# Attachment 4 Model Limitations and Improvements

## Introduction

Models are commonly used to evaluate changes in the management and operations of water resources systems. These models are computer based and use mathematical expressions, methods, and input data to represent hydrologic, physical, environmental, operational, and institutional aspects of the water resources systems. As complex as water resources systems are, the representation of the water resources system in input data, calculations and model outputs is understood to be simplified and generalized in comparison to what is observed in the historical records and documents that describe the real-world water resources system. Even so, models are useful tools in assessing historical, current, and future projected conditions of the water resources system. These conditions are described by models based on assumptions that are captured in the data and calculations used.

Because the representation of the water resources system in models is understood to be simplified and generalized in comparison to what is observed in the historical records and documents, the use of model results should be subject to a set of agreed upon limitations and subsequent analysis of results is thereby limited. The developers and expert users of the models in question should be consulted regarding these limitations. The following is a presentation of information relevant to the limitations of the models and modeled scenarios. This information should be considered in use of the model results and any subsequent analysis derived from these model results.

## General Limitations of Model Used

### CalSim II

CalSim II is a monthly model developed for planning level analyses. The model is run for an 82-year historical hydrologic period, at a projected level of hydrology and demands; and under an assumed framework of regulations. Therefore the 82-year simulation does not provide information about historical conditions, but it does provide information about variability of conditions that would occur at the assumed level of hydrology and demand with the assumed operations, under the same historical hydrologic sequence. Because it is not a physically based model, CalSim II is not calibrated and cannot be used in a predictive manner. CalSim II is intended to be used in a comparative manner.

In CalSim II, operational decisions are made on a monthly basis, based on a set of pre-defined rules that represent the assumed regulations. Modifications by the model user would be required to allow for variation in these rules based on a sequence of hydrologic events such as a prolonged drought, or statistical performance criteria such as meeting a storage target in an assumed percentage of years.

While there are certain components in the model that are downscaled to a daily time step (simulated or approximated hydrology), such as an air-temperature based trigger for a fisheries action, the results of those daily conditions are always averaged to a monthly time step. For example, a certain number of days with and without the action is calculated and the monthly result is calculated using a day-weighted average based on the total number of days in that month. Operational decisions based on those components are again made on a monthly basis. Any reporting or use of sub-monthly results from CalSim II should include disaggregation methods that are appropriate for the given application, report, or subsequent model.

Appropriate use of model results is important. Despite detailed model inputs and assumptions, the CalSim II results differ from real-time operations under stressed water supply conditions. Such model results occur due to the inability of the model to make unique real-time policy decisions under extreme circumstances, as the actual (human) operators must do. Therefore, results which indicate severely low storage, or inability to meet flow requirements or senior water rights should only be considered an indicator of stressed water supply, and should not necessarily be understood to reflect literally what would occur in the future. These conditions, in real-time operations, would be avoided by making policy decisions on other requirements in prior months. In actual future operations, as has always been the case in the past, the project operators would work in real time to satisfy legal and contractual obligations given then current conditions and hydrologic constraints.

Reclamation’s 2008 BA on the coordinated long-term operations Appendix W (Reclamation 2008b) included a comprehensive sensitivity and uncertainty analysis of CalSim II results relative to the uncertainty in the inputs. This appendix provides a good summary of the key inputs that are critical to the largest changes in several operational outputs.

## Improvements to the CALSIM II Model

CALSIM II modeling has been updated with revised daily flow. Through review and calibration to historical data, CALSIM representation of daily flows between Sacramento River at Red Bluff and Sacramento River at Freeport has been improved. More information regarding improvement of the CalSim II model used as well as the limitations of the daily patterns is included in Attachment 5 Daily Pattern Development for the Estimation of Daily Flows and Weir Spills in CalSim II.

## References Cited

ICF International. 2016. Final Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix. Appendix 5A, December 2016.

U. S. Bureau of Reclamation, 2008a. Biological Assessment on the Continued Long-term Operations of the Central Valley Project and State Water Project, Appendix H Reclamation Temperature Model and SRWQM Temperature Model, August 2008.

U. S. Bureau of Reclamation, 2008b. Biological Assessment on the Continued Long-term Operations of the Central Valley Project and State Water Project, Appendix W Sensitivity and Uncertainty Analysis, August 2008.