

Study 3.4

BENTHIC MACROINVERTEBRATE 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 benthic macroinvertebrates (BMI).

2.0 Study Goals and Objectives

The goal of this Benthic Macroinvertebrate Study (Study) is to supplement existing information regarding BMIs.

The objective of the Study is to collect BMI and habitat 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 BMI in the Bear River downstream of the reservoir is provided in Section 3.2.3.5.3.2 of SSWD's Pre-Application Document (PAD).

4.0 Study Methods

4.1 Study Area

For the purpose of this Study, the Study Area includes the Bear River downstream of the non-Project Diversion Dam to the Feather River confluence. Figure 4.1-1 shows the Study Area and the locations where BMI sampling 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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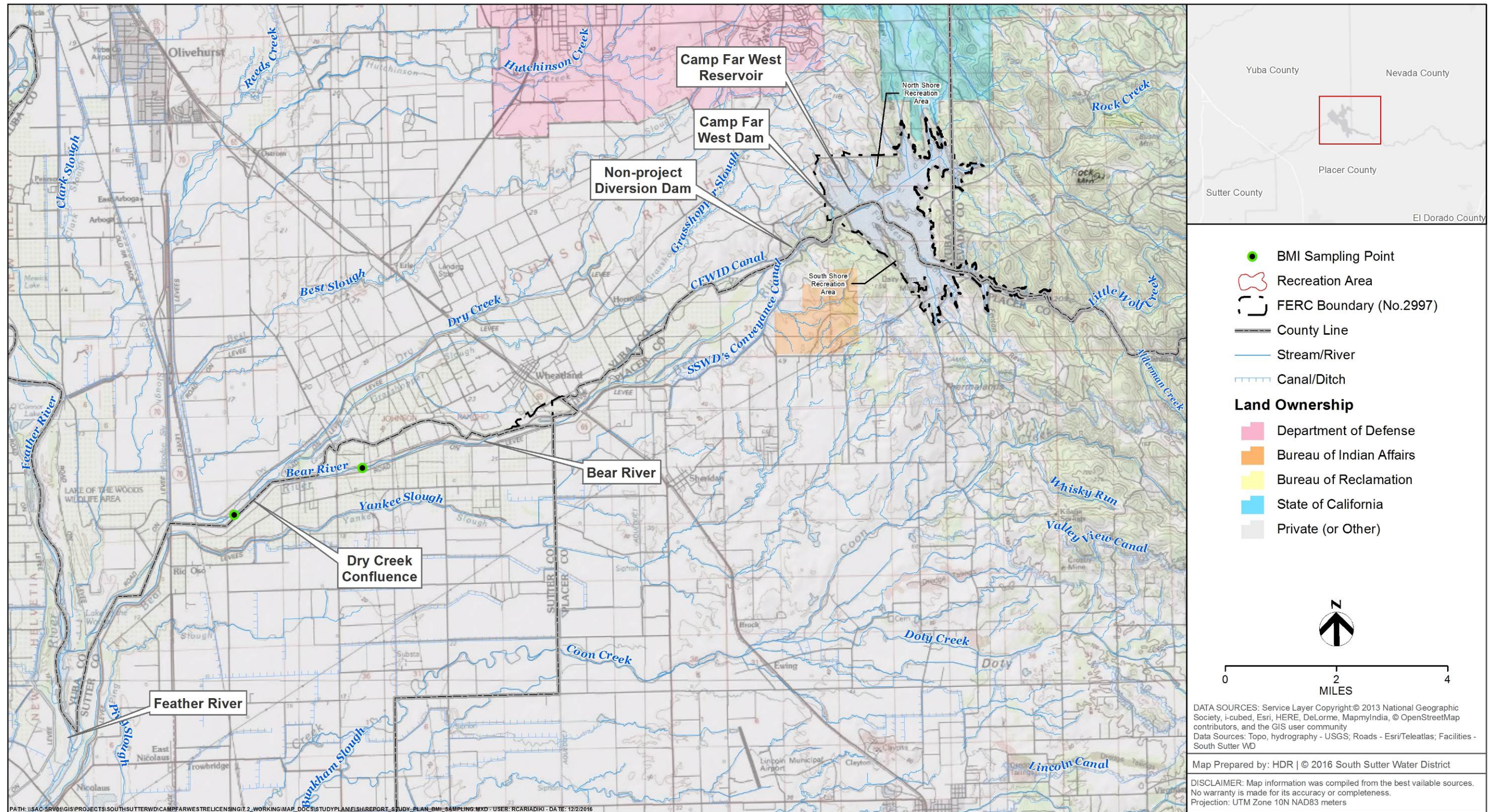


Figure 4.1-1. BMI sampling monitoring locations.

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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.
- 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*), 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 a new occurrence of 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. 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 detail the event. Work will not proceed in the secured area of the discovery until provided clearance by SSWD.

4.3 Methods

The study methods consist of the following four steps: 1) select sampling sites; 2) collect SWAMP data; 3) analyze SWAMP data; and 4) QA/QC SWAMP data. Each of these is discussed below.

SSWD will obtain all necessary permits prior to performing fieldwork.

4.3.1 Step 1 – Select Sampling Sites

SSWD will collect BMI data at two sampling locations (Figure 4.1-1). The first site will be upstream of the Pleasant Grove Bridge (and Dry Creek) and the second location will be near the highway 70 Bridge (downstream of Dry Creek). The exact sampling reach will be identified in the field per the sampling protocol.

Locations were selected to be generally representative of the overall Bear River between the non-Project Diversion Dam and Feather River Confluence. SSWD completed habitat mapping in 2015 and 2016 in order to identify typical habitats.

4.3.2 Step 2 – Collect SWAMP Data

4.3.2.1 Reach Set Up

Sampling methods will conform to the standard reach wide benthos (RWB) methods for documenting and describing BMI assemblages and physical habitat described by the SWRCB's SWAMP in May 2016 (Ode et al. 2016). If the site's average wetted width is ≤ 10 meters (m), the reach will be 150 m in length and 250 m if the width is greater than 10m. The standard sampling layout consists of 11 "main" transects (A-K) interspersed with 10 "inter-transects", all of which are arranged perpendicularly to the primary direction of stream flow (usually the thalweg), and placed at equal distances from one to the next. The first flag should be installed at water's edge on one bank at the downstream limit of the sampling reach to indicate the first main transect ("A"). The positions of the remaining transects and inter-transects are then established by heading upstream along the bank and using the transect tape or a segment of rope of appropriate length to measure off successive segments of 7.5 m (if sampling reach is 150 m), or 12.5 m (if it is 250 m).

4.3.2.2 Physical Habitat and Water Chemistry

Physical habitat and water quality will be characterized at each site. The habitat scoring criteria outlined by the SWAMP provides an effective measure of the physical integrity of a stream. The following list of quantitative measures of chemical and physical/habitat characteristics will be collected at each site:

- Reach-wide Parameters
 - GPS coordinates will be recorded at the top and bottom of the site
 - Water temperature, specific conductance, pH, and dissolved oxygen will be measured using approved standardized procedures and instruments
 - Total reach length and gradient (percent slope) as well as average width and depth will be recorded
 - Take photographs at the top, middle and bottom of the reach
 - A flow measurement will be taken within the reach
- Transect-specific Parameters
 - The wetted and bankfull widths of each transect will be taken.
 - Substrate size, depth and coarse particulate matter will be recorded at five locations along each transect.
 - Record cobble embeddedness for each cobble identified along the transects. If 25 cobbles are not recorded, supplement the data by collecting "random" cobbles within the reach.

- Algal and macrophyte cover will be recorded at each of the sampling points.
- Bank stability, riparian vegetation, human influences and instream habitat complexity will be recorded.
- Record stream shading using a densiometer

4.3.2.3 BMI Field Collection

Samples will be collected at the 11 “main” transects by rubbing cobble and boulder substrates and disturbing finer substrate upstream of a D-frame kicknet fitted with a 0.02-inch (in.) diameter mesh net. For the RWB method, the sub-sampling position alternates between left, center and right portions of the main transects, as one proceeds upstream from one transect to the next. These sampling locations are defined as the points at 25% (“left”), 50% (“center”) and 75% (“right”) across the wetted width in most systems. The subsamples will be combined in a jar, preserved with 95 percent ethanol and labeled to form a single composite sample for that study site.

4.3.2.4 BMI Laboratory Process

Each composite sample will be rinsed in a standard no. 35 sieve (0.5 mm) and transferred to a tray with twenty, 4 inch square grids for subsampling. Subsampling will be performed using a stereomicroscope with magnifications of 10 to 20 times magnification.

Subsamples will be transferred from randomly selected grids to Petri dishes where the aquatic macroinvertebrates will be removed indiscriminately with the aid of a stereomicroscope and placed in vials containing 70 percent ethanol and 2 percent glycerol. In cases where aquatic macroinvertebrates abundance exceeds 100 organisms per grid, half grids will be delineated to assure that a minimum of three discreet areas within the tray of benthic material will be subsampled. At least 600 aquatic macroinvertebrates will be subsampled from a minimum of five grids, or five half grids.

The debris from the processed grids will be placed in a remnant jar and preserved in 70 percent ethanol for later quality control testing. Subsampled aquatic macroinvertebrates will be identified by a taxonomist approved by the California Department of Fish and Game (CDFG) for U.S. Environmental Protection Agency (USEPA) evaluations using standard aquatic macroinvertebrate identification keys (e.g., Kathman and Brinkhurst 1998, Merritt and Cummins 1996, Stewart and Stark 1993, Thorp and Covich 2001, Wiggins 1996) and other appropriate references.

All organisms retained on a 0.5-mm screen will be removed from the subsample and a standard level 2a taxonomic effort will be used as specified in the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) in 2015 (Richards and Rogers 2011).

Finally, the CDFW Aquatic Bioassessment Laboratory (ABL) will be contracted to perform an external QC review of the sample identification. Fifteen to twenty percent of the samples collected will be randomly selected for QC by the taxonomist and sent to the CDFW ABL.

4.3.3 Step 3 - Data Analysis

Analytical methods will conform to the standard methods describing BMI assemblages and physical habitat outlined by SWAMP. Standard biological metrics, plus additional relevant metrics, will be calculated for each site (Table 4.3.3-1) and presented in graphical or tabular form.

Table 4.3.3-1. Biological metrics calculated to assess BMI assemblages

BMI Metrics	Description	Predicted Response to Impairment
RICHNESS MEASURES		
Taxonomic Richness	Total number of individual taxa	Decrease
No. EPT Taxa	Number of taxa in the insect orders Ephemeroptera, Plecoptera, and Trichoptera	Decrease
Ephemeroptera Taxa	Number of mayfly taxa	Decrease
Plecoptera Taxa	Number of stonefly taxa	Decrease
Trichoptera Taxa	Number of caddisfly taxa	Decrease
Coleoptera Taxa	Number of beetle taxa	Decrease
COMPOSITION MEASURES		
% EPT	Percent of the composite of mayfly, stonefly, and caddisfly larvae	Decrease
% Ephemeroptera	Percent of mayfly nymphs	Decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness	Decrease
TOLERANCE/INTOLERANCE MEASURES		
California Tolerance Value (CTV)	CTVs between 0 and 10 weighed for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)	Increase
No. of Intolerant taxa	Taxa richness of those organisms considered to be sensitive to perturbation	Decrease
% Tolerant Organisms	Percent of macrobenthos considered to be tolerant of various types of perturbation	Increase
% Dominant Taxon	Measures the dominance of the single most abundant taxon. Can be calculated as dominant 2, 3, 4, or 5 taxa	Increase
FEEDING MEASURES		
% CF+CG Individuals	Percentage of BMIs within the collector-filterer and collector gatherer functional feeding groups	Increase
% Scrapers	Percent of macroinvertebrates that graze upon periphyton	Variable
% Non-gastropoda Scrapers	Percentage of BMIs within the scraper functional feeding group excluding gastropod scrapers	Decrease
% Predators	Percent of macroinvertebrates that prey on living organisms	Decrease
% Shredders	Percent of macroinvertebrates that shred leaf litter	Decrease

The results from each site will be scored utilizing the California Stream Condition Index (CSCI) to translate BMI metrics into a measure of overall stream health (Rehn et al. 2015).

4.3.4 Step 4 – Prepare Format and Quality Assurance/Quality Control SWAMP Data

Following data collection and identification of taxa, SSWD will subject all data to quality assurance/quality control (QA/QC) procedures including, but not limited to, spot-checks of data and review of electronic data for completeness. If any datum seems inconsistent, SSWD will investigate the problem. Data QA/QC will include the CDFW ABL review described above.

5.0 Consistency of Methodology with Generally Accepted Scientific Practices

The SWAMP methods are considered the standard for BMI sampling in California. These methods have been used on other recent FERC hydroelectric relicensings in California where BMI were studied.

6.0 Schedule

SSWD anticipates the schedule to complete the study as follows:

Planning	June - July 2017
Data Collection	August - September 2017
QA/QC Review	October - December 2017
Data Analysis	October - December 2017

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 information is available.

7.0 Level of Effort and Cost

SSWD estimates the cost to complete this study in 2016 dollars is between \$10,000 and \$15,000.

8.0 References Cited

- Kathman, R.D., and R.O. Brinkhurst. 1998. Guide to the freshwater oligochaetes of North America. Aquatic Resources Center, College Grove, TN. 264 pp.
- Merritt, R.W. and K.W. Cummins (eds.). 1996. 3rd Edition. An Introduction to the Aquatic Insects of North America. Kendall and Hunt Publishing Co., Dubuque, IA.
- Ode, P.R., A.E., Fetscher, and L.B. Busse. 2016. Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 004
- Rehn, A.C., R.D. Mazor and P.R. Ode. 2015. The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams. Swamp Technical Memorandum SWAMP-TM-2015-0002
- Richards, A. B., and D. C. Rogers. 2011. List of freshwater macroinvertebrate taxa from California and adjacent states including standard taxonomic effort levels. Southwest Association of Freshwater Invertebrate Taxonomists. Chico, CA. Available from www.safit.org.

- Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT). November 2006. List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels.
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- Thorp, A.P. and A.P. Covich (eds.) 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc., San Diego, CA.
- Wiggins, G.B. 1996. Larvae of the North American Caddisfly Genera (Trichoptera). 2nd ed. Univ. Toronto Press, Canada.

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