DSM2 Extension: California Aqueduct System

Model Development

Model Structure

The model includes the Main Stem from Banks to the bifurcation, the East Branch to Silverwood Lake, the West Branch to Pyramid Lake, the South Bay Aqueduct to the Santa Clara Tank, the DMC to the Mendota Pool, O'Neill Reservoir, and San Luis Reservoir.

Channels in the Aqueduct are demarcated by existing check structures, and aggregated diversions per pool are specified at the downstream end of the pool. Channels in the DMC are generally set at 5000 feet, such that several nodes comprise a single aqueduct pool.

Geometry

All channel geometry was obtained from the Blue Book. The lengths of structures (check structures and pumping plants) were included in the length of the upstream pool. Channel depths were artificially increased in order to deal with DSM2 limitation on maximum water depth in a channel.

Elevations were adjusted to remove head added by pumping plants. Channel slopes were maintained.

Pipes and tunnels were modeled as channels, with the channel characteristics specified to mock the velocity in the pipe through a range of expected flows.

Hydraulic Boundary Conditions

Daily boundary flows at Banks and Tracy were obtained from OCO and CVO. Monthly average diversions were obtained and grouped by pool. The timing of diversions has a large effect on the model results. In the downstream reaches of the aqueduct, the use of monthly diversions and monthly average inflows can lead to unrealistic flows since the diversions may increase drastically before the flows have a chance to reach the pool. Currently, the ramping of diversions is delayed in the lower reaches to minimize this problem.

Mass balance calculations from given flows (pumping plant records) and diversions often show errors of more than 10%. Closure flows (diversions and inflows) were applied in order to provide for a mass balance.

Water Quality Boundary Conditions

Daily EC measurements were obtained from CDEC for Tracy, Banks, and several locations in the DMC and the California Aqueduct for use

in model calibration. Assumptions were made to assign EC values to inflows along the Aqueduct (closure flows and Kern Water Bank Inflows). Currently no other groundwater pump-ins are included in the model.

Object to Object Programming

The Object to Object capability is used to specify flows between O'Neill Reservoir and the DMC (in and out), San Luis Reservoir and O'Neill Reservoir (in and out), and diversions to the South Bay Aqueduct and West Branch. This allows for seamless transfer of water quality as well without the need for preprocessing EC.

Gates

Gates were used to control the water level in the system. Gate invert elevations were set at the minimum operating water surface elevation for each pool. This insures the water will never get below the minimum operating water level, unless pool diversions exceed pool inflow. The number and size of gates control how quickly and to what extent the water surface in each pool rises with increased flow. By increasing the number and size of the gates, we were able to limit the rise in water elevation to between 2 and 5 feet throughout the system. This has implications on the water quality predictions.

Model Parameters

Simulation Period: January 1, 2000 to December 31, 2003

Time Step: 15 minute

Default tolerances on closure parameters

DSM2 Complications

Recompiled for daily inputs, number of gates, maximum water height

De-bugged for issue with allowable number of gates

Treatment of inline reservoirs (use of dummy channels and gates to force flow through a reservoir.

Steep Channels (DMC Wasteways)