Water Temperature Monitoring Study
SUMMARY

Consistent with Section 6.0 of the *Water Temperature Monitoring Study Plan* (Plan) that was filed with FERC on January 9, 2017,[1] the SSWD provides the following summary for the *Water Temperature Monitoring Study* (Study). The summary includes a description of work completed to date, key findings, variances, and remaining work. Links to associated data files are also included. SSWD considers these data to be public.

Work to Date as of 3/1/18:

SSWD has completed step 1 (identify monitoring sites), step 2 (collect data), and step 3 (QA/QC review) of the Plan as these steps relate to reservoir profiles in Camp Far West Reservoir. In addition, SSWD completed step 1 as it relates to stream temperature monitoring. SSWD has started step 2 of the stream temperature portion of the Study by installing and maintaining water temperature loggers as early as May 2015 through early 2018 (Table 1). Step 3 related to stream temperature monitoring has also been started and all data downloaded through January 2018 has been QA/QC'ed. All available stream temperature data through January 2018 are presented as plots of daily minimum, average and maximum, and also provided in 15-minute intervals in HEC-DSSvue format (Table 2). Reservoir profile data from April 2015 to November 2017 are presented as plots of temperature versus elevation at three locations: 1) near the dam; 2) in the Bear River Arm of the reservoir; and 3) in the Rock Creek Arm of the reservoir. These data are being used for the development of the water temperature model described in Study 2-2, *Water Temperature Modeling Study*.

Table 1. Locations and installation periods of water temperature loggers.

Location	Bear River Mile	Installation Date	Last Download Date	Latitude	Longitude
UPSTREAM OF PROJECT AREA					
Bear River above Camp Far West Reservoir	25.1	4/10/15	11/20/17	39.011685	-121.220506
Rock Creek above Camp Far West Reservoir	--	8/6/15	1/15/18	39.063471	-121.263205
DOWNSTREAM OF PROJECT AREA					
Bear River below Powerhouse Outflow	18.0	4/10/15	1/15/18	39.04898	-121.31841
Bear River below CFW Spillway Channel	17.9	9/29/15	10/25/17	39.04719	-121.31969
Bear River below Diversion Dam	16.9	4/10/15	1/15/18	39.04163	-121.33235
Bear River at BRW gage, Highway 65 Crossing	11.4	4/10/15	1/15/18	38.99901	-121.40810
Bear River at BPG gage, Pleasant Grove Bridge	7.1	5/1/15	1/15/18	38.98561	-121.48329
Dry Creek above Bear River	--	12/1/15	1/15/18	38.99596	-121.49121
Bear River near Highway 70 Crossing	3.5	5/1/15	11/1/17	38.97249	-121.54343
Bear River above Feather River Confluence	0.1	5/1/15	1/15/18	38.93906	-121.57831
Feather River above Bear River Confluence	--	8/6/15	1/15/18	38.94277	-121.57928
Feather River below Bear River Confluence	--	5/1/15	10/6/17	38.93802	-121.58038

Key Findings:

To date, during the Study, water temperature in the Bear River upstream of Camp Far West Reservoir ranged between 5°C and 30°C. Daily temperatures fluctuated more during the summer months when air temperature was warmer and flows were lower. Winter temperatures showed

[1] The Plan is available on SSWD's public relicensing website (www.sswdrelicensing.com) under 'Study Plans.'

less variation (Figure 1). The overall water temperature pattern in the Bear River upstream of the reservoir was consistent with other streams in the area (i.e., temperatures increased in the spring and through the summer before decreasing in fall and into winter). Water temperatures in Rock Creek, which flows directly into Camp Far West Reservoir, exhibited similar trends as the Bear River except that maximum water temperatures were around 25°C.

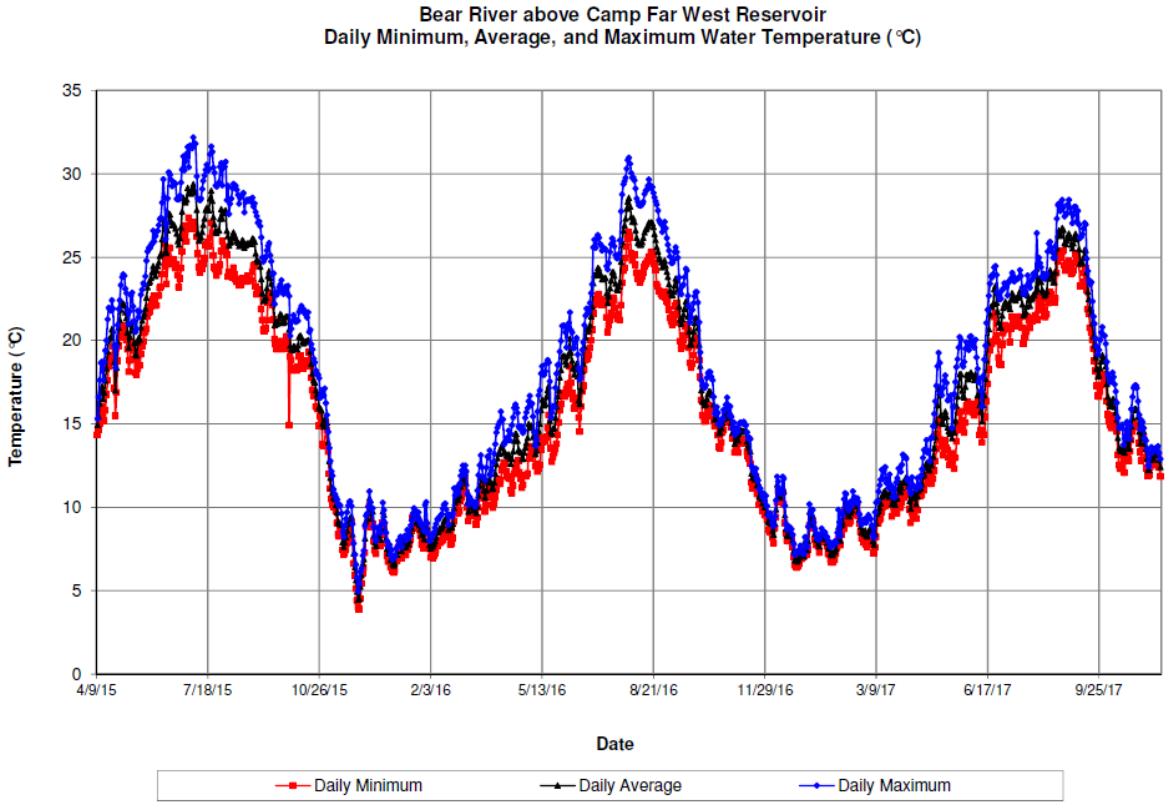

Figure 1. Daily minimum, average and maximum water temperatures in the Bear River upstream of Camp Far West Reservoir.

To date during the Study, water temperatures in Camp Far West Reservoir ranged between 8°C and 28°C depending on depth, time of year and reservoir level. The reservoir showed a thermocline, especially during the summer, around 30 feet (ft) below the surface, and the reservoir was typically fully mixed during the winter months. Water temperatures at the Camp Far West Powerhouse intake (invert elevation of 197 ft, or 103 ft below the reservoir's NMWSE of 300 ft) and at the low-level outlet intake (invert elevation of 175 ft, or 125 ft below north maximum water surface elevation (NMWSE)) ranged between 8.5°C and 21°C depending on the time of year and reservoir level (Figure 2). Water temperatures in the Rock Creek and Bear River arms of the reservoir were similar to those recorded near the dam. However, the thermocline was less pronounced and mixing occurred more often. Secchi disk readings averaged 1.4 meter (m) and ranged between 0.25-m and 4.75 m.

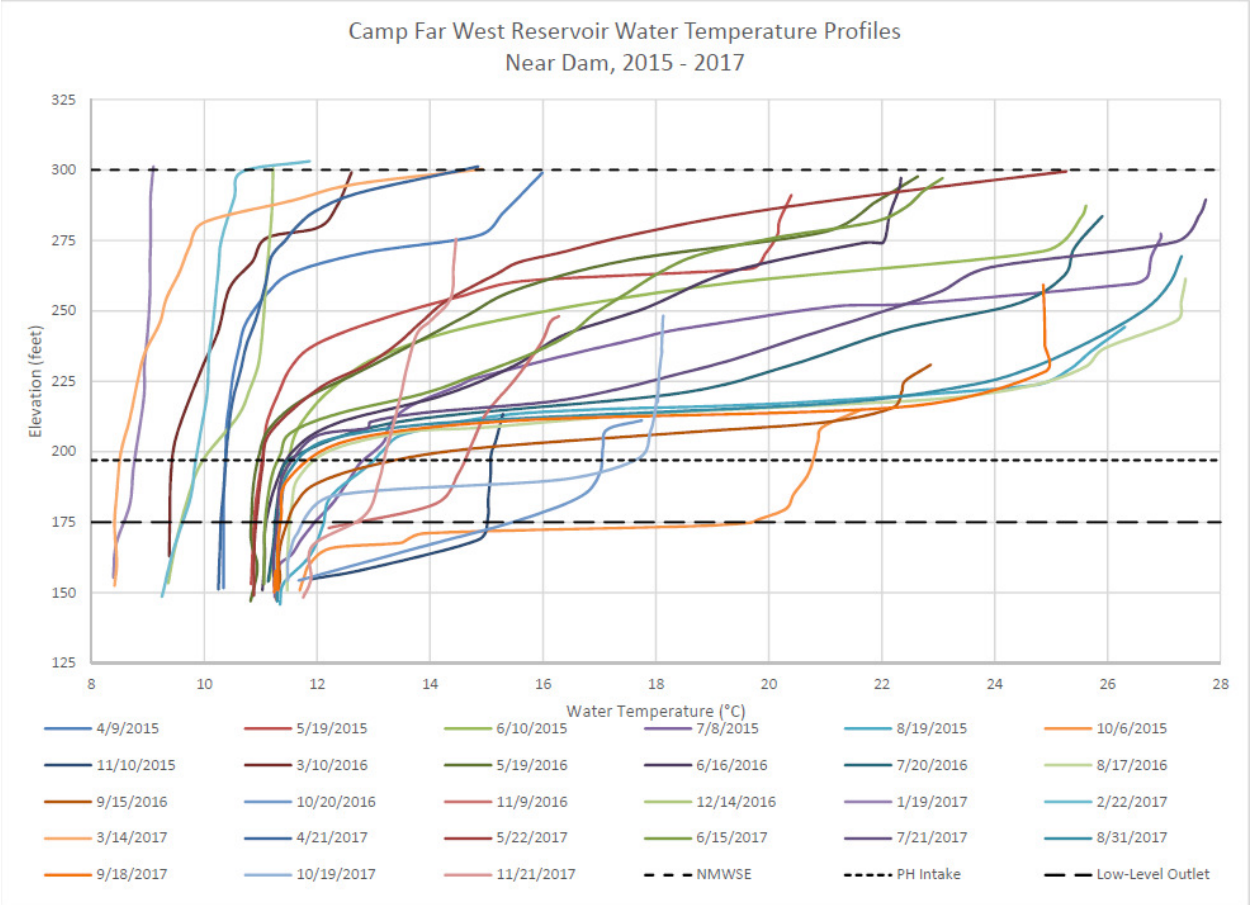

Figure 2. Monthly water temperature reservoir profiles in Camp Far West Reservoir near the dam.

Water temperatures in the Bear River between Camp Far West Dam and Powerhouse and the non-Project diversion dam ranged between 7°C and 26°C. There was very little diurnal variation at this location and water temperatures were closely tied to the release point (i.e., powerhouse or low-level outlet) and water temperatures in the reservoir. Sudden changes in water temperature occurred when SSWD switched operation from the powerhouse at an elevation of 197 ft to the low-level outlet at an elevation of 175 ft (Figure 3 and Figure 4).

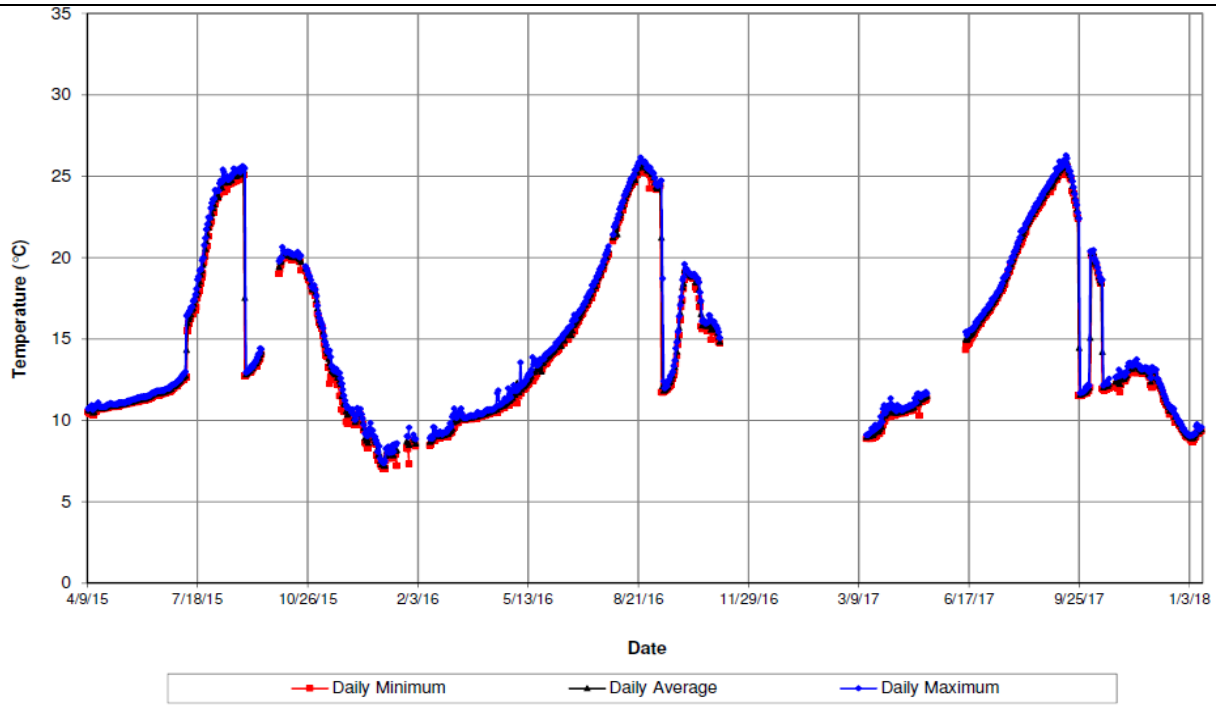

Figure 3. Daily minimum, average, and maximum water temperatures in the Bear River downstream of Camp Far West Dam and Powerhouse. Data gaps were due to lost loggers, high flows, or loggers being found out of the water due to changes in stage.

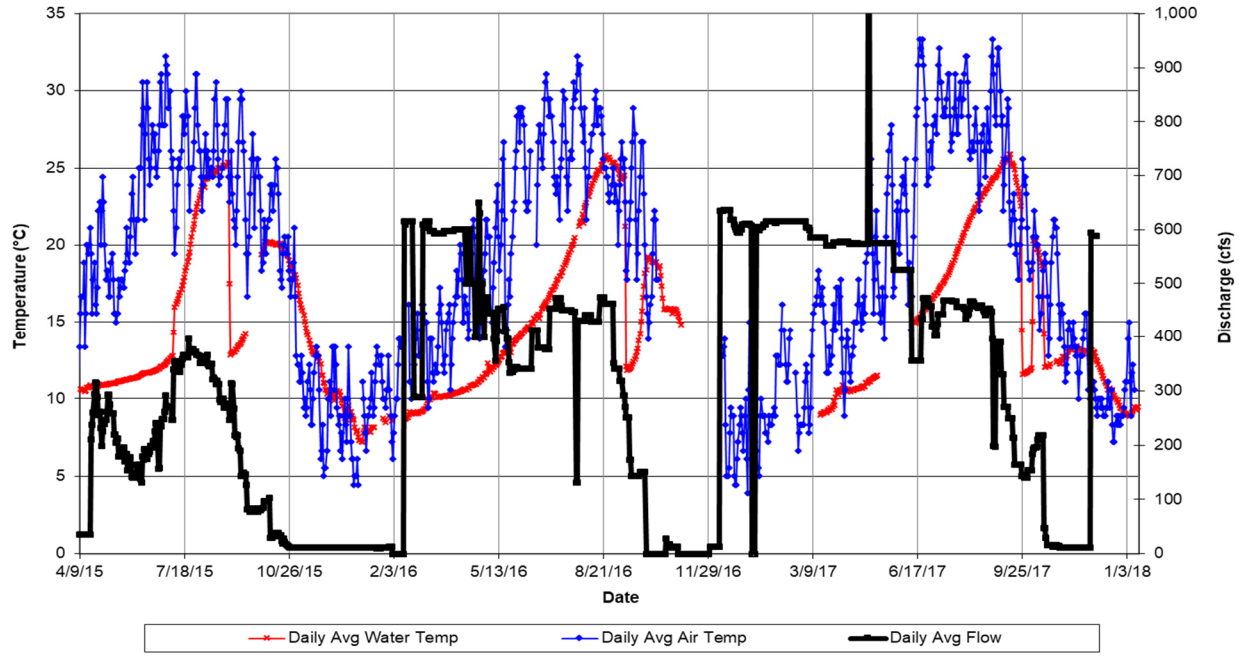

Figure 4. Daily average water temperature and flow in the Bear River downstream of Camp Far West Dam and Powerhouse and daily average air temperature near Camp Far West Dam.

Water temperatures immediately below the non-Project diversion dam showed similar characteristics and range. Water temperatures from Highway 65 to the confluence with the Feather River showed greater diurnal variation and ranged between 5°C and 35°C (Figure 5). Temperatures in this reach were also influenced by fluctuation in air temperature (Figure 6).

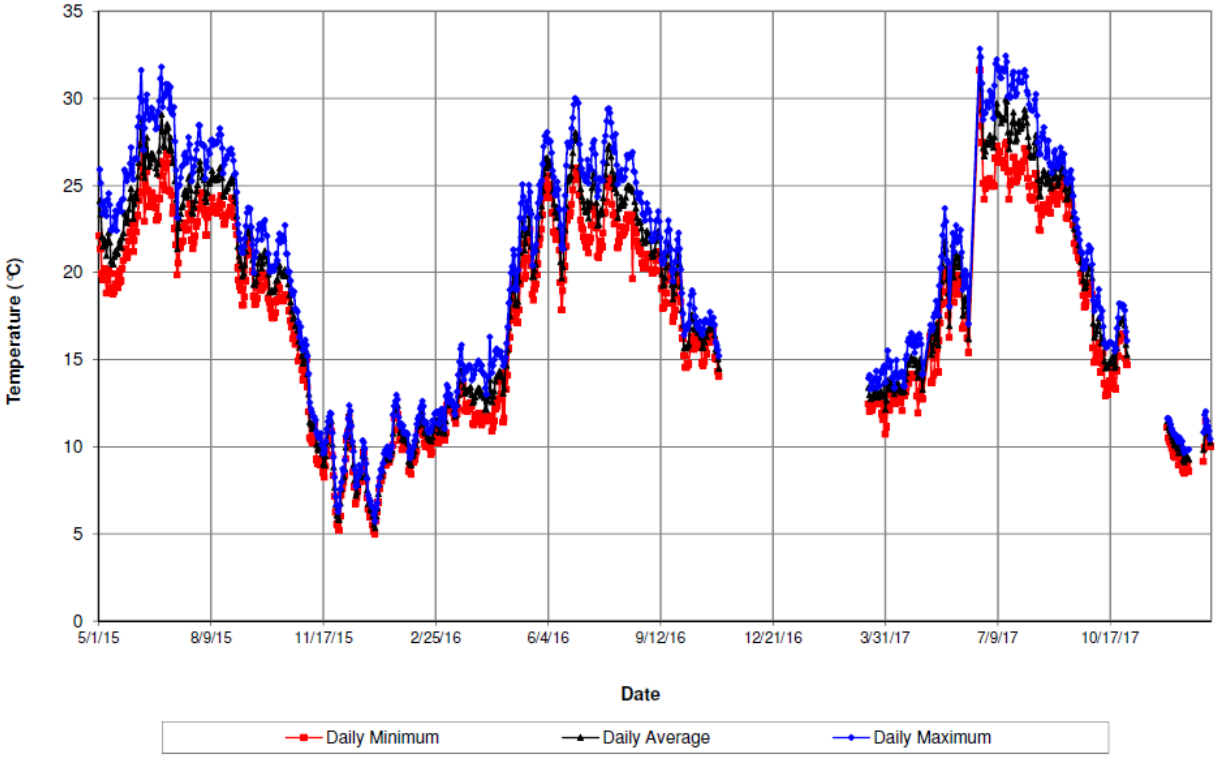

Figure 5. Daily minimum, average, and maximum water temperatures in the Bear River downstream of the Highway 70 Bridge. Data gaps were caused by lost loggers due to high flows.

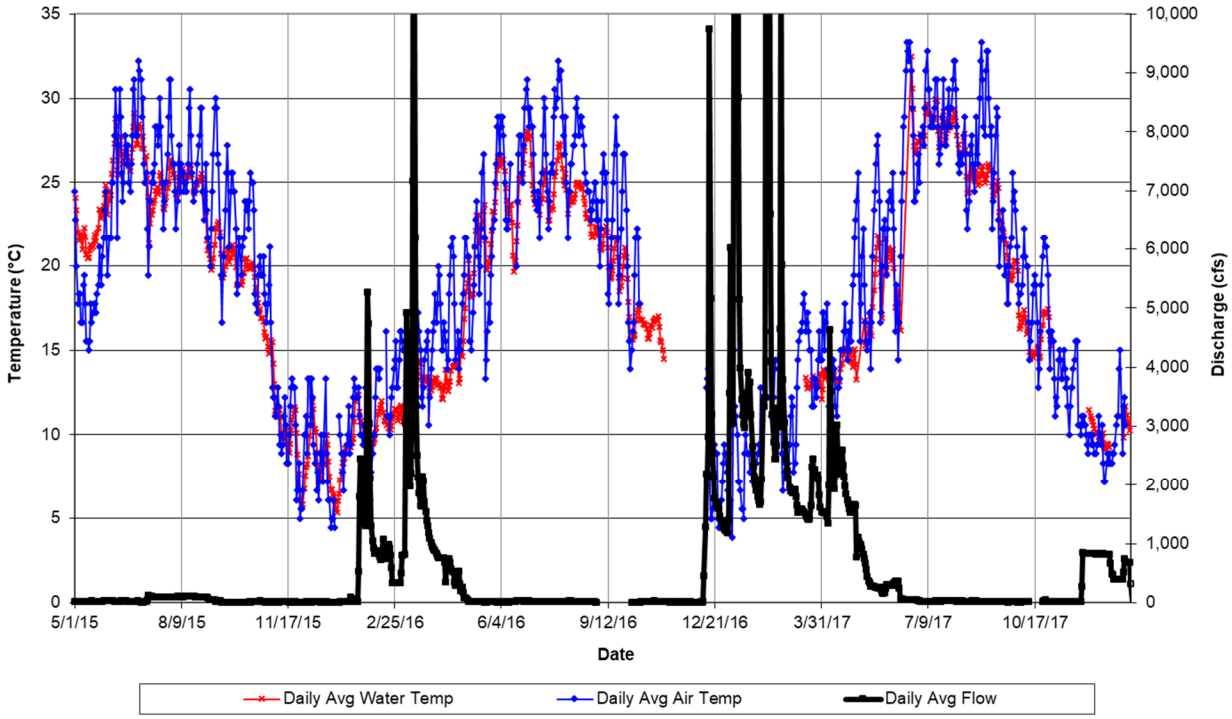

Figure 6. Daily average water temperature and flow in the Bear River downstream of the Highway 70 Bridge and daily average air temperature near Camp Far West Dam.

Associated Data Files:

The three data files listed in Table 2 below are available on SSWD's public relicensing website (www.sswdrelicensing.com).

Table 2. Data files associated with Study summary.

File Name	Data Description	File Type and Size
SSWD_TempData.DSS	Stream water temperature data for the Bear River, Rock Creek and Dry Creek. Local flow and air temperature data also provided.	HEC DSS, 7,224 kB
SSWD_Stream_Temp_Plots.PDF	Daily minimum, average and maximum water temperature plots for the Bear River, Rock Creek and Dry Creek. Daily average water temperature, air temperature and flow plots are also provided.	PDF, 5,504 kB
SSWD_Res_Profiles.PDF	Reservoir water temperature profiles for Camp Far West Reservoir plotted as temperature versus elevation.	PDF, 187 kB

Variances from Study:

There were two study variances to the Plan. The first variance was that during the winter of 2016/17, the Bear River experienced very high flows (34,900 cubic feet per second measured at Wheatland gage in January 2017) that made accessing loggers for download and maintenance unsafe. These same flows caused some loggers in the Bear River to be damaged or lost despite having redundant loggers at all locations. The Plan called for collecting water temperature in 2016 and 2017 for a total of 730 days. Table 3 shows the number of days water temperature data are available at each location. In addition, SSWD is maintaining these loggers through June

2018 in order to collect additional data for the water temperature model. These data provide an accurate characterization of water temperature in the Bear River upstream and downstream of the Project, and are adequate to inform the water temperature model being developed as part of Study 2-2.

Table 3. Water temperature loggers and number of days with data available.

Location	Bear River Mile	Installation Date	Last Download Date	Number of Days with Available Data
UPSTREAM OF PROJECT AREA				
Bear River above Camp Far West Reservoir	25.1	4/10/15	11/20/17	949
Rock Creek above Camp Far West Reservoir	--	8/6/15	1/15/18	893
DOWNSTREAM OF PROJECT AREA				
Bear River below Powerhouse Outflow	18.0	4/10/15	1/15/18	795
Bear River below CFW Spillway Channel	17.9	9/29/15	10/25/17	758
Bear River below Diversion Dam	16.9	4/10/15	1/15/18	1,008
Bear River at BRW gage, Highway 65 Crossing	11.4	4/10/15	1/15/18	804
Bear River at BPG gage, Pleasant Grove Bridge	7.1	5/1/15	1/15/18	851
Dry Creek above Bear River	--	12/1/15	1/15/18	258
Bear River near Highway 70 Crossing	3.5	5/1/15	11/1/17	793
Bear River above Feather River Confluence	0.1	5/1/15	1/15/18	905
Feather River above Bear River Confluence	--	8/6/15	1/15/18	657
Feather River below Bear River Confluence	--	5/1/15	10/6/17	647

The second variance was that reservoir profiles were not collected for 3 out of 24 months between 2016 and 2017. In January and February 2016, reservoir levels were so low that launching a boat to collect the reservoir data was not possible. In December 2017, two separate attempts were unsuccessful due to equipment malfunction and weather, respectively. These missed profiles will not affect the overall success of the study because SSWD began collecting profiles early and ended up with 29 months of profiles over a variety of reservoir levels. In addition, SSWD will continue to collect monthly reservoir profiles until June 2018. These data provide an accurate characterization of water temperature in the reservoir, and are adequate to inform the water temperature model being developed for Study 2-2.

Remaining Work:

Remaining work includes: 1) maintaining the water temperature loggers through June 2018; QA/QC'ing these data; and incorporating the data into the final dataset and plots.

SSWD anticipates that the Study will be completed by July 2018, which is consistent with the Plan.

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