Study 3.2

STREAM FISH POPULATIONS STUDY

January 2017

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 riverine fish distribution, abundance and composition in the Bear River downstream of Camp Far West Dam.

2.0 Study Goals and Objectives

The goal of the study is to supplement existing information regarding fishes in the Bear River downstream of Camp Far West Dam.

The objective of the study is to gather qualitative information to meet the Study goal.

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 fish populations in the Bear River downstream of Camp Far West Reservoir is provided in Section 3.2.5.3 of SSWD's Pre-Application Document (PAD). As a summary, no information on fish resources in the Bear River between Camp Far West Dam and the non-Project SSWD diversion dam was found, and there have been very limited fish surveys completed in the Bear River from the non-Project diversion dam to the Feather River (i.e., lower Bear River). Historically, the Sacramento-San Joaquin river drainage, which includes most of the watersheds on the west side of the Sierra Nevada, contained native fish fauna with 22 taxa, including five anadromous fish – Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), Pacific lamprey (*Lampetra tridentata*), green sturgeon (*Acipenser medirostris*) and white sturgeon (*Acipenser transmontanus*) (Moyle 1976; Lindstrom 1993; Moyle et al. 1997). Native foothill fish also included resident fishes including rainbow trout (*O. mykiss*), Sacramento hitch (*Lavinia exilicauda*), Sacramento roach (*L. symmetricus*), hardhead minnow (*Mylopharodon conocephalus*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento speckled dace (*Rhinichthys osculus*), Western sucker (*Catostomus o. occidentalis*), Sacramento perch (*Archoplites interruptus*), and sculpin (*Cottus asper* and *Cottus golosus*) (Moyle et al. 1997). The lower Bear River also has previously documented populations of non-native warmwater species such as black bass (*Micropterus* spp.), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*) and catfish (*Ictalurus* spp. and *Ameiurus* spp.) (SSWD 1980). In addition, as reported in Section 3.2.3 of the PAD, SSWD qualitatively sampled the fish community in the lower Bear River by snorkel on June 10, 2015 at two locations: near the Highway 65 Bridge and below the diversion dam.

A total of five species were observed, including smallmouth and largemouth bass, mosquito fish, Sacramento sucker, and one unidentified sunfish. Young of the year were only observed for black bass.

Additional information, which will be provided by this Study, is needed to address the Study goal regarding riverine fishes in the Bear River.

4.0 Study Methods and Analysis

4.1 Study Area

For the purpose of this Study, the Study Area includes: 1) the Bear River from Camp Far West Dam to the non-Project diversion dam; and 2) the Bear River from the non-Project diversion dam to the confluence with the Feather River. The Study Area is shown in Figure 4.1-1.

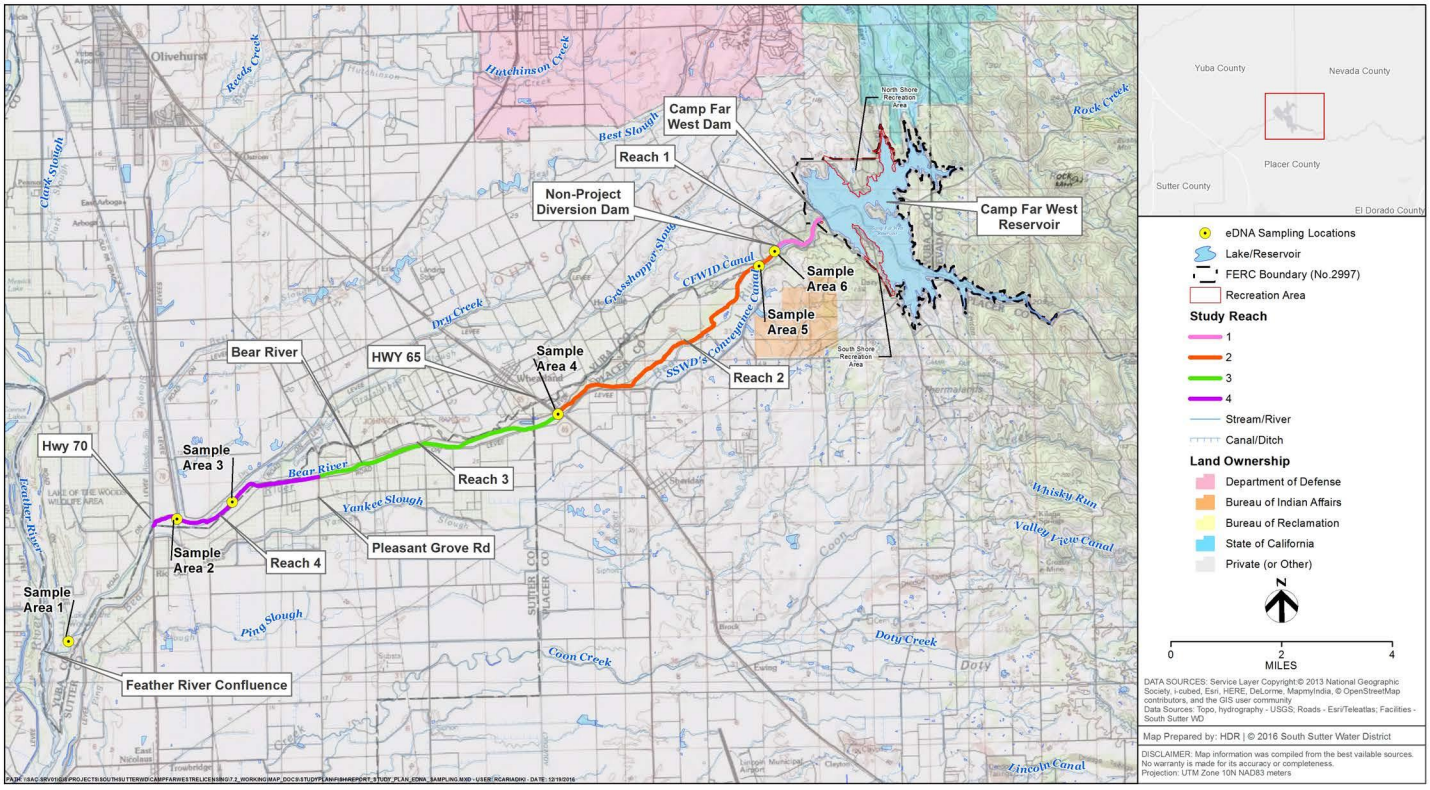

Figure 4.1-1. The Study Area for the Stream Fish Populations Study. The figure shows one survey reach between Camp Far West Dam and the non-Project diversion dam and three survey reaches between the non-Project diversion dam and the confluence with the Feather River as well as the sampling locations for eDNA.

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

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.
- 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 National Oceanic and Atmospheric Association, National Marine Fisheries Service; 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 boylii*);

American bullfrog (*Lithobates catesbeianus*); blue elderberry (*Sambucus nigra* ssp. *caerulea*); 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 Endangered Species Act- (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. The field crew will 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 details 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 performed in three steps: 1) select sampling sites; 2) collect data; and 3) perform a quality assurance/quality control (QA/QC) review of the data and analyze the data.

Fish sampling is predicated on SSWD obtaining necessary federal and State of California permits for sampling. Required permits include a Cal Fish and Wildlife scientific collecting permit (SCP). Along with the SCP and pursuant to the California Code of Regulations, Title 14 §650, a memorandum of understanding (MOU) will be entered into with CDFW for the handling of ESA-listed species. This Study plan will be attached to the SCP submittal for reference. Electrofishing and handling of fish will only occur in the reach from Camp Far West Dam to the non-Project diversion dam where ESA fishes are not expected to be present. SSWD has provided 135 days in the schedule for obtaining the permits and MOU.

4.3.1 Step 1 – Select Sampling Sites

4.3.1.1 Camp Far West Dam Reach (Reach 1)

Qualitative electrofishing surveys will be conducted at three sites in Reach 1 (i.e., the section of river from Camp Far West Dam to the non-Project diversion dam). One site will be located in the riffle habitat immediately downstream of Camp Far West Dam; a second site will be located midway between Camp Far West Dam and the non-Project diversion dam; and the third site will be located in the pool immediately upstream of the diversion dam (Figure 4.1-1). SSWD owns most of the land along Reach 1 and can access the upper sampling site on foot near the powerhouse and the two lower sampling sites via a boat launched near the non-Project diversion dam. Each site will be at least 25 meters in length, but the final site dimensions will be determined in the field by SSWD. All three sites will be fished once in the fall. Fall sampling allows young of the year fish to grow larger for more accurate identification

4.3.1.2 Lower Bear River (Reaches 2, 3 and 4)

Snorkel surveys will occur at three sites in the lower Bear River. One site will be located within 1 mile (mi) of the non-Project diversion dam, another site within 0.5-mi of the Highway 65 Bridge; and a third site within 0.5-mi of the Highway 70 Bridge (Figure 4.1-1). Access along each of these reaches is difficult given that it is almost entirely private property. SSWD will access sampling sites via its own land (Reach 2) or at public access points (Reaches 3 and 4). Each site will be assessed once monthly from April through June (three samples) and a fourth time in the fall to capture variations based on seasonal distribution. Fall sampling also allows young-of-the-year fish to grow larger for more accurate identification during snorkeling. Fall sampling may also have the opportunity to identify Chinook salmon, if they are present.

Where possible and appropriate, sites will: 1) include habitat representative of the overall geomorphic reach; 2) be selected using mesohabitat mapping information available when the sites are selected; 3) be chosen far enough upstream or downstream of access locations to minimize the effects of fishing on fish population results, but still be reasonably accessible to field crews; 4) be comparable between reaches where comparisons likely are to be made between sampling locations, when appropriate. In these instances, comparison Study sites will be located in sections of river with similar habitat types; and 5) be at least 25 meters in length. SSWD's goal in determining site length is to have adequate length to include sufficient usable fluvial habitat represented in that reach (e.g., riffle, pool and glide). Exact site length will be determined in the field by SSWD.

4.3.1.3 Environmental DNA

Environmental DNA (eDNA) sampling will be conducted at six sites (Table 4.3-1) on the Bear River between the non project diversion dam and the confluence with the Feather River. Each site will include between three and five sampling points spaced approximately 100 meters apart. Samples will be collected between February 15 and April 1, 2017. The first of two sampling events will be triggered when flows meet or exceed 2,000 cfs at the Wheatland gage (BRW, Bear River at Wheatland, California Data Exchange Center) after the beginning of the sampling

period. If flows have not reached 2,000 cfs by March 1, 2017 the first sampling event shall be initiated. The second sampling event will be completed two weeks after the first sampling event and no later than April 1, unless a flow event of 2,000 cfs or more occurs less than 2 weeks after the first sampling event, which will trigger the second sampling event. A total of 50 eDNA samples will be collected for the study.

Table 4.3-1. EDNA sampling sites on the Bear River.

Sample Area	Latitude	Longitude	Sample Point	Point Description
1 950 meters upstream of Feather River Confluence	38°56'33.04"N	121°34'20.68"W	1a	At the GPS coordinates
			1b	100 m upstream of Sample Site 1a
			1c	100 m downstream of Sample Site 1a
			1d	200m downstream of Sample Site 1a
			1e	300m downstream of Sample Site 1a
2 Railroad crossing upstream of Highway 70	38°58'27.56"N	121°32'6.36"W	2a	At the railroad crossing
			2b	100 m upstream of Sample Site 2a
			2c	100 m downstream of Sample Site 2a
			2d	200m downstream of Sample Site 2a
3 Dry Creek Confluence	38°58'42.03"N	121°31'0.13"W	3a	At the confluence
			3b	100 m upstream of Sample Site 3a
			3c	100 m downstream of Sample Site 3a
			3d	200m downstream of Sample Site 3a
			3e	300m downstream of Sample Site 3a
4 Highway 65 Crossing	38°59'59.37"N	121°24'23.68"W	4a	At the tail of the pool below the Highway 65 Crossing
			4b	100 m upstream of Sample Site 4a
			4c	100 m downstream of Sample Site 4a
			4d	200m downstream of Sample Site 4a
5 Second pool below non-Project diversion dam	39° 2'15.92"N	121°20'18.19"W	5a	At the tail of the pool
			5b	100 m upstream of Sample Site 5a
			5c	100 m downstream of Sample Site 5a
			5d	200m downstream of Sample Site 5a
6 First pool immediately below non-Project diversion dam	39° 2'29.40"N	121°19'58.38"W	6a	At the tail of the pool
			6b	100 m downstream of Sample Site 5a
			6c	200m downstream of Sample Site 5a

4.3.2 Step 2 – Data Collection

Electrofishing (boat and backpack) is the preferred method of sampling because it allows for near-perfect identification of all captured fish as well as accurate length and weight estimates. SSWD will follow all best practices outlined by Reynolds and Kolz (2012) for the safe capture and handling of fish as well as safety of the sampling team.

In instances where electrofishing will not be effective due to water conditions or the potential presence of ESA-listed fish, snorkeling will be used as the primary sampling method.

4.3.2.1 Camp Far West Dam Reach (Reach 1)

Boat-based electrofishing will be conducted at night (i.e., beginning 1 hour after sunset) in the pool habitat immediately upstream of the non-Project diversion dam, and at the selected site midway between the diversion dam and Camp Far West Dam. Sampling at night is preferred because predatory fish are more often inshore feeding during this time and all fish seem more apt to capture, perhaps due to the cover of darkness (Reynolds 1996). Boat electrofishing will take place using standard methods (Reynolds and Kolz 2012). One or two electrode booms will be employed, and the booms and boat will be outfitted with standard non-conductive material in appropriate places for safety. Electrofisher "time on" will be recorded for each sampling site and a consistent effort and pace will be employed at all sites. Fish will be identified, where possible, as to origin; hatchery or wild stock (i.e., basic visual identification, such as a clipped adipose fin). Data recorded for each fish will include species identification, length (total length of all fish species without forked caudle fins and fork length for all species with forked caudle fins), weight, and, if applicable, notes on general condition.

Backpack electrofishing will be utilized in the shallow water habitat downstream of Camp Far West Dam following the standard methods outlines by Reynolds and Kolz (2012). Backpack electrofishing will occur during daytime hours due to safety considerations while wading. Daylight also provides better light conditions for netters, especially in sites with flowing water (i.e. stream). Block nets will span the full width and depth of the sampling site. Three passes will be made with the backpack electrofishing units in the shallow water habitat. Based on the width of the channel, it is estimated that two or three backpack units will be needed to effectively sample. Field crews will consist of at least two netters for each electrofisher. If necessary, salt blocks will be placed in the stream immediately above the electrofishing station to increase conductivity. Salt blocks will be used when fish are observed escaping the direct path of the electric field generated by the electrofishing unit at elevated settings.

Fish captured by both the backpack electrofisher and boat electrofisher will be retained in aerated buckets and/or live cars until each pass is completed. Fish will be sedated as necessary and with appropriate approvals from Cal Fish and Wildlife. All fish will be identified to species and counted. Effort will be made to measure all fish. Measurements will be to the nearest millimeter (fork length for forked-tail fish and total length for all other fish) and weighed by digital scale to the nearest gram. However, measuring will cease if long holding times begin to result in mortality of captured fish. All fish removed from the site will be held in live cars or aerated buckets outside of the sampling site during subsequent passes. Captured fish will be redistributed evenly across the sampling site following completion of the final pass for the survey. Mortalities and fish condition (e.g., spinal trauma and burning) will be noted and recorded prior to release. All effort will be made to ensure sampling activities in the field will minimize potential injury or mortality to aquatic species. All data will be recorded on a standardized electrofishing form.

General information and habitat/channel metrics will be collected at each sample site. General information will include site identification, turbidity (as measured with a secchi disk), discharge (as measured at the nearest gage), crew members, number of electrofishers, date and time, air temperature, weather conditions, and GPS location. Additionally, water temperature, conductivity, and dissolved oxygen will be collected with a Yellow Springs Instrument (YSI), or equivalent, water quality instrument. Habitat metrics collected at each meso-habitat unit within the sample site will include meso-habitat type, estimated average and maximum depth, estimated average wetted and bankfull width, dominant cover type, dominant and subdominant substrate.

Prior to electrofishing at a selected site, SSWD will walk or boat the stream-bank to directly observe the presence of any northern western pond turtles (WPT) or foothill yellow-legged frog (FYLF). If a WPT or FYLF is observed, SSWD will relocate the site upstream or downstream to a location that includes similar habitat types as the selected site, and repeat the procedure (i.e., check for WPT or FYLF and relocate site if either is observed). If WPT or FYLF is not observed, SSWD will commence electrofishing. SSWD will adhere to accepted decontamination guidelines to minimize the likelihood of transmitting diseases and the spread of aquatic invasive species.

4.3.2.2 Lower Bear River (Reaches 2, 3 and 4)

Snorkel surveys will be conducted at the three selected sites during both spring and fall. Snorkeling techniques will generally follow those outlined by Thurow (1994), Dolloff et al. (1996), and O'Neal (2007). Surveys will be conducted during midday and during periods with low annual turbidity levels.

Snorkel lanes will run the full length of the survey site. Block nets will be placed at the upstream and downstream end of the site to create a closed population. One diver will swim a lane. Generally, two to three divers (as determined by the wetted stream channel width at each site) will snorkel the lanes and record species composition and abundance. Fish will be identified, counted, and visually categorized into pre-defined length-classes (i.e., 0-2 in., >2-4 in., >4-6 in., >6-8 in., >8-10 in., >10-12 in., >12-14 in., etc.). Observers will calibrate estimated fish lengths by viewing painted wooden dowels of varying known lengths underwater. Visual estimates of length will be made in English units and later converted to metric units to avoid error. Maximum sight distance for accurate determination of fish species will be recorded on the field data form. Three replicate snorkel surveys will be performed using the same diving team to assess efficiency, obtain an estimate of survey variance, and determine a level of confidence for use in abundance estimation (Slaney and Martin 1987; Hankin and Reeves 1988). Data will be recorded on a standardized fish snorkeling survey form. The site information and habitat metrics described in Section 4.3.2.1 will also be collected at each snorkeling site. Snorkeling data will be analyzed separately from the electrofishing data.

Three consecutive seine hauls will be conducted at each site using a 10 meter x 2 meter knotless mesh nylon pole seine. Net construction will consists of 6mm mesh wing sections 4m in length and a 3mm mesh 2m x2m bag section. The seine will be set by 2-3 crew members in a round haul fashion by fixing one end on the beach while the other end is deployed wading upstream and returning to shore in a half circle. Once the lead line approaches the shore it will be

withdrawn more than the cork line until fish are corralled in the bag and the lead line is on the beach. Each haul is expected to take approximately 5 minutes. Fish from each haul will be kept separate and placed in aerated 5-gallon buckets prior to processing. No seining will occur if water temperatures exceed 21°C. 20 fish from each species will be measured to the nearest millimeter and weighed to the nearest gram, additional fish will be counted and released without anesthetic.

4.3.2.3 Environmental DNA

Environmental DNA (eDNA) will be sampled during the period described in Section 4.3.1.3. Sampling will be conducted according to the USDA *Protocol for Collecting Environmental DNA Samples From Streams* (Carim et al 2016). For each sample, 2 liters of water will be filtered using sterile tubing and a portable peristaltic pump. No water will be transported or stored for sampling. Water samples will be filtered through a 0.45 or 0.8 micrometer sterile filter, and stored on ice for transport back to the lab. Samples will be labeled with sampling location, and volume of water filtered.

To prevent against cross contamination of samples, all tubing will be used once and discarded in a sealed trash container, which will be carried separate from all other sampling materials. In addition, each sample filter will be returned to its original packaging and sealed in a sterile secondary container prior to storage in the transport container. All filters will be kept in the secondary storage container and placed in a -20^{o}C laboratory freezer until DNA extraction is performed. Any filters that are opened but not used will be considered contaminated and discarded. Field (negative) controls and duplicates will be taken at the end of each field day.

eDNA samples will be tested for the presence of DNA from Chinook salmon, steelhead, green sturgeon, and white sturgeon.

4.3.4 Step 3 – Perform QA/QC Review of Data and Data Analysis

Following data collection, SSWD will subject all data to a QA/QC procedures including, but not limited to: 1) checking field data sheets 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 anomaly cannot be identified.

Following a QA/QC review, data will be entered into and organized in a Microsoft® Excel spreadsheet. Some parameters may be analyzed in Microsoft® Excel while other parameters will be analyzed using published public domain scientific software for calculating stream fish population statistics. While all species will be recorded, small sample sizes of some species may limit some statistical analyses.

SSWD will complete an analysis of the seasonal population structure and fish size (based on snorkel results) in and amongst sites in the reach downstream of the non-Project diversion dam. Analysis based on electrofishing data will include the calculation of relative fish condition factor, length/weight distribution, and population structure for the Camp Far West Dam Reach sampling. Data collected during the night boat electrofishing and daytime backpack electrofishing will be comparable based on the total "time on" of the electrofishing units and the general species composition and abundance at each site. eDNA samples will be used to determine the presence or absence of a given species during the sampling period.

5.0 Consistency of Methodology with Generally Accepted Scientific Practices

This Study is consistent with the goals, objectives, and methods outlined for most recent FERC hydroelectric relicensing efforts in California, including the Yuba River Development Project (FERC No. 2246), Yuba-Bear Hydroelectric Project (FERC Project No. 2266), and Drum-Spaulding Project (FERC Project No. 2310). The Study utilizes standard methods with one exception, eDNA. eDNA is a relatively new sampling method but has been employed in Northern California by the Department of Water Resources and others.

6.0 Schedule

SSWD anticipates the schedule to complete the study as follows:

Planning ..... January 2017
Collect Data ..... February 2017 – October 2017
QA/QC Review .....Ongoing throughout Study

The Study information will be included in SSWD's DLA and FLA. If SSWD completes the Study before preparation of the DLA, SSWD will post the information 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 2016 dollars is between $130,000 and $150,000.

8.0 References Cited

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