–
Pleasant Grove-Verona MWC		–	–	26.3	–	–
City of Sacramento		–	0.0	–	0.0	–
PCWA (Water Rights)		–	0.0	–	0.0	–
Total		**0.0**	**0.0**	**151.3**	**0.0**	–
Total CVP North-of-Delta		**377.6**	**12.2**	**2,193.8**	**0.0**	**189.4**

Notes:

* Level 4 Refuge water needs are not included.

Table 5A.B.25 CVP South-of-the-Delta – Future Conditions

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Byron-Bethany ID	Upper DMC	20.6		–	–	–	–
Tracy, City of		–	10.0	–	–	–	–
		–	5.0	–	–	–	–
		–	5.0	–	–	–	–
Banta Carbona ID		20.0		–	–	–	–
Total		**40.6**	**20.0**	**0.0**	**0.0**	**0.0**	**0.0**
Del Puerto WD	Upper DMC	12.1	–	–	–	–	–
Davis WD		5.4	–	–	–	–	–
Foothill WD		10.8	–	–	–	–	–
Hospital WD		34.1	–	–	–	–	–
Kern Canon WD		7.7	–	–	–	–	–
Mustang WD		14.7	–	–	–	–	–
Orestimba WD		15.9	–	–	–	–	–
Quinto WD		8.6	–	–	–	–	–
Romero WD		5.2	–	–	–	–	–
Salado WD		9.1	–	–	–	–	–
Sunflower WD		16.6	–	–	–	–	–
West Stanislaus WD		50.0	–	–	–	–	–
Patterson WD		16.5	–	–	6.0	–	–
Total		**206.7**	**0.0**	**0.0**	**6.0**	**0.0**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Upper DMC Loss	Upper DMC	–	–	–	–	–	18.5
Panoche WD	Lower DMC Volta	6.6	–	–	–	–	–
San Luis WD		65.0	–	–	–	–	–
Laguna WD		0.8	–	–	–	–	–
Eagle Field WD		4.6	–	–	–	–	–
Mercy Springs WD		2.8	–	–	–	–	–
Oro Loma WD		4.6	–	–	–	–	–
Total		**84.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Central California ID	Lower DMC Volta	–	–	140.0	–	–	–
Grasslands via CCID	Lower DMC Volta	–	–	–	–	81.8	–
Los Banos WMA		–	–	–	–	11.2	–
Kesterson NWR	Lower DMC Volta	–	–	–	–	10.5	–
Freitas – SJBAP		–	–	–	–	6.3	–
Salt Slough – SJBAP		–	–	–	–	8.6	–
China Island – SJBAP		–	–	–	–	7.0	–
Volta WMA		–	–	–	–	13.0	–
Grassland via Volta Wasteway		–	–	–	–	23.2	–
Total		**0.0**	**0.0**	**140.0**	**0.0**	**161.5**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Fresno Slough WD	San Joaquin River at Mendota Pool	4.0	–	–	0.9	–	–
James ID		35.3	–	–	9.7	–	–
Coelho Family Trust		2.1	–	–	1.3	–	–
Tranquillity ID		13.8	–	–	20.2	–	–
Tranquillity PUD		0.1	–	–	0.1	–	–
Reclamation District 1606		0.2	–	–	0.3	–	–
Central California ID		–	–	392.4	–	–	–
Columbia Canal Co.		–	–	59.0	–	–	–
Firebaugh Canal Co.		–	–	85.0	–	–	–
San Luis Canal Co.		–	–	23.6	–	–	–
M.L. Dudley Company		–	–	–	2.3	–	–
Grasslands WD		–	–	–	–	29.0	–
Mendota WMA		–	–	–	–	27.6	–
Losses		–	–	–	–	–	101.5
Total		**55.5**	**0.0**	**560.0**	**34.8**	**56.6**	**101.5**
San Luis Canal Co.	San Joaquin River at Sack Dam	–	–	140.0	–	–	–
Grasslands WD		–	–	–	–	2.3	–
Los Banos WMA		–	–	–	–	12.4	–
San Luis NWR		–	–	–	–	19.5	–
West Bear Creek NWR		–	–	–	–	7.5	–
East Bear Creek NWR		–	–	–	–	8.9	–
Total		**0.0**	**0.0**	**140.0**	**0.0**	**50.6**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
San Benito County WD (Ag)	San Felipe	35.6	–	–	–	–	–
Santa Clara Valley WD (Ag)		33.1	–	–	–	–	–
Pajaro Valley WD		6.3	–	–	–	–	–
San Benito County WD (M&I)		–	8.3	–	–	–	–
Santa Clara Valley WD (M&I)		–	119.4	–	–	–	–
Total		**74.9**	**127.7**	**0.0**	**0.0**	**0.0**	**0.0**
San Luis WD	CA reach 3	60.1	–	–	–	–	–
CA, State Parks and Rec		2.3	–	–	–	–	–
Affonso/Los Banos Gravel Co.		0.3	–	–	–	–	–
Total		**62.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Panoche WD	CVP Dos Amigos Pumping Plant/ CA reach 4	87.4	–	–	–	–	–
Pacheco WD		10.1	–	–	–	–	–
Total		**97.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Westlands WD (Centinella)	CA reach 4	2.5	–	–	–	–	–
Westlands WD (Broadview WD)		27.0	–	–	–	–	–
Westlands WD (Mercy Springs WD)		4.2	–	–	–	–	–
Westlands WD (Widern WD)		3.0	–	–	–	–	–
Total		**36.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Westlands WD: CA Joint Reach 4	CA reach 4	219.0	–	–	–	–	–
Westlands WD: CA Joint Reach 5	CA reach 5	570.0	–	–	–	–	–
Westlands WD: CA Joint Reach 6	CA reach 6	219.0	–	–	–	–	–
Westlands WD: CA Joint Reach 7	CA reach 7	142.0	–	–	–	–	–
Total		**1150.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Avenal, City of	CA reach 7	–	3.5	–	3.5	–	–
Coalinga, City of		–	10.0	–	–	–	–
Huron, City of		–	3.0	–	–	–	–
Total		**0.0**	**16.5**	**0.0**	**3.5**	**0.0**	**0.0**
CA Joint Reach 3 – Loss	CVP Dos Amigos PP/CA reach 3	–	–	–	–	–	2.5
CA Joint Reach 4 – Loss	CA reach 4	–	–	–	–	–	10.1
CA Joint Reach 5 – Loss	CA reach 5	–	–	–	–	–	30.1
CA Joint Reach 6 – Loss	CA reach 6	–	–	–	–	–	12.5
CA Joint Reach 7 – Loss	CA reach 7	–	–	–	–	–	8.5
Total		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**63.7**
Cross Valley Canal – CVP	CA reach 14	–	–	–	–	–	–
Fresno, County of		3.0	–	–	–	–	–
Hills Valley ID-Amendatory		3.3	–	–	–	–	–
Kern-Tulare WD		40.0	–	–	–	–	–
Lower Tule River ID		31.1	–	–	–	–	–

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Pixley ID		31.1	–	–	–	–	–
Rag Gulch WD		13.3	–	–	–	–	–
Tri-Valley WD		1.1	–	–	–	–	–
Tulare, County of		5.3	–	–	–	–	–
Kern NWR		–	–	–	–	11.0	–
Pixley NWR		–	–	–	–	1.3	–
Total		**128.3**	**0.0**	**0.0**	**0.0**	**12.3**	**0.0**
Total CVP South-of-Delta		**1,937.1**	**164.2**	**840.0**	**44.3**	**281.0**	**183.7**

Notes:

*Level 4 Refuge water supplies are not included.

1 **Table 5A.B.26 SWP North-of-the-Delta – Future Conditions**

SWP CONTRACTOR	Geographic Location	FRSA Amount (TAF)	Water Right (TAF/yr)	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Other (TAF/yr)
				Ag	M&I		
Feather River							
Palermo	FRSA	–	17.6	–	–	–	–
County of Butte	Feather River	–	–	–	27.5	–	–
Thermalito	FRSA	–	8.0	–	–	–	–
Western Canal	FRSA	150.0	145.0	–	–	–	–
Joint Board	FRSA	550.0	5.0	–	–	–	–
City of Yuba City	Feather River	–	–	–	9.6	–	–
Feather WD	FRSA	17.0	–	–	–	–	–
Garden, Oswald, Joint Board	FRSA	–	–	–	–	–	–
Garden	FRSA	12.9	5.1	–	–	–	–
Oswald	FRSA	2.9	–	–	–	–	–
Joint Board	FRSA	50.0	–	–	–	–	–
Plumas, Tudor	FRSA	–	–	–	–	–	–
Plumas	FRSA	8.0	6.0	–	–	–	–
Tudor	FRSA	5.1	0.2	–	–	–	–
Total Feather River Area		**795.8**	**186.9**	**0.0**	**37.1**	–	–

SWP CONTRACTOR	Geographic Location	FRSA Amount (TAF)	Water Right (TAF/yr)	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Other (TAF/yr)
				Ag	M&I		
Other							
Yuba County Water Agency	Yuba River	–	–	–	–	–	Variable
		–	–	–	–	–	333.6
Camp Far West ID	Yuba River	–	–	–	–	–	12.6
Bear River Exports	American R/DSA70	–	–	–	–	–	Variable
		–	–	–	–	–	95.2
Feather River Exports to American River (left bank to DSA70)	American R/DSA70	–	11.0	–	–	–	–

Table 5A.B.27 SWP South-of-the-Delta –Future Conditions

SWP Contractor	Geographic Location	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Losses (TAF/yr)
		Ag	M&I		
Alameda Co. FC&WCD, Zone 7	SBA reaches 1-4	–	47.60	1.00	–
	SBA reaches 5-6	–	33.02	None	–
	Total	–	**80.62**	**1.00**	–
Alameda County WD	SBA reaches 7-8	–	42.00	1.00	–
Santa Clara Valley WD	SBA reach 9	–	100.00	4.00	–
Oak Flat WD	CA reach 2A	5.70	–	None	–
County of Kings	CA reach 8C	9.31	–	None	–
Dudley Ridge WD	CA reach 8D	50.34	–	1.00	–
Empire West Side ID	CA reach 8C	2.00	–	1.00	–
Kern County Water Agency	CA reaches 3, 9-13B	608.86	134.60	None	–
	CA reaches 14A-C	99.20	–	180.00	–
	CA reaches 15A-16A	59.40	–	None	–
	CA reach 31A	80.67	–	None	–
	Total	**848.13**	**134.60**	**180.00**	–
Tulare Lake Basin WSD	CA reaches 8C-8D	88.92	–	15.00	–
San Luis Obispo Co. FC&WCD	CA reaches 33A-35	–	25.00	None	–
Santa Barbara Co. FC&WCD	CA reach 35	–	45.49	None	–
Antelope Valley-East Kern WA	CA reaches 19-20B, 22A-B	–	141.40	1.00	–
Castaic Lake WA	CA reach 31A	12.70	–	1.00	–
	CA reach 30	–	82.50	None	–
	Total	**12.70**	**82.50**	**1.00**	–
Coachella Valley WD	CA reach 26A	–	138.35	2.00	–

SWP Contractor	Geographic Location	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Losses (TAF/yr)
		Ag	M&I		
Crestline-Lake Arrowhead WA	CA reach 24	–	5.80	None	–
Desert WA	CA reach 26A	–	55.75	5.00	–
Littlerock Creek ID	CA reach 21	–	2.30	None	–
Mojave WA	CA reaches 19, 22B-23	–	82.80	None	–
Metropolitan WDSC	CA reach 26A	–	148.67	90.70	–
	CA reach 30	–	756.69	74.80	–
	CA reaches 28G-H	–	102.71	27.60	–
	CA reach 28J	–	903.43	6.90	–
	Total	–	**1911.50**	**200.00**	–
Palmdale WD	CA reaches 20A-B	–	21.30	None	–
San Bernardino Valley MWD	CA reach 26A	–	102.60	None	–
San Gabriel Valley MWD	CA reach 26A	–	28.80	None	–
San Gorgonio Pass WA	CA reach 26A	–	17.30	None	–
Ventura County FCD	CA reach 29H	–	3.15	None	–
	CA reach 30	–	16.85	None	–
	Total	–	**20.00**	–	–

SWP Contractor	Geographic Location	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Losses (TAF/yr)
		Ag	M&I		
SWP Losses	CA reaches 1-2	–	–	–	7.70
	SBA reaches 1-9	–	–	–	0.60
	CA reach 3	–	–	–	10.80
	CA reach 4	–	–	–	2.60
	CA reach 5	–	–	–	3.90
	CA reach 6	–	–	–	1.20
	CA reach 7	–	–	–	1.60
	CA reaches 8C-13B	–	–	–	11.90
	Wheeler Ridge Pumping Plant and CA reaches 14A-C	–	–	–	3.60
	Chrisman Pumping Plant and CA reaches 15A-18A	–	–	–	1.80
	Pearblossom Pumping Plant and CA reaches 17-21	–	–	–	5.10
	Mojave Pumping Plant and CA reaches 22A-23	–	–	–	4.00
	REC and CA reaches 24-28J	–	–	–	1.40
	CA reaches 29A-29F	–	–	–	1.90
	Castaic PWP and CA reach 29H	–	–	–	3.10
	REC and CA reach 30	–	–	–	2.40
	Total	–	–	–	**63.60**
Total		**1,017.10**	**3,038.11**	**412.00**	**63.60**

Table 5A.B.28 Meeting Participants

Aaron Miller/DWR Steve Ford/DWR Randi Field/Reclamation Gene Lee/Reclamation Lenny Grimaldo/Reclamation	Derek Hilts/USFWS Steve Detwiler/USFWS Matt Nobriga/CDFW Jim White/CDFW Craig Anderson/NMFS
Parviz Nader-Tehrani/DWR Erik Reyes/DWR Sean Sou/DWR	Robert Leaf/CH2M HILL Derya Sumer/CH2M HILL

The simulated OMR flow conditions and CVP and SWP Delta export operations, resulting from these assumptions, are believed to be a reasonable representation of conditions expected to prevail under the RPAs over large spans of years (refer to CalSim II modeling results for more details on simulated operations). Actual OMR flow conditions and Delta export operations will differ from simulated operations for numerous reasons, including having near real-time knowledge and/or estimates of turbidity, temperature, and fish spatial distribution that are unavailable for use in CalSim II over a long period of record. Because these factors and others are believed to be critical for smelt entrainment risk management, the USFWS adopted an adaptive process in defining the RPAs. Given the relatively generalized representation of the RPAs, assumed for CalSim II modeling, much caution is required when interpreting outputs from the model.

5A.8.1.1 Action 1: Adult Delta Smelt Migration and Entrainment (RPA Component 1, Action 1 – First Flush)

5A.8.1.1.1 Action 1 Summary:

Objective: A fixed duration action to protect pre-spawning adult Delta Smelt from entrainment during the first flush, and to provide advantageous hydrodynamic conditions early in the migration period.

Action: Limit exports so that the average daily combined OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent).

Timing:

Part A: December 1 to December 20 – The Smelt Working Group (SWG) may recommend a start date to the USFWS based upon an examination of turbidity data from Prisoner's Point, Holland Cut, Victoria Canal and salvage data from CVP and SWP (see below), and other parameters important to the protection of Delta Smelt including (but not limited to) preceding conditions of X2, the Fall Midwater Trawl Survey (FMWT), and river flows. The USFWS will make the final determination.

Part B: After December 20 – The action will begin if the 3-day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 nephelometric turbidity units (NTU). However the SWG can recommend a delayed start or

interruption based on other conditions such as Delta inflow that may affect vulnerability to entrainment.

Triggers (Part B):

Turbidity: Three-day average of 12 NTU or greater at all three turbidity stations (Prisoner's Point, Holland Cut, and Victoria Canal)

OR

Salvage: Three days of Delta Smelt salvage after December 20 at either facility or cumulative daily salvage count that is above a risk threshold based upon the daily salvage index approach reflected in a daily salvage index value greater than or equal to 0.5 (daily Delta Smelt salvage greater than one-half of the prior year FMWT index value).

The window for triggering Action 1 concludes when either off-ramp condition described below is met. These off-ramp conditions may occur without Action 1 ever being triggered. If this occurs, then Action 3 is triggered, unless the USFWS concludes on the basis of the totality of available information that Action 2 should be implemented instead.

Off-ramps:

Temperature: Water temperature reaches 12 degrees Celsius (°C) based on a three station daily mean at the temperature stations Mossdale, Antioch, and Rio Vista

OR

Biological: Onset of spawning (presence of spent females in the Spring Kodiak Trawl Survey [SKT] or at Banks or Jones).

5A.8.1.1.2 Action 1 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on hydrologic and assumed turbidity conditions. Under this general assumption, Part A of the action was never assumed because, on the basis of historical salvage data, it was considered unlikely or rarely to occur. Part B of the action was assumed to occur if triggered by turbidity conditions. This approach was believed to tend to a more conservative interpretation of the frequency, timing, and extent of this action. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than 2,500 cfs (within 25 percent of the monthly criteria).

Timing: If turbidity-trigger conditions first occur in December, then the action starts on December 21; if turbidity-trigger conditions first occur in January, then the action starts on January 1; if turbidity-trigger conditions first occur in February, then the action starts on February 1; and if turbidity-trigger conditions first occur in March, then the action starts on March 1. It is assumed that once the action is triggered, it continues for 14 days.

Triggers: Only an assumed turbidity trigger that is based on hydrologic outputs was considered. A surrogate salvage trigger or indicator was not included because there was no way to model it.

Turbidity: If the monthly average unimpaired Sacramento River Index (four-river index: sum of Sacramento, Yuba, Feather, and American Rivers) exceeds 20,000 cfs, then it is assumed that an event, in which the 3-day average turbidity at Hood exceeds 12 NTU, has occurred within the month. It is assumed that an event at Sacramento River is a reasonable indicator of this condition occurring, within the month, at all three turbidity stations: Prisoner's Point, Holland Cut, and Victoria Canal.

A chart showing the relationship between turbidity at Hood (number of days with turbidity is greater than 12 NTU) and Sacramento River Index (sum of monthly flow at four stations on the Sacramento, Feather, Yuba and American Rivers, from 2003 to 2006) is shown on Figure 5A.B.1. For months when average Sacramento River Index is between 20,000 cfs and 25,000 cfs, a transition is observed in number of days with Hood turbidity greater than 12 NTU. For months when average Sacramento River Index is above 25,000 cfs, Hood turbidity was always greater than 12 NTU for as many as 5 days or more within the month in which the flow occurred. For a conservative approach, 20,000 cfs is used as the threshold value.

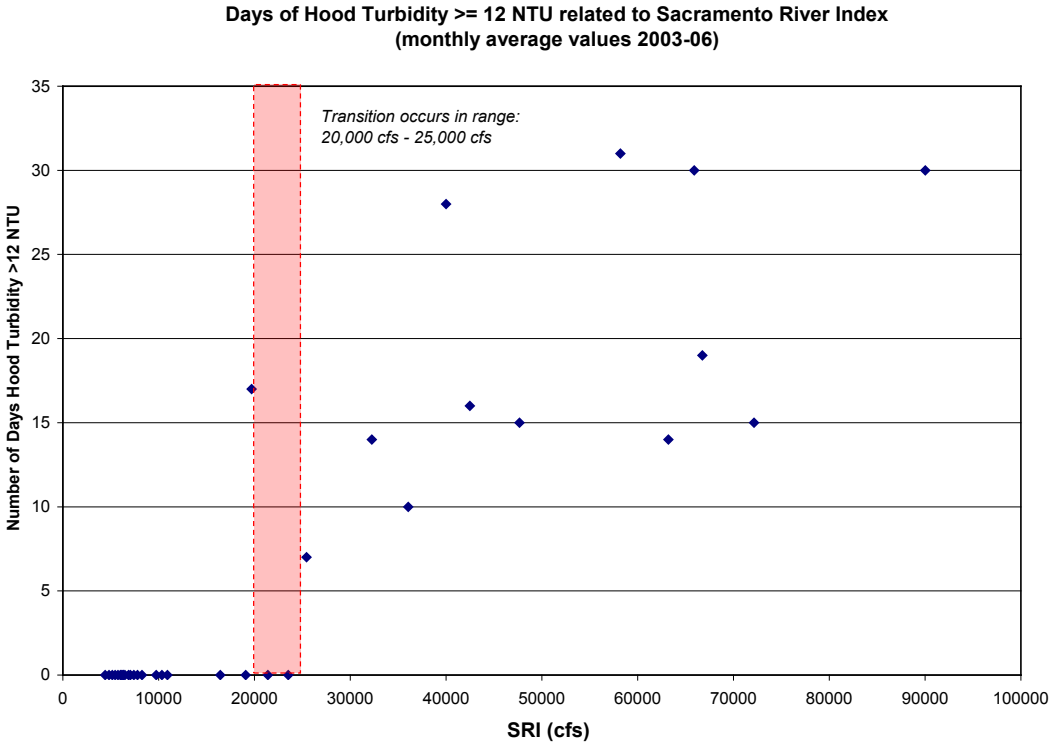

Figure 5A.B.1 Relationship between Turbidity at Hood and Sacramento River Index

Salvage: It is assumed that salvage would occur when first flush occurs.

Off-ramps: Only temperature-based off-ramping is considered. A surrogate biological off-ramp indicator was not included.

Temperature: Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought for use as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (see Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, estimated daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

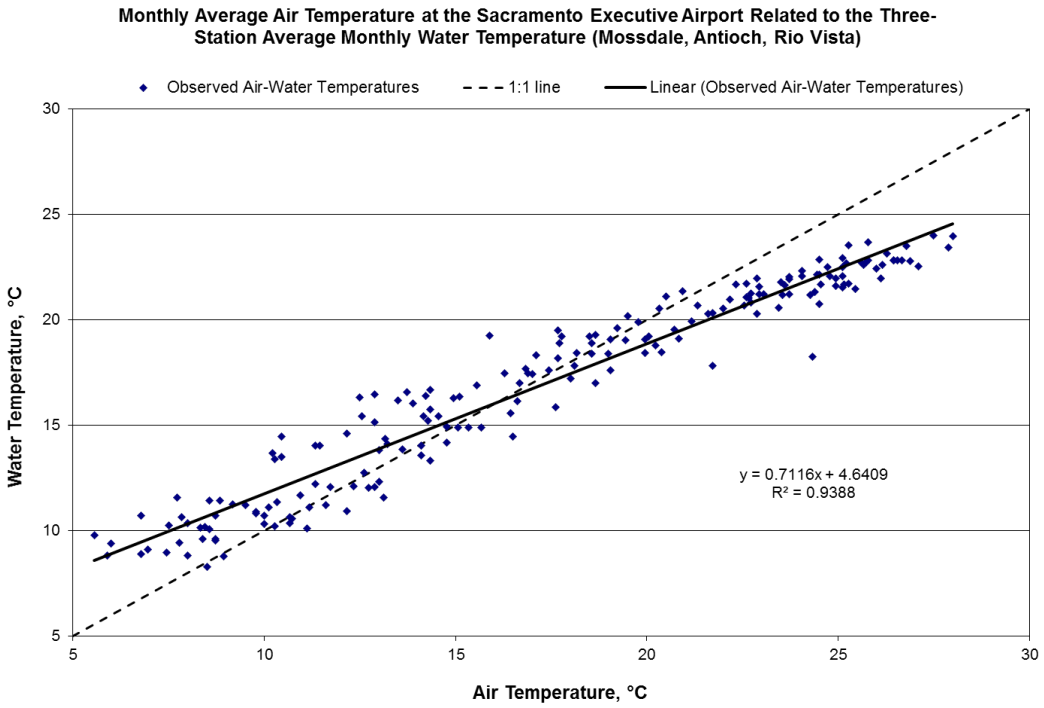

Figure 5A.B.2 Relationship between Monthly Average Air Temperature at the Sacramento Executive Airport and the Three-station Average Monthly Water Temperature

Other Modeling Considerations: For monthly analysis for the month of December (in which Action 1 does not begin until December 21), a background OMR flow must be assumed for the purpose of calculating a day-weighted average for implementing a partial-month action condition. When necessary, the background OMR flow for December was assumed to be -8,000 cfs.

For the additional condition to meet a 5-day running average no more negative than 2,500 cfs (within 25 percent), Paul Hutton's equation is used. Hutton concluded that with stringent OMR standards (1,250 to 2,500 cfs), the 5-day average would control more frequently than the 14-day average, but it is less likely to control at higher flows. Therefore, the CalSim II implementation includes both a 14-day (approximately monthly average) and a 5-day average flow criteria based on Hutton's methodology.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 1.

December 1 to December 20 for initiating Action 1 is not considered because seasonal peaks of Delta Smelt salvage are rare prior to December 20. Adult Delta Smelt spawning migrations often begin following large precipitation events that happen after mid-December.

Salvage of adult Delta Smelt often corresponds with increases in turbidity and exports. On the basis of the above discussion and Figure 5A.B.2, Sacramento River Index greater than 25,000 cfs is assumed to be an indicator of turbidity trigger being reached at all three turbidity stations: Prisoner's Point, Holland Cut, and Victoria Canal. Most sediment enters the Delta from the Sacramento River during flow pulses; therefore, a flow indicator based on only Sacramento River flow is used.

The 12°C threshold for the off-ramp criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

Results: Using these assumptions, in a typical CalSim II 82-year simulation (1922 through 2003 hydrologic conditions), Action 1 will occur 29 times in the December 21 to January 3 period, 14 times in the January 1 to January 14 period, 13 times in the February 1 to February 14 period, and 17 times in the March 1 to March 14 period. In three of these 17 occurrences (1934, 1991, and 2001), Action 3 is triggered before Action 1 and therefore Action 1 is bypassed. Action 1 is not triggered in nine of the 82 years (1924, 1929, 1931, 1955, 1964, 1976, 1977, 1985, and 1994), typically critically dry years. Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports, and other parameters of interest.

5A.8.1.2 Action 2: Adult Delta Smelt Migration and Entrainment (RPA Component 1, Action 2)

5A.8.1.2.1 Action 2 Summary:

Objective: An action implemented using an adaptive process to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions.

Action: The range of net daily OMR flows will be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions (and the general guidelines below),

specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination (see Adaptive Process description in the BO). The SWG would provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination.

Timing: Beginning immediately after Action 1. Before this date (in time for operators to implement the flow requirement) the SWG will recommend specific requirement OMR flows based on salvage and on physical and biological data on an ongoing basis. If Action 1 is not implemented, the SWG may recommend a start date for the implementation of Action 2 to protect adult Delta Smelt.

Suspension of Action:

Flow: OMR flow requirements do not apply whenever a 3-day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, the OMR flow requirements of the Action are again in place.

Off-ramps:

Temperature: Water temperature reaches 12°C based on a three-station daily average at the temperature stations: Rio Vista, Antioch, and Mossdale.

OR

Biological: Onset of spawning (presence of a spent female in SKT or at either facility).

5A.8.1.2.2 Action 2 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on the occurrence of Action 1 and X2 salinity conditions. This approach selects from between two OMR flow tiers depending on the previous month's X2 position, and is never more constraining than an OMR criterion of -3,500 cfs. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -3,500 or -5,000 cfs depending on the previous month's ending X2 location (-3,500 cfs if X2 is east of Roe Island, or -5,000 cfs if X2 is west of Roe Island), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -4,375 cfs if X2 is east of Roe Island, or -6,250 cfs if X2 is west of Roe Island).

Timing: Begins immediately after Action 1 and continues until initiation of Action 3.

In a typical CalSim II 82-year simulation, Action 1 was not triggered in nine of the 82 years. In these conditions it is assumed that OMR flow should be maintained no more negative than -5,000 cfs.

Suspension of Action: A flow peaking analysis, developed by Paul Hutton (2009), is used to determine the likelihood of a 3-day flow average greater than or

equal to 90,000 cfs in Sacramento River at Rio Vista and a 3-day flow average greater than or equal to 10,000 cfs in San Joaquin River at Vernalis occurring within the month. It is assumed that when the likelihood of these conditions occurring exceeds 50 percent, Action 2 is suspended for the full month, and OMR flow requirements do not apply. The likelihood of these conditions occurring is evaluated each month, and Action 2 is suspended for 1 month at a time whenever both of these conditions occur.

The equations for likelihood (frequency of occurrence) are as follows:

- Frequency of Rio Vista 3-day flow average > 90,000 cfs:
  - 0 percent when Freeport monthly flow < 50,000 cfs, OR
  - (0.00289 × Freeport monthly flow – 146) percent when 50,000 cfs ≤ Freeport plus Yolo Bypass monthly flow ≤ 85,000 cfs, OR
  - 100 percent when Freeport monthly flow >85,000 cfs
- Frequency of Vernalis 3-day flow average > 10,000 cfs:
  - 0 percent when Vernalis monthly flow < 6,000 cfs, OR
  - (0.00901 × Vernalis monthly flow – 49) percent when 6,000 cfs ≤ Vernalis monthly flow ≤ 16,000 cfs, OR
  - 100 percent when Vernalis monthly flow >16,000 cfs

The frequency of the Rio Vista 3-day flow average > 90,000 cfs equals 50 percent when Freeport plus Yolo Bypass monthly flow is 67,820 cfs and the frequency of Vernalis 3-day flow average > 10,000 cfs equals 50 percent Vernalis monthly flow is 10,988 cfs. Therefore these two flow values are used as thresholds in the model.

Off-ramps: Only temperature-based off-ramping is considered. A surrogate biological off-ramp indicator was not included.

Temperature: Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought for use as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 2.

Action 2 requirements are based on X2 location that is dependent on the Delta outflow. If outflows are very high, fewer Delta Smelt will spawn east of Sherman Lake; therefore, the need for OMR restrictions is lessened.

In the case of Action 1 not being triggered, CDFW suggested OMR > -5,000 cfs, following the actual implementation of the BO in winter 2009 because some adult Delta Smelt might move into the Central Delta without a turbidity event.

Action 2 is suspended when the likelihood of a 3-day flow average greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and a 3-day flow average greater than or equal to 10,000 cfs in San Joaquin River at Vernalis occurring concurrently within the month exceeds 50 percent, because at extreme high flows the majority of adult Delta Smelt will be distributed downstream of the Delta and entrainment concerns will be very low.

The 12°C threshold for the off-ramp criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

Results: Using these assumptions, in a typical CalSim II 82-year simulation (1922 through 2003 hydrologic conditions), Action 1, and therefore Action 2, does not occur in 12 of the 82 years (1924, 1929, 1931, 1934, 1955, 1964, 1976, 1977, 1985, 1991, 1994, and 2001), typically critically dry years. The criteria for suspension of OMR minimum flow requirements, described above, results in potential suspension of Action 2 (if Action 2 is active) six times in January, 11 times in February, six times in March (however, Action 2 was not active three of these six times), and two times in April. The result is that Action 2 is in effect 37 times in January (with OMR at -3,500 cfs 29 times, and at -5,000 cfs 8 times), 43 times in February (with OMR at -3,500 cfs 25 times, and at -5,000 cfs 18 times), 31 times in March (with OMR at -3,500 cfs 14 times, and at -5,000 cfs 17 times), and 80 times in April (with OMR at -3,500 cfs 46 times, and at -5,000 cfs 34 times). The frequency each month is a cumulative result of the action being triggered in the current or prior months. Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports, and other parameters of interest.

5A.8.1.3 Action 3: Entrainment Protection of Larval and Juvenile Delta Smelt (RPA Component 2)

5A.8.1.3.1 Action 3 Summary:

Objective: Minimize the number of larval Delta Smelt entrained at the facilities by managing the hydrodynamics in the Central Delta flow levels pumping rates spanning a time sufficient for protection of larval Delta Smelt, e.g., by using a VAMP-like action. Because protective OMR flow requirements vary over time (especially between years), the action is adaptive and flexible within appropriate constraints.

Action: Net daily OMR flow will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average

within 25 percent of the applicable requirement for OMR. Depending on extant conditions (and the general guidelines below), specific OMR flows within this range are recommended by the SWG from the onset of Action 3 through its termination (see Adaptive Process in Introduction). The SWG would provide these recommendations based upon weekly review of sampling data, from real-time salvage data at the CVP and SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination.

Timing: Initiate the action after reaching the triggers below, which are indicative of spawning activity and the probable presence of larval Delta Smelt in the South and Central Delta. Based upon daily salvage data, the SWG may recommend an earlier start to Action 3. The USFWS will make the final determination.

Triggers:

Temperature: When temperature reaches 12°C based on a three-station average at the temperature stations: Mossdale, Antioch, and Rio Vista.

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility).

Off-ramps:

Temporal: June 30;

OR

Temperature: Water temperature reaches a daily average of 25°C for three consecutive days at Clifton Court Forebay.

5A.8.1.4 Action 3 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on assumed temperature and X2 salinity conditions. This approach selects from among three OMR flow tiers depending on the previous month's X2 position and ranges from an OMR criteria of -1,250 to -5,000 cfs. Because of the potential low export conditions that could occur at an OMR criterion of -1,250 cfs, a criterion for minimum exports for health and safety is also assumed. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -1,250, -3,500, or -5,000 cfs, depending on the previous month's ending X2 location (-1,250 cfs if X2 is east of Chipps Island, -5,000 cfs if X2 is west of Roe Island, or -3,500 cfs if X2 is between Chipps and Roe Island, inclusively), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -1,562 cfs if X2 is east of Chipps Island, -6,250 cfs if X2 is west of Roe Island, or -4,375 cfs if X2 is between Chipps and Roe Island). The more constraining of this OMR requirement or the VAMP requirement will be selected during the VAMP period (April 15 to May 15). Additionally, in the case of the month of June, the OMR criterion from May is maintained through June (it is assumed that June OMR should not be more constraining than May).

Timing: Begins immediately upon temperature trigger conditions and continues until off-ramp conditions are met.

Triggers: Only temperature trigger conditions are considered. A surrogate biological trigger was included.

Temperature: Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought to be used as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, estimated daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

Biological: Onset of spawning is assumed to occur no later than May 30.

Clarification Note: This text previously read "Onset of spawning is assumed to occur no later than April 30", where the CalSim II lookup table has May 30 as the date. Based on RPA team discussions in August 2009, it was agreed upon that onset of spawning could not be modeled in CalSim II. This trigger was actually coded as a placeholder in case in the future this trigger was to be used; the date was selected purposefully in a way that it wouldn't affect modeling results. Temperature trigger for Action 3 does occur before end of April. Therefore it does not matter whether the document is corrected to read May 30 or the model lookup table is changed to April 30.

Off-ramps:

Temporal: It is assumed that the ending date of the action would be no later than June 30.

OR

Temperature: Only 17 years of data are available for Clifton Court water temperature. A similar approach as used in the temperature trigger was considered. However, because 3 consecutive days of water temperature greater than or equal to 25°C is required, a correlation between air temperature and water temperature did not work well for this off-ramp criterion. Out of the 17 recorded years, in 1 year the criterion was triggered in May (May 31), and in 3 years it was triggered in June (June 3, 21, and 27). In all other years it was observed in July or later. With only four data points before July, it was not possible to generate a rule based on statistics. Therefore, temporal off-ramp criterion (June 30) is used for all years.

Health and Safety: In CalSim II, a minimum monthly Delta export criterion of 300 cfs for SWP and 600 cfs (or 800 cfs depending on Shasta storage) for CVP is

assumed. This assumption is suitable for dry-year conditions when allocations are low and storage releases are limited; however, minimum monthly exports need to be made for protection of public health and safety (health and safety deliveries upstream of San Luis Reservoir).

In consideration of the severe export restrictions associated with the OMR criteria established in the RPAs, an additional set of health and safety criterion is assumed. These export restrictions could lead to a situation in which supplies are available and allocated; however, exports are curtailed forcing San Luis to have an accelerated drawdown rate. For dam safety at San Luis Reservoir, 2 feet per day is the maximum acceptable drawdown rate. Drawdown occurs faster in summer months and peaks in June when the agricultural demands increase. To avoid rapid drawdown in San Luis Reservoir, a relaxation of OMR is allowed so that exports can be maintained at 1,500 cfs in all months if needed.

This modeling approach may not fit the real-life circumstances. In summer months, especially in June, the assumed 1,500 cfs for health and safety may not be sufficient to keep San Luis drawdown below a safe 2 feet per day; under such circumstances the projects would be required to increase pumping in order to maintain dam safety.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 3.

The geographic distribution of larval and juvenile Delta Smelt is tightly linked to X2 (or Delta outflow). Therefore, the percentage of the population likely to be found east of Sherman Lake is also influenced by the location of X2. The X2-based OMR criteria were intended to model an expected management response to the general increase in Delta Smelt's risk of entrainment as a function of increasing X2.

The 12°C threshold for the trigger criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

The annual salvage season for Delta Smelt typically ends as South Delta water temperatures warm to lethal levels during summer. This usually occurs in late June or early July. The laboratory-derived upper lethal temperature for Delta Smelt is 25.4°C.

Results: Action 3 occurs 30 times in February (with OMR at -1,250 cfs 9 times, at -3,500 cfs 11 times, and at -5,000 cfs 10 times), 76 times in March (with OMR at -1,250 cfs 15 times, at -3,500 cfs 27 times, and at -5,000 cfs 34 times), all times (82) in April (with OMR at -1,250 cfs 17 times, at -3,500 cfs 29 times, and at -5,000 cfs 35 times), all times (82) in May (with OMR at -1,250 cfs 19 times, at -3,500 cfs 37 times, and at -5,000 cfs 26 times), and 70 times in June (with OMR at -1,250 cfs 7 times, at -3,500 cfs 37 times, and at -5,000 cfs 26 times). Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports and other parameters of interest. (Note: The above information is

based on the August 2009 version of the model and documents the development process; more recent versions of the model may have different results.)

5A.8.1.5 Action 4: Estuarine Habitat During Fall (RPA Component 3)

5A.8.1.5.1 Action 4 Summary:

Objective: Improve fall habitat for Delta Smelt by managing of X2 through increasing Delta outflow during fall when the preceding water year was wetter than normal. This will help return ecological conditions of the estuary to that which occurred in the late 1990s when smelt populations were much larger. Flows provided by this action are expected to provide direct and indirect benefits to Delta Smelt. Both the direct and indirect benefits to Delta Smelt are considered equally important to minimize adverse effects.

Action: Subject to adaptive management as described below, provide sufficient Delta outflow to maintain average X2 for September and October no greater (more eastward) than 74 kilometers in the fall following Wet years and 81 kilometers in the fall following Above Normal years. The monthly average X2 position is to be maintained at or seaward of these location for each individual month and not averaged over the 2-month period. In November, the inflow to CVP and SWP reservoirs in the Sacramento Basin will be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall X2 target. The action will be evaluated and may be modified or terminated as determined by the USFWS.

Timing: September 1 to November 30.

Triggers: Wet and Above Normal water-year type classification from the 1995 Water Quality Control Plan that is used to implement D-1641.

5A.8.1.5.2 Action 4 Assumptions for CalSim II Modeling Purposes:

Model is modified to increase Delta outflow to meet monthly average X2 requirements for September and October and subsequent November reservoir release actions in Wet and Above Normal years. No off-ramps are considered for reservoir release capacity constraints. Delta exports may or may not be reduced as part of reservoir operations to meet this action. The action is summarized in Table 5A.B.29.

Table 5A.B.29 Summary of Action 4 implementation in CalSim II

Fall Months following Wet or Above Normal Years	Action Implementation
September	Meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)
October	Meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)
November	Add reservoir releases up to natural inflow as needed to continue to meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)

Rationale: Action 4 requirements are based on determining X2 location. Adjustment and retraining of the ANN was also completed to address numerical sensitivity concerns.

Results: There are 38 September and 37 October months that the action is triggered over the 82-year simulation period.

5A.8.1.6 Action 5: Temporary Spring Head of Old River Barrier and the Temporary Barrier Project (RPA Component 2)

5A.8.1.6.1 Action 5 Summary:

Objective: To minimize entrainment of larval and juvenile Delta Smelt at Banks and Jones or from being transported into the South and Central Delta, where they could later become entrained.

Action: Do not install the spring HORB if Delta Smelt entrainment is a concern. If installation of the HORB is not allowed, the agricultural barriers would be installed as described in the project description. If installation of the HORB is allowed, the Temporary Barrier Project (TBP) flap gates would be tied in the open position until May 15.

Timing: The timing of the action would vary depending on the conditions. The normal installation of the spring temporary HORB and the TBP is in April.

Triggers: For Delta Smelt, installation of the HORB will only occur when particle tracking modeling results show that entrainment levels of Delta Smelt will not increase beyond 1 percent at Station 815 as a result of installing the HORB.

Off-ramps: If Action 3 ends or May 15, whichever comes first.

5A.8.1.6.2 Action 5 Assumptions for CalSim II and DSM2 Modeling Purposes:

The South Delta Improvement Program Stage 1 is not included in the Existing and Future Condition assumptions being used for CalSim II and DSM2 baselines. The TBP is assumed instead. The TBP specifies that HORB be installed and operated during April 1 through May 31 and September 16 through November 30. In response to the USFWS BO, Action 5, the HORB is assumed to not be installed during April 1 through May 31.

5A.9 NMFS RPA Implementation

The information included in this section is consistent with what was provided to and agreed by the lead agencies in the, “Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies”, on February 10, 2010 (updated May 18, 2010).

5A.9.1 Representation of National Marine Fisheries Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies

The NMFS BO was released on June 4, 2009. To develop CalSim II modeling assumptions to represent the operations related RPA actions required by this BO, DWR led a series of meetings that involved members of fisheries and project agencies. The purpose for establishing this group was to prepare the assumptions and CalSim II implementations to represent the RPAs in both Existing- and Future-Condition CalSim II simulations for future planning studies.

This memorandum summarizes the approach that resulted from these meetings and the modeling assumptions that were laid out by the group. The scope of this memorandum is limited to the June 4, 2009 BO. All descriptive information of the RPAs is taken from the BO.

Table 5A.B.30 lists the participants that contributed to the meetings and information summarized in this document.

Table 5A.B.30 Meeting Participants

Aaron Miller/DWR Randi Field/Reclamation Lenny Grimaldo/Reclamation Henry Wong/Reclamation	Derek Hilts/USFWS Roger Guinee/ USFWS Matt Nobriga/CDFW Bruce Oppenheim/ NMFS
Parviz Nader-Tehrani/ DWR Erik Reyes/ DWR Sean Sou/ DWR Paul A. Marshall/ DWR Ming-Yen Tu/ DWR Xiaochun Wang/ DWR	Robert Leaf/CH2M HILL Derya Sumer/CH2M HILL

The RPA actions in NMFS's BO are based on physical and biological processes that do not lend themselves to simulations using a monthly time step. Much scientific and modeling judgment has been employed to represent the implementation of the RPAs. The group believes the logic put into CalSim II represents the RPAs as best as possible at this time, given the scientific understanding of environmental factors enumerated in the BO and the limited historical data for some of these factors.

Given the relatively generalized representation of the RPAs assumed for CalSim II modeling, much caution is required when interpreting outputs from the model.

5A.9.1.1 Action Suite 1.1 Clear Creek

Suite Objective: The RPA actions described below were developed based on a careful review of past flow studies, current operations, and future climate change scenarios. These actions are necessary to address adverse project effects on flow and water temperature that reduce the viability of spring-run and Central Valley Steelhead in Clear Creek.

5A.9.1.1.1 Action 1.1.1 Spring Attraction Flows

Objective: Encourage spring-run movement to upstream Clear Creek habitat for spawning.

Action: Reclamation shall annually conduct at least two pulse flows in Clear Creek in May and June of at least 600 cfs for at least 3 days for each pulse, to attract adult spring-run holding in the Sacramento River main stem.

Action 1.1.1 Assumptions for CalSim II Modeling Purposes

Action: Model is modified to meet 600 cfs for 3 days twice in May. In the CalSim II analysis, flows sufficient to increase flow up to 600 cfs for a total of 6 days are added to the flows that would have otherwise occurred in Clear Creek.

Rationale: CalSim II is a monthly model. The monthly flow in Clear Creek is an underestimate of the actual flows that would occur subject to daily operational constraints at Whiskeytown Reservoir. The additional flow to meet 600 cfs for a total of 6 days was added to the monthly average flow model.

5A.9.1.1.2 Action 1.1.5 Thermal Stress Reduction

Objective: To reduce thermal stress to over-summering steelhead and spring-run during holding, spawning, and embryo incubation.

Action: Reclamation shall manage Whiskeytown releases to meet a daily water temperature of: (1) 60°F at the Igo gauge from June 1 through September 15 and (2) 56°F at the Igo gauge from September 15 to October 31.

5A.9.1.1.3 Action 1.1.5 Assumptions for CalSim II Modeling Purposes

Action: It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: A temperature model of Whiskeytown Reservoir has been developed by Reclamation. Further analysis using this or other temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in model.

5A.9.1.2 Action Suite 1.2 Shasta Operations

Objectives: To address the avoidable and unavoidable adverse effects of Shasta operations on winter-run and spring-run:

- Ensure a sufficient cold water pool to provide suitable temperatures for winter-run spawning between Balls Ferry and Bend Bridge in most years, without sacrificing the potential for cold water management in a subsequent year. Additional actions to those in the 2004 CVP and SWP operations opinion are needed, due to increased vulnerability of the population to temperature effects attributable to changes in Trinity River ROD operations, projected climate change hydrology, and increased water demands in the Sacramento River system.
- Ensure suitable spring-run temperature regimes, especially in September and October. Suitable spring-run temperatures will also partially minimize

temperature effects to naturally spawning, non-listed Sacramento River fall-run, an important prey base for endangered Southern Residents.

- Establish a second population of winter-run in Battle Creek as soon as possible, to partially compensate for unavoidable project-related effects on the one remaining population.
- Restore passage at Shasta Reservoir with experimental reintroductions of winter-run to the upper Sacramento and/or McCloud rivers, to partially compensate for unavoidable project related effects on the remaining population.

5A.9.1.2.1 Action 1.2.1 Performance Measures

Objective: To establish and operate to a set of performance measures for temperature compliance points and End-of-September (EOS) carryover storage, enabling Reclamation and NMFS to assess the effectiveness of this suite of actions over time. Performance measures will help to ensure that the beneficial variability of the system from changes in hydrology will be measured and maintained.

Action: To ensure a sufficient cold water pool to provide suitable temperatures, long-term performance measures for temperature compliance points and EOS carryover storage at Shasta Reservoir shall be attained. Performance measures for EOS carryover storage at Shasta Reservoir are as follows:

- 87 percent of years: Minimum EOS storage of 2.2 MAF
- 82 percent of years: Minimum EOS storage of 2.2 MAF and end-of-April storage of 3.8 MAF in following year (to maintain potential to meet Balls Ferry compliance point)
- 40 percent of years: Minimum EOS storage 3.2 MAF (to maintain potential to meet Jelly's Ferry compliance point in following year)

Performance measures (measured as a 10-year running average) for temperature compliance points during summer season are:

- Meet Clear Creek Compliance point 95 percent of time
- Meet Balls Ferry Compliance point 85 percent of time
- Meet Jelly's Ferry Compliance point 40 percent of time
- Meet Bend Bridge Compliance point 15 percent of time

5A.9.1.2.2 Action 1.2.1 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. System performance will be assessed and evaluated through post-processing of various model results.

Rationale: Given that the performance criteria are based on the CalSim II modeling data used in preparation of the Biological Assessment, the system performance after application of the RPAs should be similar as a percentage of

years that the end-of-April storage and temperature compliance requirements are met over the simulation period. Post-processing of modeling results will be compared to various new operating scenarios as needed to evaluate performance criteria and appropriateness of the rules developed.

5A.9.1.2.3 Action 1.2.2 November through February Keswick Release Schedule (Fall Actions)

Objective: Minimize impacts to listed species and naturally spawning non-listed fall-run from high water temperatures by implementing standard procedures for release of cold water from Shasta Reservoir.

Action: Depending on EOS carryover storage and hydrology, Reclamation shall develop and implement a Keswick release schedule, and reduce deliveries and exports as needed to achieve performance measures.

Action 1.2.2 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. Keswick flows based on operation of 3406(b)(2) releases in OCAP Study 7.1 (for Existing) and Study 8 (for Future) are used in CalSim II. These flows will be reviewed for appropriateness under this action**.** A post-process based evaluation similar to what has been explained in Action 1.2.1 will be conducted.

Rationale: Performance measures are set as percentage of years that the end-of-September and temperature compliance requirements are met over the simulation period. Post-processing of modeling results will be compared to various new operating scenarios as needed to evaluate performance criteria and appropriateness of the rules developed.

5A.9.1.2.4 Action 1.2.3 February Forecast; March – May 14 Keswick Release Schedule (Spring Actions)

Objective: To conserve water in Shasta Reservoir in the spring in order to provide sufficient water to reduce adverse effects of high water temperature in the summer months for winter-run, without sacrificing carryover storage in the fall.

Action:

- Reclamation shall make its February forecast of deliverable water based on an estimate of precipitation and runoff within the Sacramento River basin at least as conservative as the 90 percent probability of exceedance. Subsequent updates of water delivery commitments must be based on monthly forecasts at least as conservative as the 90 percent probability of exceedance.
- Reclamation shall make releases to maintain a temperature compliance point not in excess of 56°F between Balls Ferry and Bend Bridge from April 15 through May 15.

Action 1.2.3 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: Temperature models of Shasta Lake and the Sacramento River have been developed by Reclamation. This modeling reflects current facilities for temperature controlled releases. Further analysis using this or another temperature model can further verify that temperature operations can perform reasonably well with flows included in model and temperatures are met reliably at each of the compliance points. In the future, it may be that adjusted flow schedules may need to be developed based on development of temperature model runs in conjunction with CalSim II modeled operations.

5A.9.1.2.5 Action 1.2.4 May 15 through October Keswick Release Schedule (Summer Action)

Objective: To manage the cold water storage within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable habitat temperatures for winter-run, spring-run, Central Valley Steelhead, and Southern Distinct Population Segment (DPS) of Green Sturgeon in the Sacramento River between Keswick Dam and Bend Bridge, while retaining sufficient carryover storage to manage for next year's cohorts. To the extent feasible, manage for suitable temperatures for naturally spawning fall-run.

Action: Reclamation shall manage operations to achieve daily average water temperatures in the Sacramento River between Keswick Dam and Bend Bridge as follows:

- Not in excess of 56°F at compliance locations between Balls Ferry and Bend Bridge from May 15 through September 30 for protection of winter-run, and not in excess of 56°F at the same compliance locations between Balls Ferry and Bend Bridge from October 1 through October 31 for protection of mainstem spring run, whenever possible.
- Reclamation shall operate to a final Temperature Management Plan starting May 15 and ending October 31.

Action 1.2.4 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flows included in model. During the detailed effects analysis, temperature modeling and post-processing will be used to verify temperatures are met at the compliance points. In the long-term approach, for a complete interpretation of the action, development of temperature model runs are needed to develop flow schedules if needed for implementation into CalSim II.

Rationale: Temperature models of Shasta Lake and the Sacramento River have been developed by Reclamation. This modeling reflects current facilities for temperature controlled releases. Further analysis using this or another

temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in model and temperatures are met reliably at each of the compliance points. Alternative flow schedules may need to be developed based on development of temperature model runs in conjunction with CalSim II modeled operations.

5A.9.1.3 Action Suite 1.3 Red Bluff Diversion Dam (RBDD) Operations

Objectives: Reduce mortality and delay of adult and juvenile migration of winter-run, spring-run, Central Valley Steelhead, and Southern DPS of Green Sturgeon caused by the presence of the diversion dam and the configuration of the operable gates. Reduce adverse modification of the passage element of critical habitat for these species. Provide unimpeded upstream and downstream fish passage in the long-term by raising the gates year-round, and minimize adverse effects of continuing dam operations, while pumps are constructed to replace the loss of the diversion structure.

5A.9.1.3.1 Action 1.3.1 Operations after May 14, 2012: Operate RBDD with Gates Out

Action: No later than May 15, 2012, Reclamation shall operate RBDD with gates out all year to allow unimpeded passage for listed anadromous fish.

Action 1.3.1 Assumptions for CalSim II Modeling Purposes

Action: Adequate permanent facilities for diversion are assumed; therefore, no constraint on diversion schedules is included in the Future condition modeling.

5A.9.1.3.2 Action 1.3.2 Interim Operations

Action: Until May 14, 2012, Reclamation shall operate RBDD according to the following schedule:

- September 1—June 14: Gates open. No emergency closures of gates are allowed.
- June 15—August 31: Gates may be closed at Reclamation's discretion, if necessary to deliver water to TCCA.

Action 1.3.2 Assumptions for CalSim II Modeling Purposes

Action: Adequate interim/temporary facilities for diversion are assumed; therefore, no constraint on diversion schedules is included in the No Action Alternative modeling.

5A.9.1.4 Action 1.4 Wilkins Slough Operations

Objective: Enhance the ability to manage temperatures for anadromous fish below Shasta Dam by operating Wilkins Slough in the manner that best conserves the dam's cold water pool for summer releases.

Action: The Sacramento River Temperature Task Group (SRTTG) shall make recommendations for Wilkins Slough minimum flows for anadromous fish in critically dry years, in lieu of the current 5,000 cfs navigation criterion to NMFS

by December 1, 2009. In critically dry years, the SRTTG will make a recommendation.

5A.9.1.4.1 Action 1.4 Assumptions for CalSim II Modeling Purposes

Action: Current rules for relaxation of NCP in CalSim II (based on BA models) will be used. In CalSim II, NCP flows are relaxed depending on allocations for agricultural contractors. Table 5A.B.31 is used to determine the relaxation.

Table 5A.B.31 NCP Flow Schedule with Relaxation

CVP AG Allocation (percent)	NCP Flow (cfs)
< 10	3,250
10–25	3,500
25–40	4,000
40–65	4,500
> 65	5,000

Rationale: The allocation-flow criteria have been used in the CalSim II model for many years. The low allocation year relaxations were added to improve operations of Shasta Lake subject to 1.9 MAF carryover target storage. These criteria may be reevaluated subject to the requirements of Action 1.2.1.

5A.9.1.5 Action 2.1 Lower American River Flow Management

Objective: To provide minimum flows for all steelhead life stages.

Action: Implement the flow schedule specified in the Water Forum's Flow Management Standard (FMS), which is summarized in Appendix 2-D of the NMFS BO.

5A.9.1.5.1 Action 2.1 Assumptions for CalSim II Modeling Purposes

Action: The AFRMP Minimum Release Requirements (MRR) range from 800 to 2,000 cfs based on a sequence of seasonal indices and adjustments. The minimum Nimbus Dam release requirement is determined by applying the appropriate water availability index (Index Flow). Three water availability indices (i.e., Four Reservoir Index (FRI), Sacramento River Index (SRI), and the Impaired Folsom Inflow Index (IFII)) are applied during different times of the year, which provides adaptive flexibility in response to changing hydrological and operational conditions.

During some months, Prescriptive Adjustments may be applied to the Index Flow, resulting in the MRR. If there is no Prescriptive Adjustment, the MRR is equal to the Index Flow.

Discretionary Adjustments for water conservation or fish protection may be applied during the period extending from June through October. If Discretionary Adjustments are applied, then the resultant flows are referred to as the Adjusted Minimum Release Requirement (Adjusted MRR).

The MRR and Adjusted MRR may be suspended in the event of extremely dry conditions, represented by "conference years" or "off-ramp criteria". Conference years are defined when the projected March through November unimpaired inflow into Folsom Reservoir is less than 400,000 acre-feet. Off-ramp criteria are triggered if forecasted Folsom Reservoir storage at any time during the next 12 months is less than 200,000 acre-feet.

Rationale: Minimum instream flow schedule specified in the Water Forum's FMS is implemented in the model.

5A.9.1.6 Action 2.2 Lower American River Temperature Management

Objective: Maintain suitable temperatures to support over-summer rearing of juvenile steelhead in the lower American River.

Action: Reclamation shall develop a temperature management plan that contains: (1) forecasts of hydrology and storage; (2) a modeling run or runs, using these forecasts, demonstrating that the temperature compliance point can be attained (see Coldwater Management Pool Model approach in Appendix 2-D); (3) a plan of operation based on this modeling run that demonstrates that all other non-discretionary requirements are met; and (4) allocations for discretionary deliveries that conform to the plan of operation.

5A.9.1.6.1 Action 2.2 Assumptions for CalSim II Modeling Purposes

Action: The flows in the model reflect the FMS implemented under Action 2.1. It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: Temperature models of Folsom Lake and the American River were developed in the 1990s. Model development for long-range planning purposes may be required. Further analysis using a verified long-range planning level temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in the model and when temperatures are met reliably

5A.9.1.7 Action Suite 3.1 Stanislaus River/Eastside Division Actions

Overall Objectives: (1) Provide sufficient definition of operational criteria for Eastside Division to ensure viability of the steelhead population on the Stanislaus River, including freshwater migration routes to and from the Delta; and (2) halt or reverse adverse modification of steelhead critical habitat.

5A.9.1.7.1 Action 3.1.2 Provide Cold Water Releases to Maintain Suitable Steelhead Temperatures

Action: Reclamation shall manage the cold water supply within New Melones Reservoir and make cold water releases from New Melones Reservoir to provide suitable temperatures for CV steelhead rearing, spawning, egg incubation smoltification, and adult migration in the Stanislaus River downstream of Goodwin Dam.

Action 3.1.2 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flow operations resulting from the minimum flow requirements described in Action 3.1.3.

Rationale: Temperature models of New Melones Lake and the Stanislaus River have been developed by Reclamation. Further analysis using this or another temperature model can further verify that temperature operations perform reasonably well with flows included in model and temperatures are met reliably. Development of temperature model runs is needed to refine the flow schedules assumed.

5A.9.1.7.2 Action 3.1.3 Operate the East Side Division Dams to Meet the Minimum Flows, as Measured at Goodwin Dam

Objective: To maintain minimum base flows to optimize Central Valley Steelhead habitat for all life history stages and to incorporate habitat maintaining geomorphic flows in a flow pattern that will provide migratory cues to smolts and facilitate out-migrant smolt movement on declining limb of pulse.

Action: Reclamation shall operate releases from the East Side Division reservoirs to achieve a minimum flow schedule as prescribed in NMFS BO Appendix 2-E. When operating at higher flows than specified, Reclamation shall implement ramping rates for flow changes that will avoid stranding and other adverse effects on Central Valley Steelhead.

Action 3.1.3 Assumptions for CalSim II Modeling Purposes

Action: Minimum flows based on Appendix 2-E flows (presented in Figure 5A.B.3) are assumed consistent to what was modeled by NMFS (May 14 and 15, 2009 CalSim II models provided by NMFS; relevant logic merged into baselines models).

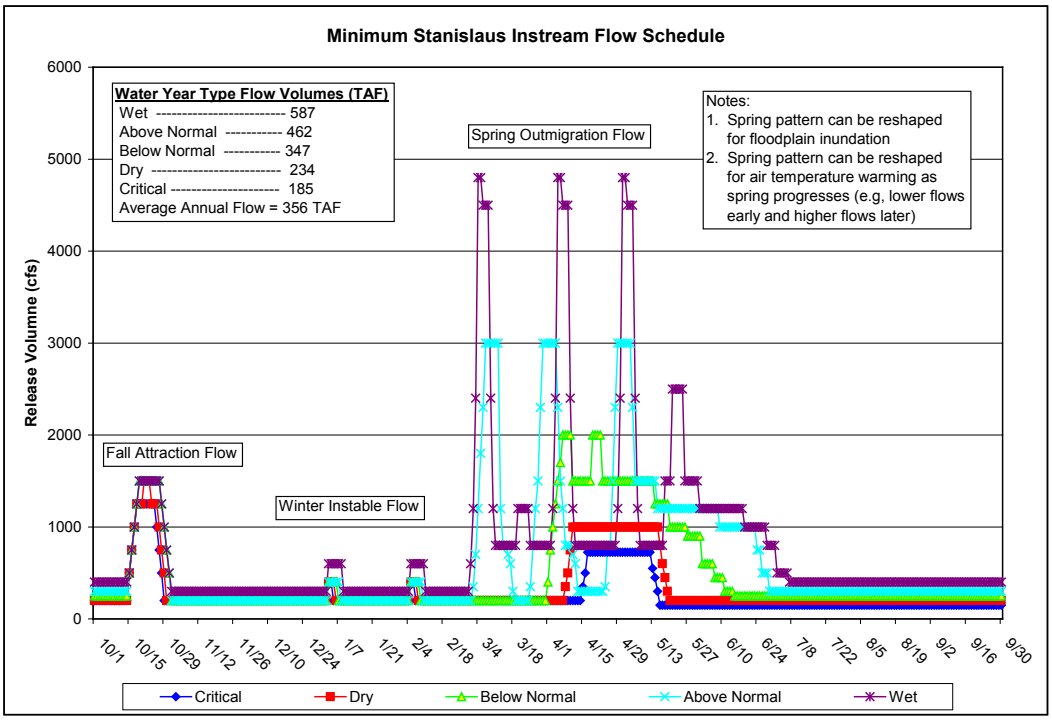

Figure 5A.B.3 Minimum Stanislaus instream flow schedule as prescribed in Appendix 2-E of the NMFS BO (06/04/09)

Annual allocation in New Melones is modeled to ensure availability of required instream flows (Table 5A.B.32) based on a water supply forecast that is comprised of end-of-February New Melones Storage (in TAF) plus forecasted inflow to New Melones from March 1 to September 30 (in TAF). The forecasted inflow is calculated using perfect foresight in the model. An allocated volume of water is released according to water year type following the monthly flow schedule illustrated in Figure 5A.B.3.

Table 5A.B.32 New Melones Allocations to Meet Minimum Instream Flow Requirements

New Melones index (TAF)	Annual Allocation Required for Instream Flows (TAF)
< 1000	0 to 98.9
1,000 to 1,399	98.9
1,400 to 1,724	185.3
1,725 to 2,177	234.1
2,178 to 2,386	346.7
2,387 to 2,761	461.7
2,762 to 6,000	586.9

Rationale: This approach was reviewed by National Oceanic and Atmospheric Administration (NOAA) fisheries and verified that the year typing and New Melones allocation scheme are consistent with the modeling prepared for the BO.

5A.9.1.8 Action Suite 4.1 Delta Cross Channel Gate Operation, and Engineering Studies of Methods to Reduce Loss of Salmonids in Georgiana Slough and Interior Delta

5A.9.1.8.1 Action 4.1.2 DCC Gate Operation

Objective: Modify DCC gate operation to reduce direct and indirect mortality of emigrating juvenile salmonids and Green Sturgeon in November, December, and January.

Action: During the period between November 1 and June 15, DCC gate operations will be modified from the proposed action to reduce loss of emigrating salmonids and Green Sturgeon. From December 1 to January 31, the gates will remain closed, except as operations are allowed using the implementation procedures/modified Salmon Decision Tree.

Timing: November 1 through June 15.

Triggers: Action triggers and description of action as defined in NMFS BO are presented in Table 5A.B.33.

Table 5A.B.33 NMFS BO DCC Gate Operation Triggers and Actions

Date	Action Triggers	Action Responses
October 1 – November 30	Water quality criteria per D-1641 are met and either the Knights Landing Catch Index (KLCI) or the Sacramento Catch Index (SCI) are greater than 3 fish per day, but less than or equal to 5 fish per day.	Within 24 hours of trigger, DCC gates are closed. Gates will remain closed for 3 days.
	Water quality criteria per D-1641 are met and either the KLCI or SCI is greater than 5 fish per day.	Within 24 hours, close the DCC gates and keep closed until the catch index is less than 3 fish per day at both the Knights Landing and Sacramento monitoring sites.
	The KLCI or SCI triggers are met, but water quality criteria are not met per D-1641 criteria.	DOSS reviews monitoring data and makes recommendation to NMFS and WOMT per procedures in Action IV.5.

Date	Action Triggers	Action Responses
December 1 – December 14	Water quality criteria are met per D-1641.	DCC gates are closed. If Chinook Salmon migration experiments are conducted during this time period (e.g., Delta Action 8 or similar studies), the DCC gates may be opened according to the experimental design, with NMFS' prior approval of the study.
	Water quality criteria are not met, but both the KLCI and SCI are less than 3 fish per day.	DCC gates may be opened until the water quality criteria are met. Once water quality criteria are met, the DCC gates will be closed within 24 hours of compliance.
	Water quality criteria are not met, but either the KLCI or SCI is greater than 3 fish per day.	DOSS reviews monitoring data and makes recommendation to NMFS and WOMT per procedures in Action IV.5
December 15 – January 31	December 15 – January 31	DCC Gates Closed.
	NMFS-approved experiments are being conducted.	Agency sponsoring the experiment may request gate opening for up to 5 days; NMFS will determine whether opening is consistent with ESA obligations.
	One-time event between December 15 and January 5, when necessary, to maintain Delta water quality in response to the astronomical high tide, coupled with low inflow conditions.	Upon concurrence of NMFS, DCC Gates may be opened 1 hour after sunrise to 1 hour before sunset, for up to 3 days, then return to full closure. Reclamation and DWR will also reduce Delta exports down to a health and safety level during the period of this action.
February 1 – May 15	D-1641 mandatory gate closure.	Gates closed, per WQCP criteria.
May 16 – June 15	D-1641 gate operations criteria	DCC gates may be closed for up to 14 days during this period, per 2006 WQCP, if NMFS determines it is necessary.

Action 4.1.2 Assumptions for CalSim II Modeling Purposes

Action: The DCC gate operations for October 1 through January 31 were layered on top of the D-1641 gate operations already included in the CalSim II model. The general assumptions regarding the NMFS DCC operations are summarized in Table 5A.B.34.

Timing: October 1 through January 31.

Table 5A.B.34 DCC Gate Operation Triggers and Actions as Modeled in CalSim II

Date	Modeled Action Triggers	Modeled Action Responses
October 1 – December 14	Sacramento River daily flow at Wilkins Slough exceeding 7,500 cfs; flow assumed to flush salmon into the Delta	Each month, the DCC gates are closed for the number of days estimated to exceed the threshold value.
	Water quality conditions at Rock Slough subject to D-1641 standards	Each month, the DCC gates are not closed if it results in violation of the D-1641 standard for Rock Slough; if DCC gates are not closed due to water quality conditions, exports during the days in question are restricted to 2,000 cfs.
December 15 – January 31	December 15-January 31	DCC Gates Closed.

Flow Trigger: It is assumed that from October 1 to December 14, the DCC will be closed if Sacramento River daily flow at Wilkins Slough exceeds 7,500 cfs. Using historical data (1945 through 2003, USGS gauge 11390500 "Sacramento River below Wilkins Slough near Grimes, CA"), a linear relationship is obtained between average monthly flow at Wilkins Slough and the number of days in month where the flow exceeds 7,500 cfs. This relation is then used to estimate the number of days of DCC closure for the October 1 to December 14 time period (Figure 5A.B.4).

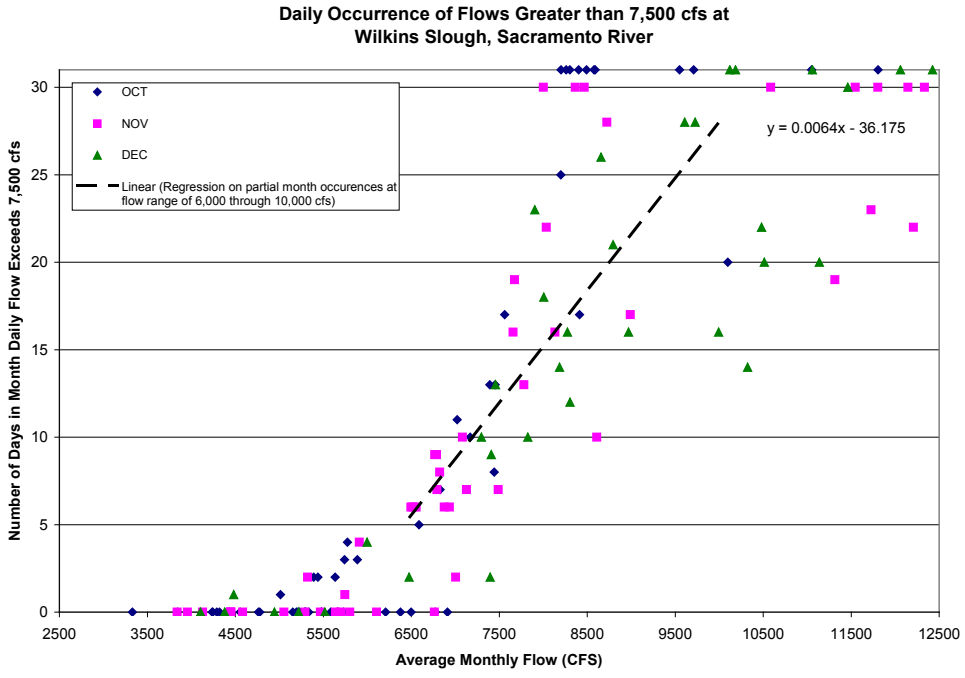

Figure 5A.B.4 Relationship between monthly averages of Sacramento River flows and number of days that daily flow exceeds 7,500 cfs in a month at Wilkins Slough

It is assumed that from December 15 through January 31 that the DCC gates are closed under all flow conditions.

Water Quality: It is assumed that during the October 1 – December 14 time period, the DCC gates may remain open if water quality is a concern. Using the CalSim II-ANN flow-salinity model for Rock Slough, the current month's chloride level at Rock Slough is estimated assuming DCC closure per NMFS BO. The estimated chloride level is compared against the Rock Slough chloride standard (monthly average). If estimated chloride level exceeds the standard, the gate closure is modeled per D-1641 schedule (for the entire month).

It is assumed that during the December 15 through January 31 time period the DCC gates are closed under all water quality conditions.

Export Restriction: During the October 1 to December 14 time period, if the flow trigger condition is such that additional days of DCC gates closed is called for, however water quality conditions are a concern and the DCC gates remain open, then Delta exports are limited to 2,000 cfs for each day in question. A monthly Delta export restriction is calculated based on the trigger and water quality conditions described above.

Rationale: The proposed representation in CalSim II should adequately represent the limited water quality concerns are that Sacramento River flows are low during the extreme high tides of December.

5A.9.1.9 Action Suite 4.2 Delta Flow Management

5A.9.1.9.1 Action 4.2.1 San Joaquin River Inflow to Export Ratio

Objectives: To reduce the vulnerability of emigrating Central Valley Steelhead within the lower San Joaquin River to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta, by increasing the inflow to export ratio. To enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the main stem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: For CVP and SWP operations under this action, "The Phase II: Operations beginning is 2012" is assumed. From April 1 through May 31, (1) Reclamation shall continue to implement the Goodwin flow schedule for the Stanislaus River prescribed in Action 3.1.3 and Appendix 2-E of the NMFS BO); and (2) Combined CVP and SWP exports shall be restricted to the ratio depicted in table 5A.B.35 below based on the applicable San Joaquin River Index, but will be no less than 1,500 cfs (consistent with the health and safety provision governing this action.)

Action 4.2.1 Assumptions for CalSim II Modeling Purposes

Action: Flows at Vernalis during April and May will be based on the Stanislaus River flow prescribed in Action 3.1.3 and the flow contributions from the rest of the San Joaquin River basin consistent with the representation of VAMP

contained in the BA modeling. In many years this flow may be less than the minimum Vernalis flow identified in the NMFS BO.

Exports are restricted as illustrated in Table 5A.B.35.

Table 5A.B.35 Maximum Combined CVP and SWP Export during April and May

San Joaquin River Index	Combined CVP and SWP Export Ratio
Critically dry	1:1
Dry	2:1
Below normal	3:1
Above normal	4:1
Wet	4:1

Rationale: Although the described model representation does not produce the full Vernalis flow objective outlined in the NMFS BO, it does include the elements that are within the control of the CVP and SWP, and that are reasonably certain to occur for the purpose of the EIS/EIR modeling.

In the long-term, a future SWRCB flow standard at Vernalis may potentially incorporate the full flow objective identified in the BO; and the Merced and Tuolumne flows would be based on the outcome of the current SWRCB and Federal Energy Regulatory Commission (FERC) processes that are underway.

5A.9.1.10 Action 4.2.3 Old and Middle River Flow Management

Objective: Reduce the vulnerability of emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: From January 1 through June 15, reduce exports, as necessary, to limit negative flows to -2,500 to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids. The reverse flow will be managed within this range to reduce flows toward the pumps during periods of increased salmonid presence. Refer to NMFS BO document for the negative flow objective decision tree.

5A.9.1.11 Action 4.2.3 Assumptions for CalSim II Modeling Purposes

Action: Old and Middle River flows required in this BO are assumed to be covered by OMR flow requirements developed for actions 1 through 3 of the USFWS BO Most Likely Scenario.

Rationale: Based on a review of available data, it appears that implementation of actions 1 through 3 of the USFWS RPA, and action 4.2.1 of the NOAA RPA will adequately cover this action within the CalSim II simulation. If necessary, additional post-processing of results could be conducted to verify this assumption.

Although the described model representation does not produce the full Vernalis flow objective outlined in the NMFS BO, it does include the elements that are within the control of the CVP and SWP, and that are reasonably certain to occur for the purpose of the EIS/EIR modeling.

In the long-term, a future SWRCB flow standard at Vernalis may potentially incorporate the full flow objective identified in the BO; and the Merced and Tuolumne flows would be based on the outcome of the current SWRCB and FERC processes that are underway.

5A.9.1.12 Action 4.2.3 Old and Middle River Flow Management

Objective: Reduce the vulnerability of emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: From January 1 through June 15, reduce exports, as necessary, to limit negative flows to -2,500 to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids. The reverse flow will be managed within this range to reduce flows toward the pumps during periods of increased salmonid presence. Refer to NMFS BO document for the negative flow objective decision tree.

5A.9.1.12.1 Action 4.2.3 Assumptions for CalSim II Modeling Purposes

Action: Old and Middle River flows required in this BO are assumed to be covered by OMR flow requirements developed for actions 1 through 3 of the USFWS BO Most Likely Scenario

Rationale: Based on a review of available data, it appears that implementation of actions 1 through 3 of the USFWS RPA, and action 4.2.1 of the NOAA RPA will adequately cover this action within the CalSim II simulation. If necessary, additional post-processing of results could be conducted to verify this assumption.

5A.10 References

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