

Study 3.1

SALMONID REDD 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 anadromous fish in the Bear River downstream of a non-Project diversion dam (i.e., lower Bear River).

For the purpose of this Salmonid Redd Study (Study), "anadromous fish" refers to Chinook salmon (*Oncorhynchus tshawytscha*)¹ and steelhead (*O. mykiss*).² Since differentiating between anadromous and rainbow trout (i.e., resident *O. mykiss*) redds cannot be done through visual assessment alone, all *O. mykiss* redds observed will be reported as steelhead.

2.0 Study Goals and Objectives

The goal of the study is to supplement existing information regarding the spawning of salmonids in the Bear River downstream of the non-Project diversion dam.

The objectives of this Study are to gather information necessary to meet the Study goal.

This Study does not include Section 7 ESA informal consultation with the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS).

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 anadromous fish in the Bear River downstream of Camp Far West Dam is provided in Section 3.2.3 of SSWD's Pre-Application Document (PAD). Existing information regarding spring-run Chinook salmon ESU and its critical habitat is provided in Section 3.2.5.3.8 of the PAD, and existing information regarding Central Valley steelhead its critical habitat is provided in Section 3.2.5.3.7 of the PAD.

¹ The spring-run Chinook Salmon Evolutionary Significant Unit (ESU) and its critical habitat are listed as threatened under the Endangered Species Act (ESA). In the Bear River, spring run Chinook salmon ESU critical habitat occurs from the confluence with the Feather River upstream for about 5 miles.

² The Central Valley steelhead Distinct Population Segment and its critical habitat are listed as threatened under the ESA. In the Bear River, Central Valley steelhead Distinct Population Segment critical habitat occurs from the confluence with the Feather River upstream to the non-Project diversion dam.

Reports issued in 1991 and 1993 by the California Department of Fish and Game,³ (CDFG) (1991) and Reynolds et al. (1993) respectively, stated that fall flows, specifically October and November, in the lower Bear River appeared to influence the Chinook salmon run size. During years of high water in October and November, Cal Fish and Wildlife reported runs as high as 300 Chinook salmon in 1984 and as low as zero in 1985.

From 1982 through 1986, the Cal Fish and Wildlife conducted sporadic salmon surveys from the non-Project diversion dam to Highway 70, and reportedly found Chinook salmon redds, carcasses and live fish. In addition, in 2015, SSWD conducted habitat mapping surveys of the lower Bear River and found a total of 31,543 ft² of salmonid spawnable gravel.

Additional information, which will be provided by this Study, is needed to address the Study goal regarding Project effects on anadromous fish. Specifically, data gathered from this Study will provide information on life history timing and habitat availability/suitability in the lower Bear River and how these may be influenced by Project O&M.

4.0 Study Methods and Analysis

4.1 Study Area

For the purpose of this Study, the Study Area includes the section of the lower Bear River from the non-Project diversion dam to the Highway 70 Bridge (River Mile 3.5) (Figure 4.1-1). The habitat downstream of the Highway 70 Bridge is likely to be primarily utilized by anadromous fish as a migration corridor, and not for spawning.

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

³ The California Department of Fish and Wildlife was previously the California Department of Fish and Game. In this PAD, the California Department of Fish and Wildlife is referred to as “*Cal Fish and Wildlife*” except in references that were published before the name change in 2012. In those cases, Cal Fish and Wildlife is referred to as the “*California Department of Fish and Game*” or “*CDFG*.”

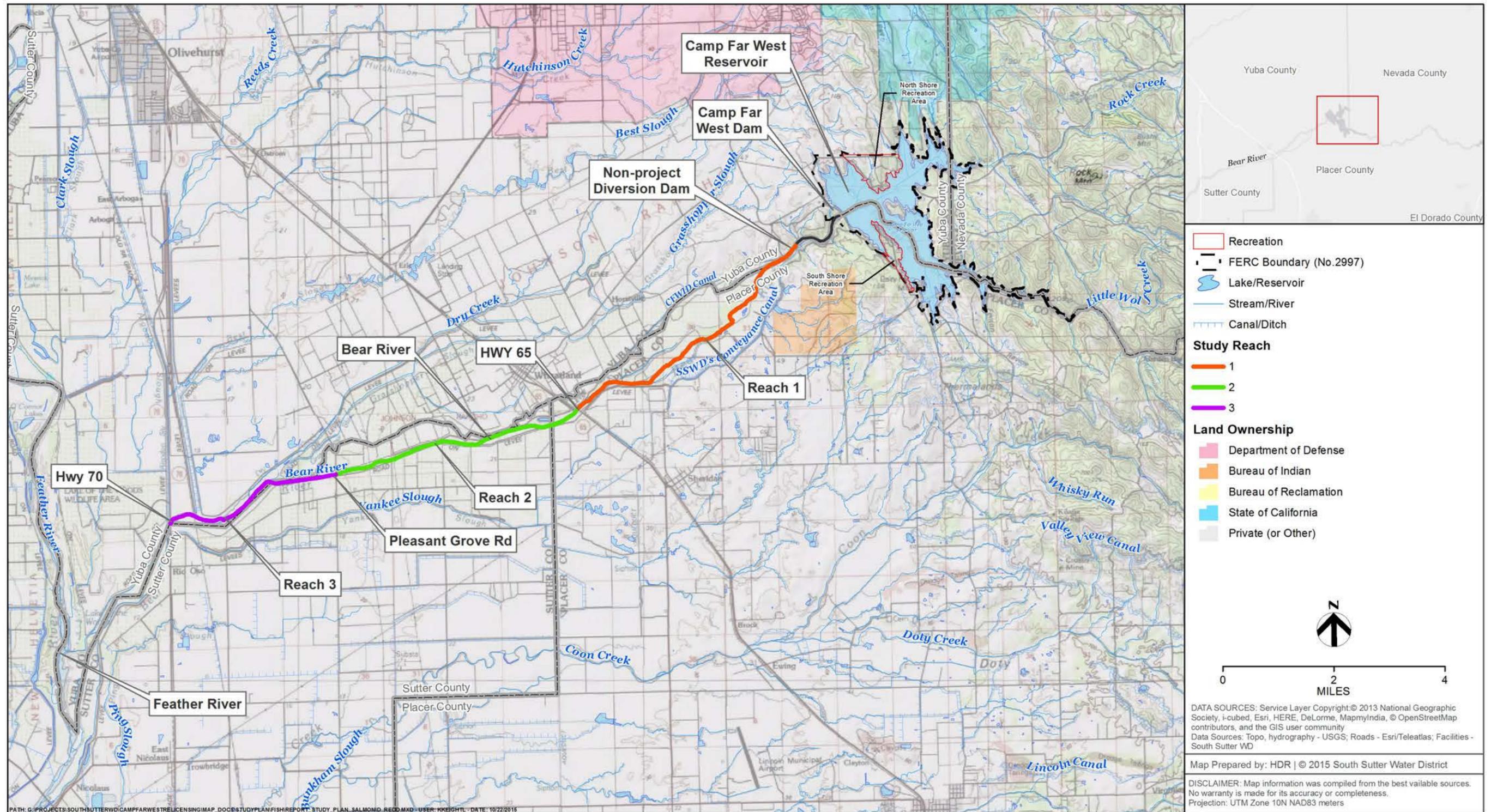


Figure 4.1-1. Study Area for the Salmonid Redd Study.

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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 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 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 HEC-DSS format. A viewer for these files (HEC-DSSVue) can be obtained from the United States Army Corps of Engineers at the following website as of March 2008: <http://www.hec.usace.army.mil/software/hec-dss/hecdssvue-dssvue.htm> in both Microsoft® Excel and *.DSS formats.
- 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 four steps: 1) spawning gravel mapping; 2) gravel permeability 3) redd surveys; and 4) perform a quality assurance/quality control (QA/QC) review of the data and analyze the data. Each step is described below.

Redd surveys are predicated on SSWD obtaining necessary federal and State of California permits for survey work. 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 Cal Fish and Wildlife for the all work being conducted. This Study will be attached to the SCP submittal for reference.

As of December 2016 SSWD has consulted with CDFW and NMFS regarding the need for permits for this study. As a result of this consultation both agencies agreed that only a CDFW issued SCP would be required to take the physical measurements described below between October 1 and January 31 (the spawning period for CVS fall-run Chinook Salmon). After

January 31, there is a chance that steelhead spawning could occur in the Bear River, and SSWD would need additional permits in the form of a Section 4(d) take waiver. SSWD applied for both of the permits described above and will collect physical dimensions of redds as soon as those permits are issued.

4.3.1 Step 1 – Gravel Mapping

Potential spawning gravel sites in the entire Study Area will be mapped by a combination of inflatable kayak and on foot, as necessary. All gravel mapping will occur outside of the spawning season in order to avoid disturbing any redds. To define an appropriate level of effort or, spatial extent, surveys will be conducted within the bankfull⁴ elevation, as determined in the field. Potential spawning locations will be determined based on substrate size and composition. Additionally, where substrate is determined to be suitable, in wetted areas of the low flow active channel, water velocity and depth will be recorded and associated to river discharge on the day of survey. The following substrate criteria will be used to determine if a site is suitable for spawning:

- Suitable substrate size as determined by D_{50} (the particle size that 50% of the samples are equal or smaller to) of Wolman Pebble Count (Wolman 1954) ranging in diameter from 0.11 to 5.9 in. (Raleigh et al. 1986)

The Wolman Pebble Count technique will be carried out using the step-toe procedure. A transect will be selected at each potential site to record average depth and velocity at a minimum of 20 points per transect. Water velocity will be recorded using a Swiffer Current Velocity Meter. When a site is determined to meet the above criteria, its GPS coordinate will be recorded.

4.3.2 Step 2 – Gravel Permeability

In riffles within the intensive study sites selected for Study 3.1, *Instream Flow*, gravel permeability will be measured. For particles between 0.1 to 6 inches stored in riffles, a standpipe or similar method will be used to determine fine sediment infiltration. This gravel permeability assessment will be done outside of spawning season. Methods will be as stated in Barnard and McBain (1994). A modified Terhune's permeability standpipe will be used so that permeability and dissolved oxygen can be taken without removing the standpipe. This allows us to measure and compare intragravel permeability and dissolved oxygen. A synthetic rubber plunger is placed into the pipe to evacuate water from the standpipe. Dissolved oxygen is measured using an electronic probe lowered into the evacuated standpipe that has refilled with intragravel water.

⁴ SSWD determined during habitat mapping that the average low flow active channel width was 60 ft and the 1.5 yr. width was 112 ft. The return interval of 1.5 yr. is generally associated with bankfull discharge in unregulated systems. However, in a regulated system, the "low flow active channel" is important hydrologically because the releases from the diversion dam control flow timing and volume.

4.3.3 Step 3 – Redd Surveys

4.3.3.1 Survey Timing and Reaches

Surveys will be conducted from October through March in order to capture the primary spawning period of both steelhead and Chinook salmon. The Study Area will be broken down into three sub-reaches as follows (Figure 4.1-1):

- Reach 1. Non-Project diversion dam to the Highway 65 Bridge
- Reach 2. Highway 65 Bridge to the Pleasant Grove Bridge
- Reach 3. Pleasant Grove Bridge to the Highway 70 Bridge

Redd surveys will occur once monthly beginning in October. If an anadromous salmonid, carcass or redd are observed during the once monthly survey, SSWD will conduct one biweekly survey until the end of March. When conditions allow (i.e. flows are safe for wading or boating) each sub-reach will be surveyed, once, on consecutive days during each survey. All surveys will be conducted when flows are safe and water clarity allows for observing redds. Any adult salmon carcasses found during field surveys will be documented with photographs and GPS locations.

4.3.3.2 Survey Methods

Redd surveys will generally follow Gallagher et al. (2007). All redds will be identified for species use, photographed from the bank and geo-referenced. Whether redds were constructed by Chinook salmon or *O. mykiss* will be determined based on the following:

- Presence of spawning pair: Upon sighting of a redd, it will be visually assessed for an attending spawning pair and species identification. Chinook salmon generally defend their redds for 1 to 2 weeks after being built, while steelhead do not (Briggs 1953, Smith 1977). Monitoring frequency may not allow reliable species association to be determined by this observation.
- Redd construction timing. Fall-run Chinook salmon typically construct redds from October through December, while steelhead typically spawn from December through March, with peak spawning occurring in January and February (Myers et al. 1998, Moyle 2002).
- Redd size: Chinook salmon redds are larger than steelhead redds. Chinook salmon redd size in the Sacramento-San Joaquin drainages ranges from 22 to 486 ft² (U.S. Fish and Wildlife Service 1995). In the Sacramento River basin, average redd size for steelhead is 56 ft². Redd size will be based on visual estimations only.
- Gravel size. Chinook salmon construct redds in larger gravel sizes than steelhead. Sommer et al. (2001) documented that Feather River Chinook salmon preferred spawning gravel size ranges from 0.11 to 5.9 in. (Raleigh et al. 1986), while steelhead preferred

gravel size for spawning ranges from 0.25 to 3.0 in. (U.S. Fish and Wildlife Service 1995). Gravel size will be based on visual estimations only.

If a determination of species cannot be made for a redd it will be reported as an unknown salmonid redd.

During redd count surveys, individual redds will be counted and uniquely labeled on data forms and in the field to avoid double counting and to allow estimation of observer efficiency (Gallagher et al. 2007). The date each redd was first observed, fish species, unique identifier number, and location will be recorded on the data form. Redds will be marked in the field by GPS and mapped on geo-referenced aerial photographs for reference during future surveys. Redds under construction will be noted as such and re-examined on consecutive surveys and classified appropriately based on their apparent completion.

For each redd, measurements will be made to establish its overall size and characterize the hydrological conditions associated with it. The edges of the redd will be defined as the place where the gravel is no longer visibly worked or where it conforms to the surrounding substrate. Total area of the redd will be estimated from field measurements and recorded. Meso and macro-habitat type will be recorded for each redd (i.e. riffle/edgewater, run/thalweg, etc.) Lastly, the median grain-size of each redd will be estimated and any evidence of superimposition since the previous survey will be documented.

Total redd area will be calculated from field measurements treating the pot as a circle or ellipse and the tail spill as a square, triangle, or rectangle depending on the individual measurements. All measurements will be recorded in meters to the nearest decimeter.

Pot Dimensions

Pot dimensions will be measured, including length, width, and depth. Pot length is the total length of the pot parallel to stream flow from the top to bottom edge. Pot width is the maximum width perpendicular to stream flow from one edge to the other. Pot depth will be measured at the maximum depth of the excavation relative to the surrounding undisturbed stream bed. When irregular pots are encountered, crews will do their best to estimate maximum width.

Pot substrate is the size of the dominant substrate in the pot. Sizes will be visually estimated as the length of the diameter of the smallest axis in centimeters.

Tail Spill Dimensions

Tail spill dimensions consist of a length and two widths. Tail spill length is the total length of the tail spill parallel to stream flow from the top edge of the middle of the pot to the bottom edge of the tail spill. Tail spill widths are the maximum width of the tail spill perpendicular to stream flow. Measurements will be taken at a distance of 1/3 and 2/3 down from the top of the tail spill. When irregular tail spills are encountered, crews will do their best to estimate maximum width.

Tail spill substrate is the size of the dominant substrate in the tail spill. Sizes will be visually estimated as the length of the diameter of the smallest axis in centimeters.

Redd Age

Redd age will be determined for all redds using Gallagher's (07) 1-5 scale. Documenting redd age will help determine how long we are able to observe redds and also estimate our ability to count all redds present. Redd ages will be recorded using the following:

- 1 = new since last survey but still clear,
- 2 = still measurable but already measured,
- 3 = no longer measurable but still apparent,
- 4 = no red apparent, only a flag, and
- 5 = poor conditions; cannot determine if present and measurable or not

Evidence of superimposition will be assessed by indication of whether the dimensions of any newly constructed redd overlaps the egg pocket area of the previously mapped redd at that location.

4.3.4 Step 4 – Perform QA/QC Review of Data

Following data collection, SSWD will subject all data to 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. A GIS technician will analyze redd polygon areas collected in the field and provide total redd area in square feet by reach.

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, such as the Don Pedro Relicensing (FERC Project No. 2299). In addition, the methods are consistent with those used by the Lower Yuba River Accord River Management Team in Chinook salmon and steelhead redd surveys in the Yuba River downstream of Englebright Dam.

6.0 **Schedule**

SSWD anticipates the schedule to complete the study as follows:

Planning	October 2016
Collect Redd Data	October 2016 – March 2017
Collect Gravel Data.....	July 2017 – September 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 \$100,000 and \$120,000.

8.0 **References Cited**

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