C-2 MODEL DESCRIPTION

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Introduction

The purpose of the system operations modeling and Delta hydrodynamic, water quality and particle tracking modeling is to quantify environmental water management, water supply reliability, and water quality benefits and assess the potential environmental impacts of each project alternative. This chapter summarizes the models and modeling process applied to the project; additional details on modeling assumptions are also provided.

Evaluation of the project alternatives requires simulation of three key, interrelated systems: (1) the statewide operations of the CVP and California State Water Project (SWP), (2) Delta hydrodynamics and water quality, and (3) CCWD's local operations. Separate models are available, or have been developed as part of this project, for simulating each of these systems, and the information produced from each model can be integrated to assess the potential of each alternative to achieve project objectives, and the potential effects on CVP/SWP operations and the Delta and upstream environments. Tools used for the project include: (1) the Los Vaqueros operations model, (2) CalSim II, including the artificial neural network (ANN) module for the Delta, and (3) DSM2, including the "hydro", "qual", and particle tracking modules. The statewide and CCWD operations models were combined to run together in an integrated fashion, as described below. This integration was designed to improve sharing of information between the models and provide a more accurate representation of the interrelationship between statewide and CCWD operations.

Operations Models

The operations models used for the project are described below. Complete model output is available for review through CCWD by contacting Marguerite Naillon, Special Projects Manager, at mnaillon@ccwater.com or (925) 688-8018.

WRIMS

The Water Resources Integrated Modeling System (WRIMS) is a generalized water resources software program developed by DWR's Bay-Delta Office. WRIMS is entirely data driven and can be applied to most reservoir-river basin systems. WRIMS represents a given physical system (reservoirs, streams, canals, pumping plants, etc.) through a network of nodes and arcs. The model user describes system connectivity and various operational constraints using a modeling language known as Water Resources Simulation Language (WRESL). WRIMS simulates facility operations using optimization techniques to route water through the network based on mass balance accounting. A mixed integer programming solver determines an optimal set of decisions at each monthly time step for a set of user-defined priorities (weights) and system constraints. The model is described by DWR (2000a) and Draper et al. (2004).

CalSim II

As California's largest water projects, CVP and SWP operations influence and, at times, control flow in the Sacramento and San Joaquin river basins and the Delta. For this Draft EIS/EIR, water conditions and facility operations in the Delta and upstream areas are being simulated using the CalSim II model.

CalSim II is an application of the WRIMS software that was jointly developed by Reclamation and DWR for performing planning studies related to CVP and SWP operations. The primary purpose of CalSim II is to evaluate the water supply reliability of the CVP and SWP at current or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP/SWP exports to the San Francisco Bay Area (Bay Area), Central Coast, and Southern California. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over the period of simulation, representing a fixed level of development. The historical flow record of October 1921 to September 2003, adjusted for the influence of land use change and upstream flow regulation, is used to represent the possible range of water supply conditions. Major Central Valley rivers, reservoirs, and CVP/SWP facilities are represented by a network of arcs and nodes. CalSim II uses monthly mass balance accounting, and therefore cannot simulate the tidal hydrodynamics of the Delta, and has limited ability to represent Delta water quality.

There are many sources of information documenting the CalSim II model, including two peer reviews. Relevant reports include the following (Reclamation, 2008):

- External peer review commissioned by the CALFED Bay-Delta Program (CALFED) (Close et al., 2003)
- Analysis of an historical operations simulation (DWR, 2003)
- Analysis of the effect varying selected parameters has upon model results (sensitivity analysis study) (DWR, 2005)
- Analysis of the significance of the simulation time step to the estimated SWP delivery amounts (DWR, 2005).
- Peer review of San Joaquin River Valley application (Ford et al., 2006)

CalSim II can be used in either a comparative or an absolute mode. The comparative mode consists of comparing two model runs: one that contains a reservoir expansion project alternative and one that does not. Differences in certain factors, such as deliveries or reservoir storage levels, are analyzed to determine the effects of the project alternatives on system-wide operations. All of the assumptions are the same for the No Action/No Project and action alternative model runs, except the action itself, and the focus of the analysis is the differences in the results. In the absolute mode, results of a single model run, such as the amount of delivery or reservoir levels, are considered directly. Model assumptions and results are generally believed to be more reliable in a comparative study than an absolute study.

Results from a single simulation may not necessarily correspond to actual system operations for a specific month or year, but are representative of general water supply conditions. Model results are best interpreted using various statistical measures such as long-term or year-type averages.

Common Assumptions Common Model Package

In previous analyses, the CalSim II version that supported the 2004 Operations Criteria and Plan (2004 OCAP) and OCAP Biological Assessment (OCAP BA) had been used to analyze statewide operations (Reclamation, 2004a).[1] However, a revised and updated CalSim II model version has been developed for the DWR/Reclamation Surface Storage Investigations and has been adopted for the project Draft EIS/EIR analysis. This updated version of CalSim II is described in the following sections.

DWR, Reclamation and a team of consultants have developed a set of "common assumptions", together with a common set of tools and model studies, collectively known as the Common Assumptions Common Model Package (CACMP). The CACMP is intended to provide a common baseline for analyzing the surface storage projects currently under evaluation in California and to provide an evaluation framework that facilitates consistent analyses among the surface storage project teams. The CACMP shares many of the same operational rules and facilities as the 2004 OCAP BA modeling studies; however, the CACMP did make a number of changes corresponding to updated information, including, but not limited to: (1) SWP Banks Pumping Plant capacity is limited to 6,680 cfs in both the existing and future scenarios; (2) CCWD's Alternative Intake Project, the SBA Enlargement Project, and the Freeport Regional Water Project are incorporated into the future scenarios; (3) minimum flow requirements in the Lower Yuba River for both existing and future scenarios correspond to D-1644; and (4) the Delta-Mendota Canal-California Aqueduct (DMC-CA) Intertie with a limited CVP/SWP integration is included in the future scenario (CACMP, 2007a). For a full description of the assumptions incorporated into the CACMP modeling, consult the Common Assumptions team.

As part of the CACMP effort, the Los Vaqueros operations model (described later in this chapter) was integrated into the CACMP CalSim II model to allow dynamic calculation of operational parameters. The CACMP CalSim II model version used as the basis of the project modeling studies completed for the Draft EIS/EIR is Version 8D[2]. The CACMP includes a set of CalSim II studies. One of the studies simulates the existing condition as of 2005 and is the basis for the project Existing Condition. The CACMP Future No Action study is the basis of the Future No Action/No Project Alternative[3].

CalSim II Revisions and Updates

Revisions to CACMP CalSim II Version 8D were required for modeling for this Draft EIS/EIR to: (1) update the existing condition to account for new facilities, (2) include a limited Environmental Water Account (EWA) program, (3) include a representation of assumed future Delta operations in light of the December 2007 court interim remedial order in *NRDC vs. Kempthorne* and OCAP reconsultation, (4) adjust CVP/SWP annual allocation procedures, and (5) improve the efficiency of model simulation. These revisions are discussed in the following sections.

1 These OCAP BA studies were released by Reclamation on February 2, 2004, with revisions released June 30, 2004. The studies and their outlined assumptions are available from Reclamation's Central Valley Operations Office Web site (Reclamation, 2004b).

2 CACMP CalSim II Version 8D contains studies for two levels of development. Studies for existing and future no action conditions were dated April 22, 2007.

3 The Sacramento Valley hydrology used in the Future No Action CalSim II model reflects 2020 land-use assumptions associated with Bulletin 160-98 (DWR, 1998). The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation to support Reclamation studies.

Existing Conditions

The CACMP assumes an existing condition as of June 2004. The CACMP version of CalSim II has been updated to include: (1) the SBA Enlargement Project[4]; and (2) CCWD's Alternative Intake Project[5].

Limited EWA

The objective of simulating the EWA Program for project modeling is to represent the limited program as it has been implemented in 2008 and is expected to be implemented in coming years by SWP and CVP operations. This is referred to as Limited EWA (Reclamation, 2008). The EWA Program is not represented in the CACMP. Modeling for this Draft EIS/EIR assumes that EWA purchases are limited to 60,000 acre-feet, as provided for by the Lower Yuba River Accord (YCWA, 2007). Modeling also assumes that EWA actions are limited to the Vernalis Adaptive Management Plan (VAMP) export reduction at the Banks Pumping Plant.

Operational Modifications for new Operations Criteria and Plan (OCAP) Biological Opinions

The United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) have been required by federal court orders in *Natural Resources Defense Council v Kempthorne* (2007) and *Pacific Coast Federation of Fishermen's Associations v Gutierrez* (2008) to issue new biological opinions based on the 2008 OCAP for operating the SWP and CVP. USFWS issued its biological opinion on December 15, 2008. NMFS is currently preparing its biological opinion with a target for completion by mid summer 2009.

In the case of *Natural Resources Defense Council v Kempthorne*, the May 25, 2007 court order found the 2004 OCAP BO to be unlawful and inadequate and the accompanying Delta Smelt Risk Assessment Matrix, adopted to implement the 2004 OCAP BO, in violation of the Administrative Procedure Act. After a seven-day evidentiary hearing, held on August 21 through 24 and August 29 through 31, 2007, a list of interim remedies was developed. These remedies were included in an interim remedial order, dated December 14, 2007, which was intended to prevent the extinction of the delta smelt and the destruction or adverse modification of their habitat via a number of restrictions to CVP and SWP operations. This order continued in effect until completion of the reconsultation on the OCAP and issuance of the USFWS OCAP BO for delta smelt on December 15, 2008.

The analyses pertaining to operations of the SWP and CVP in this document are based on the Interim Order issued by Judge Wanger and the 2004 OCAP. The interim measures rely upon real-time conditions and cannot be simulated with one simple set of rules. Future measures are also likely to be based on real-time conditions. Modeling for this Draft EIS/EIR considered moderate and severe restrictions on Delta export operations to protect fisheries that capture the range of current and anticipated future operating rules, based on the terms of the interim remedial order.

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4 The SBA conveys water from Bethany Reservoir to ACWD, SCVWD, and Zone 7. The SBA was originally designed for a capacity of 300 cubic feet per second (cfs). The purpose of the SBA Enlargement Project is to increase the capacity of the SBA to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce SWP peak power consumption. This enlargement to 430 cfs total capacity is included in the existing conditions assumptions for these model studies.

5 CCWD's Alternative Intake Project (AIP) consists of a new 250 cfs screened intake in Victoria Canal, and associated pump station and pipeline to connect to CCWD's Old River facilities.

The assumptions used in modeling these operations for the Draft EIS/EIR are described in Appendix C-3, under “Fishery Restrictions Applied in CalSim II Model”.

Because NMFS has not yet issued its biological opinion, it is not yet possible to assess the changes to SWP and CVP operations that may occur due to the combined effects of the USFWS and NMFS biological opinions for the 2008 OCAP. Reclamation and DWR intend to complete an analysis of the effects that the new biological opinions will have on the operations of SWP and CVP. It is possible that the new opinions may result in moderate to severe fishery restrictions being imposed on Delta exports, depending on annual hydrologic conditions, above and beyond those caused by the Interim Order. The analysis of the effects of the new biological opinions on the operations of the SWP and CVP will be described in the Final Federal Feasibility Report and Final EIS/EIR for this project.

Water Supply Index-Delivery Index

CalSim II CVP/SWP delivery logic uses runoff forecast information and uncertainty and a standardized rule (Water Supply Index (WSI) versus Demand Index (DI) Curve) to estimate the total water available for delivery and carryover storage. The WSI is a conservative estimate of the water available to be shared between different uses, including deliveries, Delta requirements, and carryover storage. The WSI is the sum of the beginning-of-month storage in project reservoirs and forecast inflow. The WSI changes from month to month as storage levels change, forecasts become more certain and the accumulated inflows to the reservoirs increase. Once the WSI value is determined, CalSim II calculates a DI value from the WSI-DI curve. The DI is the sum of water available for deliveries and carryover storage. Generation of the WSI-DI curves has been automated in CalSim II to minimize CVP/SWP delivery shortages resulting from over-optimistic allocations.

The fishery restrictions assumed in CalSim II studies for project alternatives, discussed above, significantly alter CVP/SWP system operations. The WSI-DI curves were “retrained” to account for newly simulated constraints on reverse flows in the Old and Middle rivers prior to developing Los Vaqueros CalSim II simulations. After completion of the WSI-DI retraining, south-of-Delta (SOD) SWP and CVP Delta Index versus Export Index tables were adjusted manually to better address conveyance constraints through the Delta and at the export pumps.

Model Simulation Efficiency

The CACMP CalSim II model simulation is separated into five steps to correctly account for use of Central Valley Project Improvement Act (CVPIA) (b)(2) water, and available capacity for wheeling water at Banks and Jones pumping plants. These steps are known as D-1485, D-1641, B2, Conveyance, and Transfer. A 12-month period is simulated under each step before proceeding to the next step. The results from the final step are accepted as the end-of-year system state, and serve as the initial conditions for each of the steps in the following year’s analysis. The purpose of the first three steps is to define CVPIA (b)(2) actions, which are subsequently fully implemented in the Conveyance step[6]. The Conveyance step also includes “Stage 1” transfers. “Stage 2” transfers are included in the subsequent Transfer step.

Modeling for the project alternatives uses a “single-step” simulation developed from the April 22, 2007 five-step Joint Point of Diversion (JPOD) model using the Conveyance step. CVP

6 Simulated (b)(2) actions include additional releases from Whiskeytown, Shasta, and Folsom reservoirs to support AFRP target flows, and pumping curtailment at the Jones Pumping Plant.

operations to meet the CVPIA (b)(2) requirements are based on simulated b2 actions developed for the CACMP. The purpose of the D1641, D1485 and b2 steps in CalSim II is to determine which b2 actions are implemented in each water year. These steps are omitted in project simulations because the b2 actions defined for the CACMP are used.

Water transfers, with the exception of EWA north-of-Delta (NOD) purchases, are not simulated. The “Stage 1” transfers cycle was not included. Joint Point of Diversion is not simulated in single-step CalSim II studies performed for this project. Under Stage 1, as defined in D1641, CVP diversions at the Banks Pumping Plant are limited to that needed to deliver water to the Cross-Valley Canal. Under Stage 2, CVP is allowed to wheel additional water through Banks Pumping Plant subject to meeting certain requirements. Neither Stage 1 nor Stage 2 of JPOD is included in the modeling performed for this project.

Delta ANN Module

Salinity in the Delta cannot be modeled accurately by the simple mass balance routing and coarse time step used in CalSim II. Instead, CalSim II uses two algorithms to translate water quality standards into flow equivalents that are subsequently used to help define facility operations. The Kimmerer-Monismith equation relates Delta salinity (defined by the X2 location) to Delta outflow (Kimmerer and Monismith, 1992). Using Delta outflow captures the effects of seawater intrusion and provides a good estimate of the salinity variation in the western Delta. However, salinity in the interior Delta is also influenced by the relative magnitude of flows through the Delta channels and export pumping. Agricultural drainage and M&I wastewater discharges also can affect local salinity conditions. To capture these effects in the interior Delta, DWR developed an ANN algorithm[7] capable of mimicking DSM2.

Prior to the CACMP, the ANN algorithm used to mimic DSM2 was trained on four input parameters (Delta inflow from the Sacramento Valley, Delta inflow from the San Joaquin River, total Delta exports, and Delta Cross Channel gate operations) to estimate electrical conductivity (EC) at key locations in the Delta. Appendix D of the Benchmark Studies Assumptions (DWR and Reclamation, 2002) provides details of implementation of the ANN within CalSim II. ANN performance is discussed by DWR (1999, 2002). The ANN was further refined as part of the CACMP. The refined ANN is trained on six input parameters that additionally include Net Delta Consumptive Use and Tidal Energy (the difference between daily maximum and daily minimum hourly astronomical tide). Training the ANN on six parameters produces water quality results that mimic DSM2 more closely than the four-input ANN. The CACMP ANN refinements also allow simulation of flow-salinity relationships at six locations. The six locations are as follows: (1) Emmaton, (2) Jersey Point, (3) Contra Costa Canal Pumping Plant No. 1 (CCC PP No. 1), (4) Collinsville, (5) Chipps Island, and (6) Antioch. The Emmaton, Jersey Point, Collinsville, Chipps Island, and Antioch salinity standards are modeled directly at their respective locations in the Delta. However, the CCC PP No. 1 chloride standard is translated into an equivalent salinity standard for the Old River at Rock Slough because of DSM2 difficulties in accurately modeling water quality in Rock Slough.

[7] An Artificial Neural Network (ANN) is a non-linear statistical data modeling tool that can be used to model complex relationships between inputs and outputs or to find patterns in data.

Los Vaqueros Model

Using the WRIMS software, a model representing CCWD's existing Los Vaqueros Project and expansion project facility configurations was created, and then integrated with CalSim II. The Los Vaqueros Model represents the Los Vaqueros Reservoir, CCWD's Delta intakes at Rock Slough, Old River, and Victoria Canal, CCWD's intertie with the EBMUD Mokelumne Aqueduct, and new facilities as appropriate for the project alternatives (described in Chapter 3).

The Los Vaqueros Model was initially developed as a "stand-alone" model that requires input from other models to define boundary conditions. Inputs required for simulation include:

- Delta conditions (balanced vs. excess water conditions)
- Delta surplus available for diversion
- X2 location[8]
- Chloride concentration at Rock Slough, Old River, and AIP intakes

Delta Hydrodynamic and Water Quality Modeling – DSM2

DSM2 is a branched, one-dimensional model for simulating hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels (DWR, 2000b). The model is used by DWR and others to perform operational and planning studies of the Delta. Details of the model, including source codes, model calibration, and model performance, are available from the DWR Bay-Delta Office, Modeling Support Branch web site (DWR, 2000b). Documentation of model development is discussed in annual reports to the SWRCB. A DSM2 schematic is shown in **Figure C2-1**.

The Hydro module of DSM2, applied to the Delta, simulates tidal hydrodynamics (channel stage, flow, and water velocity) using a 15-minute time step. For the project, DSM2 Hydro is used to evaluate changes in stage and flow in the south and central Delta.

The Qual module of DSM2 can simulate the movement of both conservative and non-conservative constituents. For the project, DSM2-Qual is used to assess changes in EC as a surrogate for salinity at key locations within the Delta. Additionally, a fingerprinting analysis is used to identify sources of EC and provide the basis for the EC-to-chloride conversion at CCWD's intakes.

The particle tracking module (PTM) simulates the movement of neutrally buoyant particles by advection and dispersion, using a random walk methodology. DSM2-PTM is a quasi three-dimensional extension of DSM2. Using the mean velocity from DSM2-Hydro, DSM2-PTM

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8 X2 is the distance in kilometers from the Golden Gate Bridge to the point where daily average salinity is 2 parts per thousand (ppt) at one meter above the bottom of the Sacramento River channel. The location of X2 is used as a surrogate measure of ecosystem health in the Delta. Under the State Water Resources Control Board (SWRCB)Water Right Decision 1641 (D-1641), CVP/SWP operators are responsible for maintaining the X2 location, as specified in the 1995 Water Quality Control Plan.

applies a logarithmic vertical velocity profile and a parabolic lateral velocity profile to allow longitudinal dispersion. For the project, DSM2-PTM is used to model the transport and fate of passive or non-mobile organisms within the Delta to help quantify circulation changes and resulting entrainment risks.

Tidal forcing is imposed at the downstream boundary at Martinez as a time series of stage (for the hydrodynamic module) and salinity (for the water quality module). DWR has traditionally used a “19-year mean tide” (or “repeating tide”) in 73-year (1922 through 1994) DSM2 planning studies, in which the tide is represented by a single repeating 25-hour cycle. An “adjusted astronomical tide” was later developed by DWR for a 16-year period (1976 to 1991) that accounts for the spring-neap variation of the lunar tide cycle (DWR, 2001a). As part of the Common Assumptions effort, an updated version of DSM2 has been developed that has extended the simulation period to 82 years (1922 through 2003) and uses an adjusted astronomical tide for the entire period of record. CACMP DSM2 Version 9 is used to provide water quality data at CCWD’s three Delta diversion locations (Rock Slough, Old River, Victoria Canal)[9] to simulate Los Vaqueros operations within CalSim II, and to evaluate Delta water quality impacts as a result of the project.

In this Draft EIR/EIS, two different levels of development are considered, 2005 for existing conditions and 2030 for future conditions. The differences between these levels of development in the DSM2 model are the amount of agricultural diversions and agricultural return flows, and the operations of South Delta barriers. The agricultural diversions and return flows (to approximately 250 diversion nodes and 200 drainage nodes) were calculated by the Delta Island Consumptive Use model with consideration of precipitation, seepage, evapotranspiration, irrigation, soil moisture, leach water, runoff, crop type, and acreage. The DSM2 model for existing conditions includes the South Delta Temporary Barriers Project (DWR, 2008b), which consists of four rock barriers that are installed seasonally across south Delta channels (at the head of Old River, Middle River, Old River near Tracy, and Grant Line Canal) as fish and agricultural barriers.

DSM2 modeling of future conditions includes the four proposed South Delta Improvement Program (SDIP) permanent operable barriers (at the head of the Old River, Grant Line Canal, Old River at Tracy Road Bridge, and Middle River at Old River) replacing the existing temporary barriers in order to minimize the number of in- and out-migrating salmon moving toward export pumps; to maintain adequate water levels for south Delta farmers to prevent cavitation from occurring in their irrigation pumps; and to improve water quality in south Delta channels by providing better circulation (DWR, 2008c). SDIP proposed three sets of operations for the gates: Plans A, B, and C. Plan C permanent barrier operations were assumed in DSM2 for future conditions.

Key DSM2 inputs include tidal stage, boundary inflow and salinity concentration, and operation of flow control structures. **Table C2-1** summarizes basic input requirements and assumptions for the CACMP DSM2 version. Results from CalSim II are used to define Delta boundary inflows, including the Sacramento River flow at Hood, San Joaquin River flow at Vernalis, inflow from

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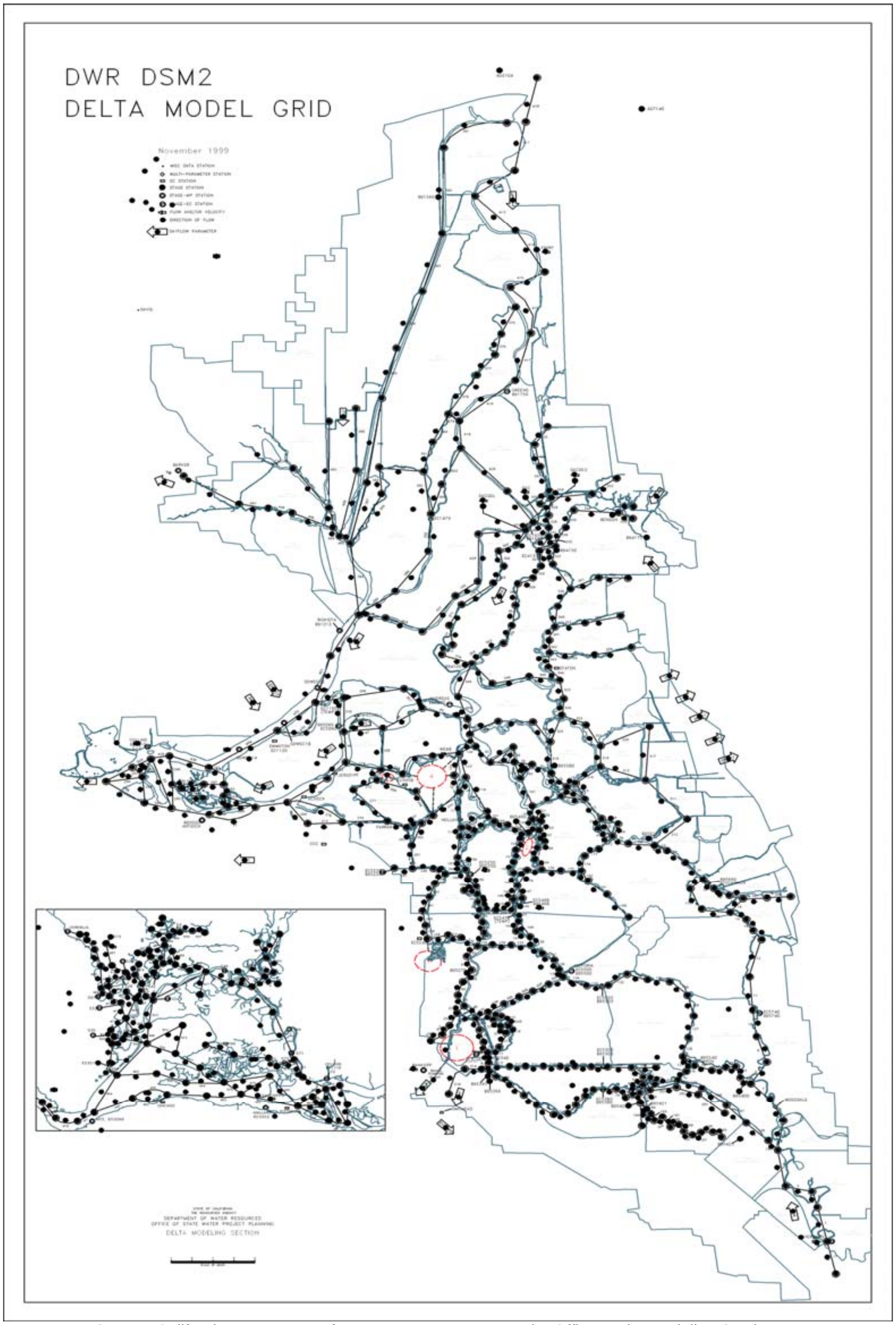
9 The Los Vaqueros module within CalSim II relies on input chloride concentrations to determine CCWD operations. The DSM2 channel locations used for this purpose are as follows:
(1) Rock Slough - ROLD024 (Old River at Bacon Island near Contra Costa Canal) was used for future LOD and CHCCC006 (Contra Costa Pumping Plant No.1) was used for the existing LOD. This distinction is made to include the effects of the CCWD Canal Replacement Project in the future LOD conditions.
(2) Old River - ROLD034, Old River near Byron.
(3) Victoria Canal (AIP) - CHVCT000, Victoria Canal at AIP.

the Yolo Bypass, and inflow from the east-side streams. In addition, net Delta outflow from CalSim II is used to calculate the DSM2 salinity boundary at Martinez.



Source: California Department of Water Resources, Bay-Delta Office, Delta Modeling Section, http://modeling.water.ca.gov/delta/models/dsm2/documentation.shtml.

Figure C2-1: Illustration of DSM2 Schematic

TABLE C2-1:
CACMP DSM2 INPUT REQUIREMENTS AND ASSUMPTIONS

Parameters	Assumptions
Period of Simulation	October 1976 – September 1991
Boundary Flows	CalSim II output: Sacramento River flow at Hood San Joaquin River flow at Vernalis Inflow from the Yolo Bypass Inflow from the east-side streams Net Delta Outflow CCWD diversions
Boundary Stage	15-minute adjusted astronomical tide
Agricultural Diversion & Return Flows	Delta Island Consumptive Use model, 2005/2030 level of development
Salinity	
Martinez EC	Computed from modified G-model, adjusted astronomical tide and Net Delta Outflow from CalSim II
Sacramento River	Constant value = 175 µS/cm
Yolo Bypass	Constant value = 175 µS/cm
Mokelumne River	Constant value = 150 µS/cm
Cosumnes River	Constant value = 150 µS/cm
Calaveras River	Constant value = 150 µS/cm
San Joaquin River	CalSim II EC estimate using link-node salt balance model
Agricultural Drainage	Varying monthly values that are constant year to year
Facility Operations	
Delta Cross Channel	CalSim II output
South Delta Barriers	Temporary barriers/SDIP operation of permanent barriers

Modeling Process

Modeling for the project alternatives included: (1) establishing baseline Delta water quality conditions; (2) developing operating rules for the project alternatives to optimize project benefits while minimizing potential environmental impacts, and (3) conducting impact analyses of the project alternatives. These modeling steps are summarized below.

Baseline Conditions

A set of baseline Delta water quality conditions was established using an iterative modeling procedure, as illustrated in **Figure C2-2**. These baseline conditions are inputs to CalSim II, and determine Los Vaqueros Reservoir blending operations. Two pairs of baseline conditions were developed, corresponding to scenarios with moderate and severe fishery restrictions on export pumping (described in Chapter 4.3) for both existing and future levels of development. These four distinct baseline conditions were developed using the following steps:

1. Retrain CalSim II WSI-DI (Water Supply Index versus Delivery Index) curves, and update Delta Index-Export Index tables for south-of-Delta CVP and SWP exports to account for imposed constraints on Delta exports (moderate or severe fishery restriction scenarios). Initial Delta water quality conditions were taken from DSM2

studies developed as part of the CACMP[10]. Initial Delta conditions were taken from CACMP CalSim II[11].

2. Simulate monthly operations for an 82-year period using the modified CACMP CalSim II version with integrated Los Vaqueros Model.
3. Simulate Delta tidal flows and EC using CACMP DSM2 for the 82-year period DSM2 run based on monthly CCWD/Los Vaqueros diversions and boundary flows from CalSim II (output from Step 2) as input.
4. Repeat steps 2 and 3 until changes in Los Vaqueros Project diversions and deliveries between iterations are small.

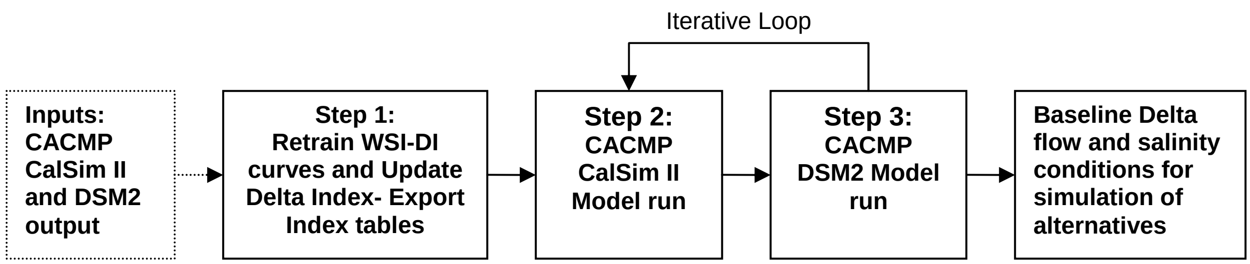


Figure C2-2: Development of Baseline Conditions

Minimizing Potential Delta Water Quality Impacts

Once baseline inputs were defined, operating rules were developed to avoid significant water quality impacts to other beneficial uses of Delta water. These operating rules were developed using the following steps as illustrated in **Figure C2-3**.

1. The system-wide baseline conditions defined through the iterative process shown in Figure C2-2 were used to simulate Los Vaqueros system operations for the Future No Action/No Project Alternative and a single project alternative.
2. The DSM2 model was used to estimate Delta water quality at important Delta locations for the Future No Action/No Project Alternative and project alternatives using Delta boundary flow inputs provided by CalSim II (Figure C2-2).
3. Water quality impacts were calculated by comparing Future No Action/No Project Alternative and the project alternative salinity (EC) output from Step 2.

[10] CACMP DSM2 V9 was used for both the existing and future levels of development. Chloride concentrations at CCWD diversion locations and in the South Delta were converted from DSM2 EC data based on the flow fraction of Martinez water present at each location, which were computed from a DSM2 fingerprinting study. The chloride conversion relationship assumes that if the fraction by volume of water from the Martinez boundary was less than 0.4% then, for that time step, Cl (mg/L) = 0.15*EC (µS/cm) – 12; otherwise Cl (mg/L) = 0.285*EC (µS/cm) – 50.

[11] CalSim II requires an initial estimate of CCWD diversions, which are subsequently refined during model simulation. The initial set of CCWD diversions were defined using the stand-alone Los Vaqueros Model. Inputs to the stand-alone Los Vaqueros Model include Delta conditions taken from April 22, 2007 five-step JPOD CalSim II model, CONV step output, and Delta water quality taken from CACMP DSM2 V9.

4. Operating rules were developed in the Los Vaqueros Model for the project alternative to minimize water quality impacts caused by the project alternative.
5. Steps 1 through 4 were repeated until all impacts calculated in Step 3 were found to be less than significant. Once this was completed, the final set of operating rules was incorporated in the CACMP CalSim II Los Vaqueros integrated model.

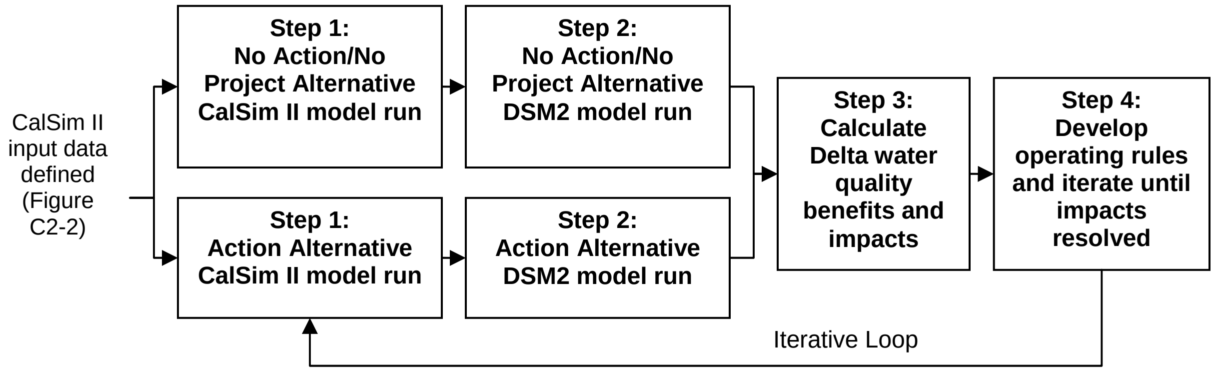


Figure C2-3: Development of Water Quality Rules