

**Appendix 5A Surface Water Resources
Modeling of Alternatives**

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1 Introduction

The Sites Authority developed model simulations to support analysis of long-term operations as part of developing a Draft Environmental Impact Report and Environmental Impact Statement for completion in August 2021.

The results of model simulations are provided for informational purposes. Please do not use any information contained in these products for any purpose other than those related to the Sites Authority Planning process. If there are any questions regarding the results of these model simulations, please contact the Sites Authority.

Information regarding daily operations, hydrodynamic, water temperature and reservoir discharge temperature modeling are provided in separate appendices. For daily operations modeling documentation, please review Appendix 5C, Upper Sacramento River Daily River Flow and Operations Model. For Delta hydrodynamics documentation, please review Appendix 6B Sacramento – San Joaquin Delta Modeling. For river temperature modeling documentation, please review Appendix 6C, River Temperature Modeling. For reservoir discharge temperature modeling documentation, please review Appendix 6D, Sites Reservoir Discharge Temperature Modeling.

Any use of model simulation results should observe limitations of the models used as well as the limitations to the modeled alternative. These results should only be used for comparative purposes. More information regarding limitations of the models as well as limitations to the modeled alternatives is included in Appendix 5A Attachment 6, Model Limitations.

2 Modeled Alternatives

The following action alternatives were prepared:

- No Action Alternative 011221
- Alternative 1A 011221
- Alternative 1B 011221
- Alternative 2 011221
- Alternative 3 020121

The assumptions used for each alternative and each model listed above are documented in the following attachments:

- Appendix 5A, Attachment 1 Model Assumptions
- Appendix 5A, Attachment 2 CalSim II Model Assumptions Callouts
- Appendix 5A, Attachment 3 DSM2 Model Assumptions Callouts
- Appendix 5A, Attachment 4 HEC5Q and Reclamation Temperature Model Assumptions Callouts
- Appendix 5A, Attachment 5 CalSim II Model Delivery Specifications
- Appendix 5A, Attachment 6 Model Limitations and Improvements
- Appendix 5A, Attachment 7 Daily Pattern Development for the Estimation of Daily Flows and Weir Spills in CalSim II

The following is a summary of the alternatives and the models used.

No Action Alternative

The No Action Alternative represents CVP and SWP operations to comply with the 2019 Biological Opinions and 2020 State Water Incidental Take Permit regulatory environment as of January 2021 under historical climate conditions. The No Action Alternative assumptions include existing facilities and ongoing programs that existed as of January 2021. The No Action Alternative assumptions also include facilities and programs that received approvals and permits by January 2021.

Alternative 1A

Alternative 1A represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. In Alternative 1A, a bridge across the reservoir provides access to the west of the Project; CVP operational flexibility is not considered; and Sites operations affect operations at Banks PP, Shasta, and Oroville. Alternative 1A conveys

water from the Sacramento River through existing or upgraded TC Canal and GCID Main Canal facilities to new and upgraded regulating reservoirs and into the new Sites Reservoir. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

Alternative 1B

Similar to Alternative 1A, Alternative 1B represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan Pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. Alternative 1B assumes Reclamation investment equivalent to 91 TAF of Sites storage for use as CVP operational flexibility. Aside from volume dedicated to CVP operational flexibility, Alternative 1B facilities and project components are the same as Alternative 1A, described above. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

Alternative 2

Alternative 2 represents operations with a Sites Reservoir capacity of 1.3 MAF and a Dunnigan Pipeline that connects the TC Canal to the Sacramento River in addition to the facilities, regulations and operations described in the No Action Alternative. In Alternative 2 a local access road around the southern end of the reservoir provides access to the west of the Project; CVP operational flexibility is not considered; and Sites operations affect operations at Banks PP, Shasta, and Oroville. Alternative 2 conveys water from the Sacramento River through existing or upgraded TC Canal and GCID Main Canal facilities to new and upgraded regulating reservoirs and into the new Sites Reservoir. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and to the Sacramento River for direct release to the river. Alternative 2 also includes a partial release from the Dunnigan Pipeline into the CBD, for delivery to the Yolo Bypass.

Alternative 3

Alternative 3 represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan Pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. Alternative 3 assumes Reclamation investment equivalent to 345 TAF of Sites storage for use as CVP operational flexibility. Aside from volume dedicated to CVP operational flexibility, Alternative 3 facilities, and project components are the same as Alternative 1A, as described above. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

The following model simulations were prepared for each alternative:

- CalSim II
- DSM2

- HEC5Q
- Reclamation Temperature Model

3 CalSim II

Reclamation / California Department of Water Resources (DWR) CalSim II planning model was used to simulate the coordinated operation of the CVP and SWP over a range of hydrologic conditions. CalSim II is a generalized reservoir-river basin simulation model that allows for specification and achievement of user-specified allocation targets, or goals (Draper et al. 2004). CalSim II represents the best available planning model for CVP and SWP system operations and has been used in previous system-wide evaluations of CVP and SWP operations (U.S. Bureau of Reclamation 2015).

4 DSM2

DSM2 is a one-dimensional hydrodynamic and water quality simulation model used to simulate hydrodynamics, water quality, and particle tracking in the Sacramento-San Joaquin Delta (DWR, 2002). DSM2 represents the best available planning model for Delta tidal hydraulic and salinity modeling. It is appropriate for describing the existing conditions in the Delta, as well as performing simulations for the assessment of incremental environmental impacts caused by future facilities and operations (U.S. Bureau of Reclamation 2015).

5 HEC5Q

Over the past 15 years, various temperature models were developed to simulate temperature conditions on the rivers affected by CVP and SWP operations (SRWQM, San Joaquin River HEC5Q model) (Reclamation 2008). Recently, these models were compiled and updated into a single modeling package called in here as the HEC5Q model. Further updates were performed under the LTO EIS modeling that included improved meteorological data and subsequent validation of the Sacramento and American River models, implementation of the Folsom Temperature Control Devices and low-level outlet, implementation of the Trinity auxiliary outlet, improved temperature targeting for Shasta and Folsom Dams, as well as improved documentation and streamlining of the models as well as improved integration with the CalSim II model (U.S. Bureau of Reclamation 2015).

6 Reclamation Temperature Model

Reclamation Temperature Model includes reservoir and stream temperature models, which simulate monthly reservoir and stream temperatures used for evaluating the effects of CVP/SWP project operations on mean monthly water temperatures in the basin (Reclamation 2008). The model simulates temperatures in seven major reservoirs (Trinity, Whiskeytown, Shasta, Oroville,

Folsom, New Melones and Tulloch), four downstream regulating reservoirs (Lewiston, Keswick, Goodwin and Natoma), and five main river systems (Trinity, Sacramento, Feather, American and Stanislaus). The river component of the Reclamation Temperature model calculates temperature changes in the regulating reservoirs, below the main reservoirs. With regulating reservoir release temperature as the initial river temperature, the river model computes temperatures at several locations along the rivers. The calculation points for river temperatures generally coincide with tributary inflow locations. The model is one-dimensional in the longitudinal direction and assumes fully mixed river cross sections. The effect of tributary inflow on river temperature is computed by mass balance calculation. The river temperature calculations are based on regulating reservoir release temperatures, river flows, and climatic data (U.S Bureau of Reclamation 2015).

7 References

- Anderson, James. (2018). Using river temperature to optimize fish incubation metabolism and survival: a case for mechanistic models. 10.1101/257154.
- California Department of Water Resources, Modeling Support Branch. Last updated September 2002. Site accessed February 4, 2011. URL = <http://modeling.water.ca.gov/>.
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- U. S. Bureau of Reclamation, 2015. Coordinated Long Term Operation of the CVP and SWP EIS, Appendix 5A CalSim II and DSM2 Modeling.