

Study 2.1

WATER TEMPERATURE MONITORING

February 2016

1.0 Project Nexus

South Sutter Water District's (SSWD) continued operation and maintenance (O&M) of the Camp Far West Hydroelectric Project (Project) may have an effect on water temperatures.

2.0 Study Goals and Objectives

The goal of this Water Temperature Monitoring Study (Study) is to provide information to determine whether continued Project O&M has an adverse effect on water temperature.

The objective of the study is to collect water temperature data adequate to meet the study goals.

The Study does not include the development of potential requirements in the new license.

3.0 Existing Information and Need for Additional Information

Existing, relevant and reasonably available information regarding water temperature in Camp Far West Reservoir and in the Bear River downstream of the reservoir is provided in Section 3.2.2.9.1 of SSWD's Pre-Application Document (PAD).

The data collected during this Study will be added to the existing water temperature data to provide a larger data set. These data will be used in the development of water temperature models (SSWD's relicensing Study 2.2) and in future discussions of habitat conditions in Camp Far West Reservoir and the Bear River.

4.0 Study Methods

4.1 Study Area

For the purpose of this Study, the Study Area includes: 1) the Bear River and Rock Creek immediately upstream from Camp Far West Reservoir; 2) Camp Far West Reservoir; 3) the Bear River downstream of Camp Far West Dam to the Feather River confluence; and 4) the Feather River immediately upstream and downstream of the Bear River confluence. Figure 4.1-1 shows the Study Area and the location and types of water temperature monitoring that will be performed in this Study.

If SSWD proposes an addition to the Project, the Study Area will be expanded if necessary to include areas potentially affected by the addition.

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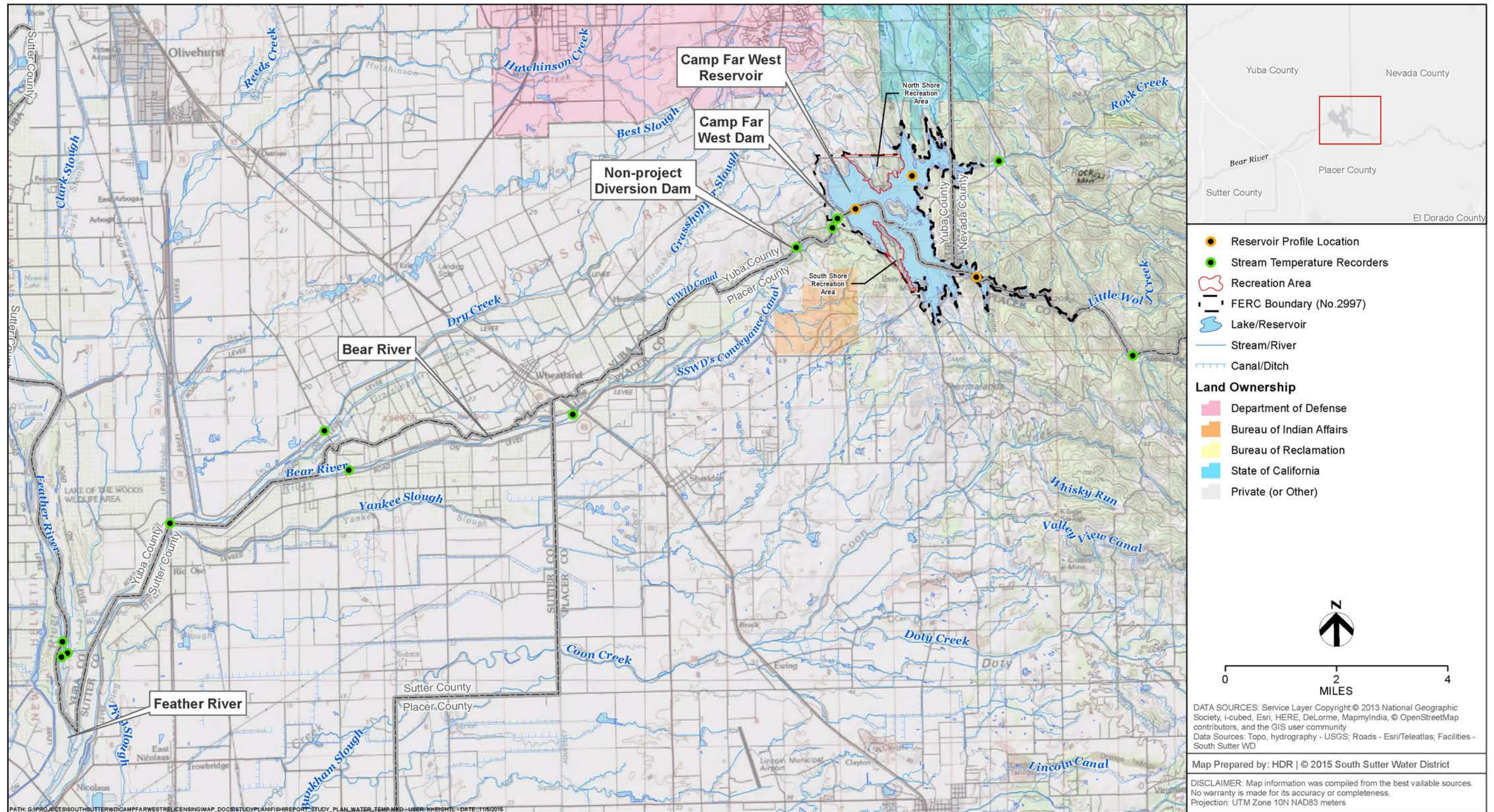


Figure 4.1-1. Water temperature monitoring locations.

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4.2 General Concepts and Procedures

The following general concepts and practices apply to all SSWD relicensing studies:

- Personal safety is the most important consideration of each fieldwork team.
- If required for the performance of the study, SSWD will make a good faith effort to obtain permission to access private property well in advance of initiating the study. SSWD will only enter private property if such permission has been provided by the landowner.
- SSWD will acquire all necessary agency permits and approvals prior to beginning fieldwork for a study that requires them.
- Field crews may make variances to the study plan in the field to accommodate actual field conditions and unforeseen problems. When a variance is made, the field crew will follow to the extent applicable the protocols in and intent of the study plan.
- When SSWD becomes aware of a variance to the study plan, SSWD will issue an e-mail to the Federal Energy Regulatory Commission (FERC); Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); United States Fish and Wildlife Service; California Department of Fish and Wildlife (Cal Fish and Wildlife); and the State Water Resources Control Board, describing the variance and reason for the variance. SSWD will summarize in its Draft Application for New License (DLA) and in its Final Application for New License (FLA) all study plan variances.
- SSWD's performance of the study does not presume that SSWD is responsible in whole or in part for measures that may arise from the study.
- If Global Positioning System (GPS) data are required by a study plan, they will be collected using either a Map Grade Trimble GPS (i.e., sub-meter data collection accuracy under ideal conditions), a Recreation Grade Garmin GPS unit (i.e., 3-meter data collection accuracy under ideal conditions), or similar units. GPS data will be post-processed and exported from the GPS unit into Geographic Information System (GIS) compatible file format in an appropriate coordinate system using desktop software. The resulting GIS file will then be reviewed by both field staff and SSWD's consultant's relicensing GIS analyst. Metadata will be developed for deliverable GIS data sets. Upon request, GIS maps will be provided to NMFS, United States Fish and Wildlife Service, Cal Fish and Wildlife or State Water Resources Control Board in a form, such as ESRI Shapefiles, GeoDatabases, or Coverage with appropriate metadata. Metadata will be Federal Geographic Data Committee compliant.
- SSWD's field crews conducting relicensing studies will record incidental records of aquatic, botanical and wildlife species observed during the performance of a study. All incidental observations will be reported in the DLA and FLA. The purpose of this effort is not to conduct a focused study (i.e., no effort in addition to the specific field tasks identified for the specific study plan) or to make all field crews experts in identifying all species, but only to opportunistically gather data during the performance of a relicensing

study. Species included for incidental observation will include, but are not limited to: bald eagle (*Haliaeetus leucocephalus*); golden eagle (*Aquila chrysaetos*); osprey (*Pandion haliaetus*); any bats or positive sign of bats; Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*), including redds and carcasses; northern western pond turtle (*Actinemys marmorata*); foothill yellow-legged frog (*Rana boylei*); American bullfrog (*Lithobates catesbeianus*), and aquatic invasive species.

- Field crews will be trained on, provided with, and use materials (e.g., Quat disinfectant) for decontaminating their boots, waders, and other equipment between water-based study sites. Major concerns are amphibian chytrid fungus, and invasive invertebrates (e.g., zebra mussel, *Dreissena polymorpha*).
- If in the performance of a study, SSWD observes an ESA-listed or special-status species, within 30 days of the observation SSWD will submit to Cal Fish and Wildlife's California Natural Diversity Database a record, on the appropriate form, of the observation.
- If a study plan requires collection and reporting of time series data, the data will be provided at a minimum in Microsoft® Excel (*.xls) or HEC-DSS (*.dss) format. A viewer for *.dss files (HEC-DSSVue) can be obtained from the United States Army Corps of Engineers at the following website as of October 2015: <http://www.hec.usace.army.mil/software/hec-dssvue/>
- If a field crew encounters human remains during field work, all work within a 100-foot radius of the discovery will stop immediately. The field crew will not disturb the remains in any way, secure the area to the best of its ability, mark the location with flagging tape in such a way as to not draw attention to the remains, and record the location using a GPS unit or plot the location by hand on a map if no GPS unit is available. As soon as possible thereafter, the field crew will contact SSWD and the relicensing Cultural Resources Lead to report the discovery. SSWD will report the finding and initiate the appropriate steps required under State of California and federal law to address the discovery. Any human remains encountered will be treated with respect, and the field crew members will keep the location confidential and will not disclose the location of the discovery to the public or to any other study crews. The field crew will keep a log of all calls/contacts it makes regarding the discovery and that detail the event. Work will not proceed in the secured area of the discovery until provided clearance by SSWD.

4.3 Methods

The Study will be completed in the four steps: 1) identify monitoring sites; 2) install and maintain recorders and collect/download data; 3) perform quality assurance/quality control (QA/QC) of data; and 4) prepare report. Steps 1 and 2 each has two components: 1) stream water temperature monitoring; and 2) reservoir water temperature monitoring. Each step is described below.

4.3.1 Step 1 – Identify Monitoring Sites

The locations where stream and reservoir water temperatures data will be collected during the Study are described below.

4.3.1.1 Stream Water Temperature

Table 4.3-1 provides a list of 12 locations at which SSWD will maintain continuous water temperature recorders in streams, and their locations are shown in Figure 4.1-1. Each of these are locations where data have been collected previously, to maintain continuous data records. To the extent possible, continuous water temperature recorders will be located near existing United States Geological Survey (USGS) or SSWD stream flow gages in order to relate water temperature and flow.

Table 4.3-1. SSWD water temperature monitoring locations.

Location	River Mile ¹	Installation Date	Latitude	Longitude
UPSTREAM OF PROJECT AREA				
Bear River above Camp Far West Reservoir	25.1	4/10/15	39.011685	-121.220506
Rock Creek above Camp Far West Reservoir	--	8/6/15	39.063471	-121.263205
DOWNSTREAM OF PROJECT AREA				
Bear River below Powerhouse Outflow	18.0	4/10/15	39.04898	-121.31841
Bear River below CFW Spillway Channel	17.9	9/30/15	39.04719	-121.31969
Bear River below Diversion Dam	16.9	4/10/15	39.04163	-121.33235
Bear River at BRW gage, Highway 65 Crossing	11.4	4/10/15	38.99901	-121.40810
Bear River at BPG gage, Pleasant Grove Bridge	7.1	4/10/15	38.98561	-121.48329
Dry Creek above Bear River	--	12/1/15	38.99596	-121.49121
Bear River near Highway 70 Crossing	3.5	4/10/15	38.97249	-121.54343
Bear River above Feather River Confluence	0.1	4/10/15	38.93906	-121.57831
Feather River above Bear River Confluence	--	8/6/15	38.94277	-121.57928
Feather River below Bear River Confluence	--	4/10/15	38.93802	-121.58038

¹ River miles are for locations in the Bear River only.

4.3.1.2 Reservoir Water Temperature

Table 4.3-2 provides a list of locations where reservoir profiles will be collected once per month, and their locations are shown in Figure 4.1-1. The monitoring locations are meant to characterize Camp Far West Reservoir water temperatures in the Rock Creek and Bear River arms of the reservoir as well as near the dam.

Table 4.3-2. SSWD reservoir water temperature profile locations at Camp Far West.

Location	First Profile Date	Latitude	Longitude
Near Camp Far West Dam	4/9/15	39.05140	-121.31237
Rock Creek Arm of Reservoir	4/9/15	39.05972	-121.29323
Bear River Arm of Reservoir	4/9/15	39.03301	-121.27238

4.3.2 Step 2 – Install and Maintain Recorders and Collect/Download Data

4.3.2.1 Stream Water Temperature

The stream water temperature recorders in the active flow channel will have 12-bit resolution with a minimum accuracy of plus or minus 0.2°C (i.e., Onset or equivalent). Each stream recorder will be contained in a durable protective housing that permits the active flow of water in and around the unit. Each stream recorder will be secured by a cable to a stable root mass, tree trunk or man-made structure, or secured using embedded rebar where necessary such that the recorder will be secured in the channel during high flow periods. The stream recorders will be installed in the channel thalweg, and the housing and cable will be disguised as much as possible while ensuring the ability to retrieve the unit for future downloads. A GPS coordinate will be taken and recorded at each installation point, along with any waypoints that may prove valuable for future retrieval, especially where there is not a defined trail leading to the access point. Photographs of the recorder site, including installation configuration, will be taken. Each recorder will be set to record water temperature at 15-minute intervals. SSWD will visit each recorder and download data monthly.

Prior to installation, each recorder will be numbered and calibrated to manufacturer's recommended specifications. SSWD will install a redundant water temperature recorder at each site. Redundant recorders will be located as close as possible to the primary recorders. Where a redundant recorder occurs, the primary recorder will be labeled with the recorder number for the site (e.g., "BR1") with the suffix "a" and the redundant recorder with the number for the site with the suffix "b." Data from both recorders will be downloaded during each scheduled visit.

During each visit, SSWD will download data into an optic shuttle or directly to a personal computer. Immediately after the data are safely downloaded, back-ups will be recorded on portable memory devices (i.e., USB "thumb drive"). Only after the raw water temperature data are safely backed-up will the optic shuttle be cleared or the data manipulated.

Prior to each download of data, a National Institute of Standards and Technology (NIST) traceable digital thermometer will be used to determine the water temperature at the recorder. The water temperature reading from the NIST-traceable thermometer will be compared to the last logger reading to check for accuracy drift of the recorder.

In addition, during each site visit, SSWD will be prepared to replace or fix a recorder installation. Should a recorder need to be replaced because it is missing or has failed, SSWD will be able to do so immediately to reduce the potential for additional data loss. Any recorder or optic shuttle that fails to download will be returned to the manufacturer for possible data recovery.

During each visit besides downloading data from the recorder, SSWD will also check equipment operation/calibration, battery life, and calibrate the instrument to manufacturer's specifications. After the recorder is removed from the water, it will be cleaned and visually inspected.

SSWD will maintain a record of all recorder installations and data downloads for a comparison between the NIST-traceable thermometer and recorder water temperature readings, and a record of any problems that were encountered in the field.

4.3.2.2 Reservoir Water Temperature Data Collection

Reservoir profiles will be taken at Camp Far West Reservoir once monthly. Sampling will occur at three locations: 1) near the dam; 2) in the Rock Creek arm of the reservoir; and 3) in the Bear River arm of the reservoir (Table 4.3.1-2 and Figure 4.1-1). A GPS receiver will be used during each successive sampling occasion to locate the geographical coordinates of each sample site. Care will be taken to identify the same site for successive profiles where water conditions and GPS accuracy allow.

SSWD will use a Hydrolab[®] DataSonde 5[®] multi-parameter water quality monitoring system (or equivalent) to measure water temperature ($\pm 0.2^{\circ}\text{C}$) at each of the reservoir sampling sites. Generally, measurements will be taken at 10-foot (ft) vertical increments where the change in temperature with respect to depth is low. Where the temperature gradient is higher or where measuring water temperatures near the intake elevations, 5-ft or smaller vertical increments will be used. At each sample depth, the parameter readings will be allowed to stabilize before water temperature will be recorded. Data will be collected throughout the entire water column.

SSWD will collect a Secchi disk depth reading as an indicator of water clarity and photic zone during each reservoir water temperature profile collection. Secchi depth readings will be taken by lowering a Secchi disc over the shaded side of the boat until the disc is no longer visible from the boat. The disk will then be raised until visible, at which location the depth of the disc will be recorded in tenths of a foot, and the average of the two readings will be used as the water clarity reading for that location.

4.3.3 Step 3 – Perform QA/QC Review of Data

Following data collection, SSWD will subject all data to a QA/QC procedures including, but not limited to: 1) checking field data sheets (e.g., comparison of NIST-traceable thermometers and recorder readings) to be sure no corrections are needed; 2) spot-checking data; and 3) reviewing recorder readings and electronic data for completeness. The datasets will also be reviewed graphically to check for errors. If any datum seems inconsistent during the QA/QC procedure, SSWD will investigate the problem. Values that are determined to be anomalous will be removed from the database if the reason for the reading cannot be identified.

If data are unavailable for brief periods of the record, the missing data will be synthesized into the record using a straight line interpolation method, and the data will be indicated as “synthesized” in the record and all subsequent summaries.

The raw data files will be retained in their unaltered state for future QA/QC reference and data modified in the final record will be so indicated in the record.

4.3.4 Step 4 – Prepare Report

At the conclusion of the study, SSWD will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods; 3) Results; 4) Discussion; and 5) Description of Variances from the study plan, if any. The report will include all data in mean daily increments except for reservoir profile data that will be in instantaneous readings. Data will be provided in Microsoft® Excel and HEC-DSS format, on compact disc (CD). The report sections will also include plots of stream water temperature showing mean daily water temperatures over time with mean daily stream flow at a site nearby the monitoring site, if available. Plots of water temperature profiles will also be included in the report.

5.0 Consistency of Methodology with Generally Accepted Scientific Practices

This Study is consistent with the goals, objectives, and methods outlined for the most recent FERC hydroelectric relicensing efforts in California, including for the Don Pedro Project (FERC No. 2299), Yuba River Hydroelectric Project (FERC No. 2246) and Merced River Hydroelectric Project (FERC No. 2179) relicensings. The study includes standard water temperature monitoring methods.

6.0 Schedule

SSWD anticipates the schedule to complete the study as follows:

Planning	January 2016
Continue Data Collection.....	January 2016 – December 2016
QA/QC Review.....	February 2016 – December 2016
Study Report Preparation.....	January 2017

The Study report will be included in SSWD’s DLA and FLA. If SSWD completes the Study report before preparation of the DLA, SSWD will post the report on SSWD’s Relicensing Website and issue an e-mail to Relicensing Participants advising them that the report is available.

7.0 Level of Effort and Cost

SSWD estimates the cost to complete this study in 2015 dollars is between \$60,000 and \$70,000.

8.0 References Cited

None.