5.C Upstream Water Temperature Methods and Results

EXHIBIT BKS-256

Device (WS TCD), which is described in Appendix 6B, Section C of the 2015 LTO EIS (Reclamation 2015). For the 2015 validation equilibrium temperature scaling factors in the HEC5Q inputs were adjusted to match the simulated temperatures with 2013 calibration results. The 2015 validation process used the hydrology and meteorological boundary condition data from the 2013 calibration.

5.C.2.3.2 Model Inputs

Model inputs to the American River HEC5Q model include initial storage levels, reservoir and tributary inflows, reservoir outflows, diversions, and reservoir evaporation derived from CalSim II outputs. Table 5.C-3 lists the CalSim II outputs used in the derivation of inputs to the American River HEC5Q model.

The daily downscaled CalSim II timeseries all assume a constant (uniform) daily flow over each month of the 82-year CalSim II simulation period. As mentioned previously, 6-hour meteorological inputs to the model were derived from observed Nicolaus CIMIS data and then were adjusted to the Q5 climate scenario. The same note about the climate change adjustments to the meteorological inputs and inflow temperatures in the Trinity-Sacramento River model applies to the American River HEC5Q model.

5.C.2.3.3 Simulation of Selective Withdrawal

Folsom Dam has multiple TCDs. There is a main temperature control shutter device, which allows water to come from different elevations of the reservoir pool to go through the power outlets. There is a low-level outlet that allows access to the reservoir pool below the power outlets. These are operated in combination to meet a specified tailwater temperature target, particularly during the summer and fall months. The model also includes a WS TCD mentioned previously, which pulls water from specified levels and temperature ranges of the reservoir pool for the local water supply diversion from the Folsom Lake.

Annual schedules of monthly tailwater temperature targets for Folsom Dam are specified based on a combination of End-of-May Folsom Lake storage and June to September inflow volume to Folsom Lake, an indicator of the available cold water pool, for each year of the CalSim II simulation period. The annual schedules were developed for different tiers of volume of cold water pool (Folsom End-of-May storage plus June to September inflow), with each tier corresponding to a specific temperature target schedule for the year. A representative subset of the Automated Temperature Selection Procedure' (ATSP) temperature target schedules specified in the 2009 NMFS BiOp were used in the selection procedure for use in the HEC5Q model. Table 5.C-4 shows the annual temperature target schedules for the different Folsom End-of-May storage plus June to September inflow volume tiers. As can be seen from the table, the schedules only vary for the May-Nov period. A description of the annual temperature target schedules development is provided in Appendix 6B, Section C of the 2015 LTO EIS (Reclamation 2015). Based on the tailwater target temperature schedule timeseries, the model determines which configuration of the shutters and low-level outlet will produce a release temperature that best meets the monthly temperature target. The low-level outlet with a maximum release capacity of 700 cfs, is allowed to operate from September 15th to November 30th. The WS TCD included in the American River HEC5Q model is operated to withdraw stored water within the temperature range of 63°F – 65°F, and an elevation range of 320 ft to 460 ft. Appendix 6B, Section C of the 2015 LTO EIS (Reclamation 2015) provides a complete description of the Folsom Dam TCD operating logic in the American River HEC5Q model.

5.C.2.4 Stanislaus River-Lower San Joaquin River HEC5Q Model

5.C.2.4.1 Description of the Model

The Stanislaus River-Lower San Joaquin River HEC5Q model simulates water temperatures for the Stanislaus River (from the Middle Fork upstream of New Melones Reservoir to the confluence with San Joaquin River), and the San Joaquin River from the Stanislaus River confluence to Mossdale. Figure 5.C-3 shows a schematic of the Stanislaus River HEC5Q model and shows all of the reservoir and river control points where temperatures are simulated. The model uses inputs from CalSim II that have been temporally downscaled to daily timeseries and 6-hour meteorological data derived from observed data from the Modesto CIMIS station adjusted for the projected climate at about year 2030 under Q5 climate scenario. The Stanislaus River-Lower San Joaquin River model was last fully calibrated in 2013, with a calibration period of 1990-2010 (A.D. et al. 2007, A.D. et al. 2013).

5.C.2.4.2 Model Inputs

Model inputs to the Stanislaus River HEC5Q model include initial storage levels, reservoir and tributary inflows, reservoir outflows, diversions, and reservoir evaporation derived from CalSim II outputs. Table 5.C-5 lists the CalSim II outputs used in the derivation of inputs to the Stanislaus River HEC5Q model. The daily downscaled CalSim II timeseries all assume a constant (uniform) daily flow over each month of the 82-year CalSim II simulation period. One exception is the inflow to New Melones Reservoir. New Melones inflow from CalSim II is partitioned into four components, and used as inflow to Collierville Power House, Stanislaus Power House, Middle Fork Stanislaus and South Fork Stanislaus because of differing temperatures of each inflow source. In addition, the monthly CalSim II inflow is downscaled to a daily timestep by fitting to a cubic-spline. This allows the simulation of a daily varying inflow into the reservoir with a smooth transition between the individual months, while assuming same monthly volume of inflow consistent with CalSim II.

As mentioned previously, 6-hour meteorological inputs to the model were derived from observed Modesto CIMIS data and then were adjusted to the Q5 climate scenario. The same note about the climate change adjustments to the meteorological inputs and inflow temperatures in the Trinity-Sacramento River model applies to the Stanislaus River-Lower San Joaquin River HEC5Q model.

5.C.2.5 Model Limitations

There are several limitations to the HEC5Q models and the simulated water temperatures, both in their capability to simulate observed water temperatures and as applied in this BA. Calibration of the HEC5Q model was focused on simulating daily average observed temperatures, primarily in the warmer periods, and the model adequately represents the thermal responses to the hydrologic and meteorological changes. Even though the HEC5Q models simulate water

Table 5.C-4: Final Temperature Targeting Schedules for Folsom Dam

Schedule Number	Folsom End-of-May Storage plus Jun-Sep Inflow (TAF)	Folsom Dam Release Temperature Target (^{0}F)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22	<=600	52.0	52.0	52.0	59.0	66.8	66.0	66.0	63.0	67.5	68.0	60.5	56.0
21	700	52.0	52.0	52.0	59.0	65.9	65.2	66.2	63.3	66.7	68.1	60.6	56.0
20	750	52.0	52.0	52.0	59.0	66.3	65.6	65.6	62.9	67.0	67.3	59.7	56.0
19	850	52.0	52.0	52.0	59.0	65.6	65.0	66.0	63.5	66.3	67.5	59.8	56.0
18	900	52.0	52.0	52.0	59.0	65.8	65.2	65.2	62.8	66.4	66.6	58.8	56.0
17	950	52.0	52.0	52.0	59.0	65.0	64.4	65.4	63.1	65.6	66.7	58.9	56.0
16	1050	52.0	52.0	52.0	59.0	65.2	64.6	64.6	62.4	65.7	65.8	57.9	56.0
15	1100	52.0	52.0	52.0	59.0	64.3	63.8	64.8	62.7	64.9	65.9	58.0	56.0
14	1200	52.0	52.0	52.0	59.0	64.5	64.0	64.0	62.0	65.0	63.0	58.0	56.0
13	1250	52.0	52.0	52.0	59.0	63.7	63.2	64.2	62.3	64.2	63.1	58.1	56.0
12	1350	52.0	52.0	52.0	59.0	63.7	63.2	63.2	61.3	64.2	63.1	58.1	56.0
11	1400	52.0	52.0	52.0	59.0	62.9	62.4	63.4	61.6	63.3	63.2	58.1	56.0
10	1500	52.0	52.0	52.0	59.0	62.9	62.4	62.4	60.6	63.3	63.2	58.1	56.0
9	1550	52.0	52.0	52.0	59.0	61.9	61.4	62.4	60.6	62.3	63.2	58.1	56.0
8	1650	52.0	52.0	52.0	59.0	62.0	61.6	61.6	59.9	62.5	58.3	57.2	56.0
7	1700	52.0	52.0	52.0	59.0	61.0	60.6	61.6	59.9	61.5	58.3	57.2	56.0
6	1800	52.0	52.0	52.0	59.0	61.0	60.6	60.6	58.9	61.5	58.3	57.2	56.0
5	1850	52.0	52.0	52.0	59.0	60.0	59.6	60.6	58.9	60.5	58.3	57.2	56.0
4	1950	52.0	52.0	52.0	59.0	60.0	59.6	59.6	57.9	60.5	58.3	56.2	56.0
3	2000	52.0	52.0	52.0	59.0	59.0	58.6	59.6	57.9	59.5	57.3	56.2	56.0
2	2100	52.0	52.0	52.0	59.0	59.0	58.6	58.6	56.9	59.5	56.3	55.2	56.0
1	2150	52.0	52.0	52.0	59.0	58.0	57.6	58.6	56.9	58.5	55.3	55.2	56.0

Figure 5.C.7-14-6. Monthly Temperature Ranges for American River at Hazel Ave, Critical Years

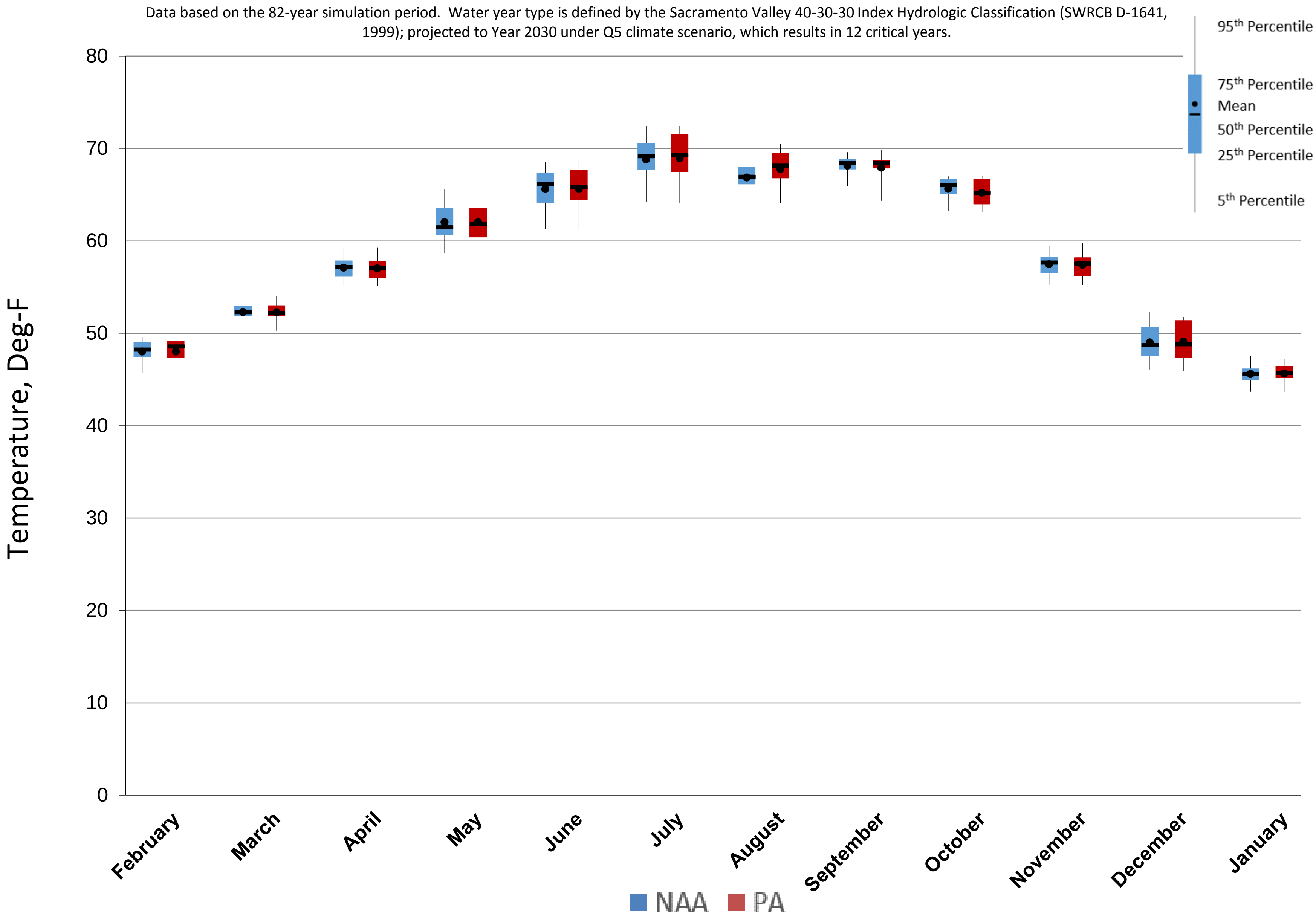

Figure 5.C.7-15-6. Monthly Temperature Ranges for American River at Watt Ave, Critical Years

Data based on the 82-year simulation period. Water year type is defined by the Sacramento Valley 40-30-30 Index Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030 under Q5 climate scenario, which results in 12 critical years.

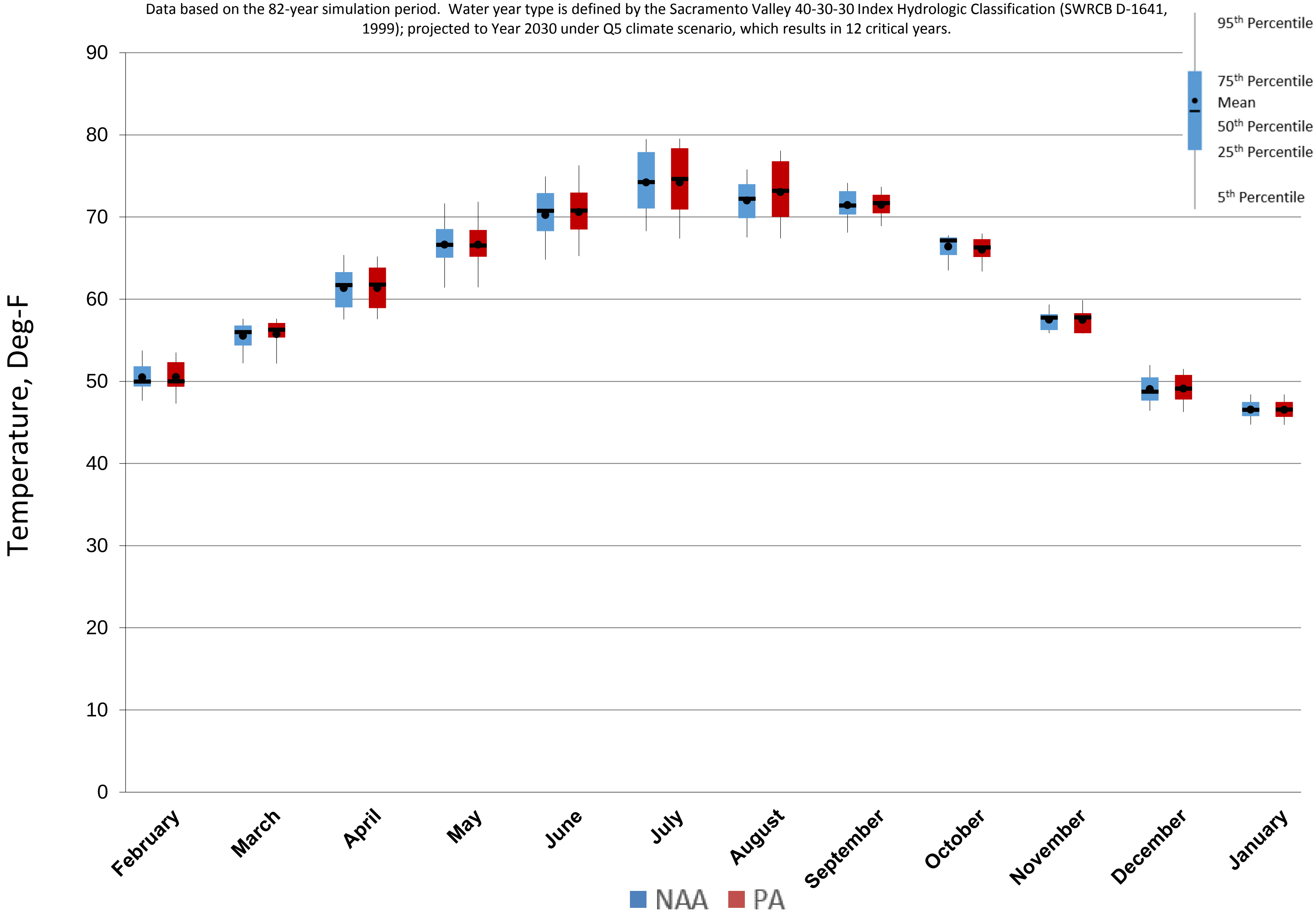

Figure 5.C.7-16-6. Monthly Temperature Ranges for American River at Sacramento River Confluence, Critical Years