Appendix D CalSim-II Model

CalSim-II Software

CalSim-II was developed using the Water Resources Integrated Modeling Software (WRIMS), which is an optimization linear programming (LP)/mixed integer linear programming (MILP) solver that determines an optimal set of decisions for each time period given a set of weights and system constraints. The physical description of the system is expressed through a user interface with tables outlining the system characteristics. The priority weights and basic constraints are also entered in the system tables. The programming language used, Water Resources Engineering Simulation Language (WRESL), serves as an interface between the user and the LP/MILP solver, time-series database, and relational database. Specialized operating criteria are expressed in WRESL.

Key Processes

CalSim-II is a planning model developed by the Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation). It simulates the State Water Project (SWP) and the Central Valley Project (CVP) and areas tributary to the Sacramento-San Joaquin Delta. CalSim-II provides quantitative hydrologic-based information to those responsible for planning, managing and operating the State Water Project (SWP) and the federal CVP. As the official model of those projects, CalSim-II is typically the system model that is used for any inter-regional or statewide analysis in California. CalSim-II uses described optimization techniques to route water through a CVP-SWP system network representation. The network includes over 300 nodes and over 900 arcs, representing 24 surface reservoirs and the interconnected flow system.

The model operates on a monthly time step from water year 1992 through 2003. Using historical rainfall and runoff data, which has been adjusted for changes in water and land use that have occurred or may occur in the future, the model simulates the operation of the water resources infrastructure in the Sacramento and San Joaquin river basins on a month-to-month basis during this 82-year period. In the model, the reservoirs and pumping facilities of the SWP and CVP are operated to assure the flow and water quality requirements for these systems are met. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over 82 years from 1922 to 2003, representing a fixed level of development.

The model operates in six or seven steps to simulate the different regulatory regimes: D1485, D1641, B2, Joint Point of Diversion (JPOD), EWA, and EWA2 if needed.

OCAP Study 7.0 is a 6-step study, incorporating a full EWA representation with the same set of assets and actions developed for the Common Assumptions Model Common Model Package. OCAP Studies 7.1 and 8.0 use a 7-step limited EWA representation where the only purchase is from the Yuba Basin, export actions are confined to the VAMP- and possibly post-VAMP May shoulder periods, and the size of the actions are tailored to the available asset so as to discourage any occurrence of carry over storage debt at San Luis.

The results from the final case of the position analysis (EWA or EWA2) is accepted as the end-of-year system state, and serve as the initial conditions for each of the cases in the following year's analysis. The general modeling procedure is outlined below, and shown in Figure 1:

1. Run the D1641 simulation for Oct-Sep of the current water year.
2. Run the D1485 simulation for Oct-Sep of the current water year and compute annual water costs for implementing D1641 operations relative to D1485 operations (i.e., Water Quality Control Plan [WQCP] costs).
3. Run the B2 simulation for Oct-Sep of the current water year, dynamically accounting for the (b)(2) account balance with knowledge of annual WQCP costs, and implementing fish protection actions according to preferences defined for OCAP.
4. Run the CONV simulation for Oct-Sep of the current water year, repeating B2 actions from Step 3, assessment of JPOD capacity, and simulated CVP usage of 50 percent of JPOD capacity.
5. Run the TXFR simulation for the Oct-Sep of the current year, reflecting transfer operations.
6. Run the EWA simulation for Oct-Sep of the current water year, repeating B2 actions from Step 3, repeating CVP usage of 50 percent of JPOD capacity from Step 4, taking EWA actions, comparing Step 4 and 5 results to assess EWA debt, and managing EWA debt through acquisition and application of assets (e.g., SWP transfer or 50 percent of B2 gains to EWA, EWA usage of 50 percent of JPOD capacity, fixed purchases north and south of Delta).
7. Run the EWA2 simulation to use the limited EWA representation (Study 7.1 and 8.0 only)
8. Accept the state of the system from the end of September in Step 6 or 7 as the initial condition for the following year's analysis cases (i.e., D1641, D1485, B2, JPOD, and EWA).

Repeat all above steps for every year of the period of record.

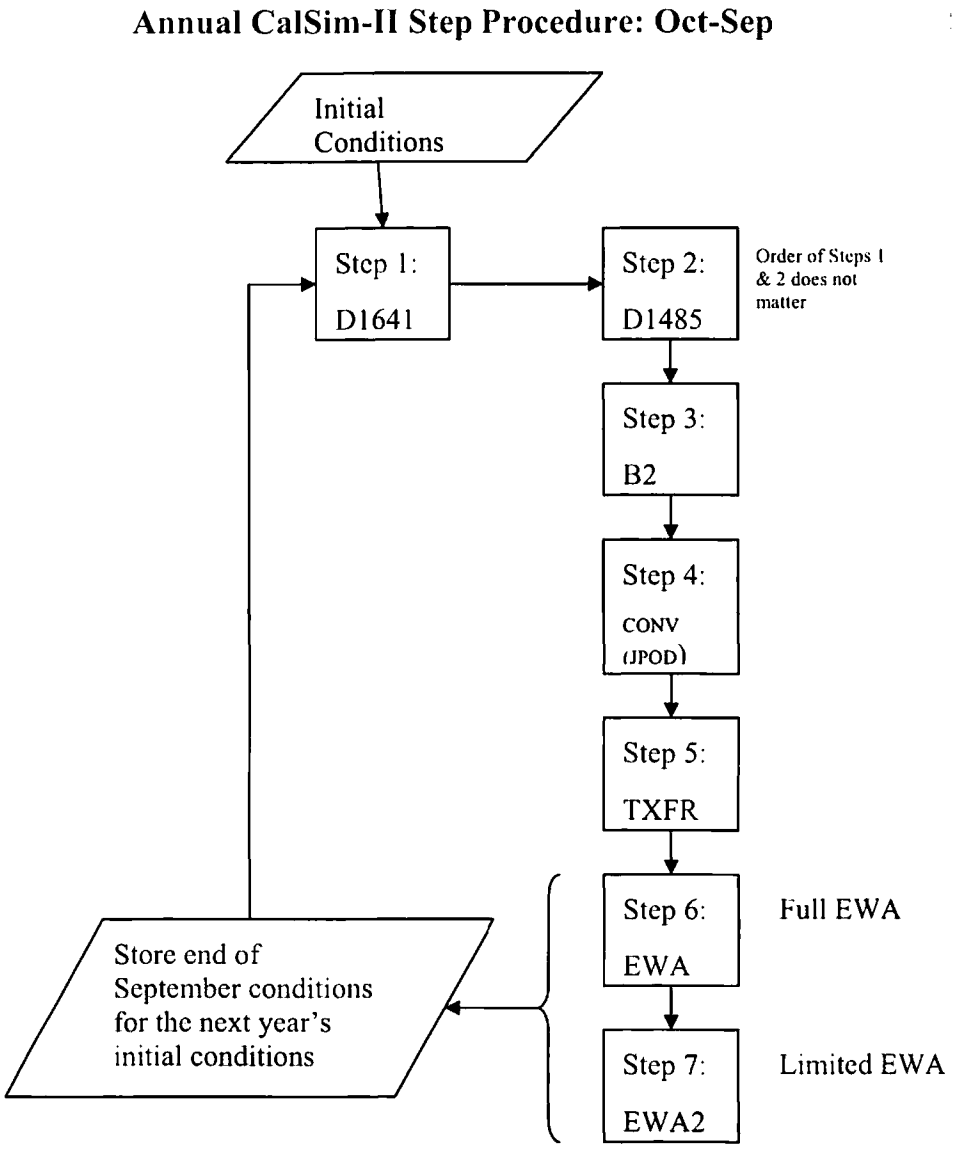

Figure 1. CalSim-II Procedure to Simulate EWA Operations (Study 7.0 only uses the first six steps)

Hydrology

Reservoir inflows, stream gains, diversion requirements, irrigation efficiencies, return flows and groundwater operation are all components of the hydrology for CalSim-II.