Study 3.8

STREAM FISH POPULATIONS UPSTREAM OF ENGLEBRIGHT RESERVOIR

August 2011

1.0 Project Nexus and Issues

Yuba County Water Agency's (YCWA or Licensee) continued operation and maintenance (O&M) of the existing Yuba River Development Project (Project) has a potential to affect fish in streams upstream of the Englebright Dam.[1]

2.0 Resource Management Goals of Agencies and Indian Tribes with Jurisdiction Over the Resource Studied

YCWA believes that four agencies have jurisdiction over fish in the geographic area covered in this study proposal: 1) the United States Department of Agriculture, Forest Service (Forest Service) on National Forest System (NFS) land; 2) United States Department of Interior, Fish and Wildlife Service (USFWS); 3) California Department of Fish and Game (CDFG); and 4) State Water Resources Control Board Division of Water Rights (SWRCB). Each of these agencies and their jurisdiction, as understood by YCWA at this time, is discussed below.

Forest Service

The Forest Service's jurisdiction and applicable management goals are described by the Forest Service from page 59 to 76 in the Forest Service's March 2, 2011 letter to FERC providing the Forest Service's comments on YCWA's Pre-Application Document, or PAD (YCWA 2010). The Forest Service's jurisdiction and management goals are not repeated here.

USFWS

USFWS's jurisdiction and goals and objectives are described by USFWS on pages 1 through 3 of USFWS's March 7, 2011 letter to FERC that provided USFWS's comments on YCWA's PAD. USFWS's jurisdiction, goals and objectives are not repeated here.

CDFG

CDFG's jurisdiction is described by CDFG on page 1 of CDFG's March 2, 2011 letter to FERC providing CDFG's comments on YCWA's PAD. CDFG's goal, as described on page 2 of CDFG's letter is to preserve, protect, and as needed, to restore habitat necessary to support native fish, wildlife and plant species.

[1] Englebright Dam was constructed by the California Debris Commission in 1941, is owned, operated and maintained by the United States Army Corps of Engineers; and is not included as a Project facility in FERC licenses for the Yuba-River Development Project.

SWRCB

SWRCB has authority under the federal Clean Water Act (33 U.S.C. §11251-1357) to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Throughout the relicensing process the SWRCB maintains independent regulatory authority to condition the operation of the Project to protect water quality and the beneficial uses of stream reaches consistent with Section 401 of the federal Clean Water Act, the Regional Water Quality Control Board Basin Plans, State Water Board regulations, CEQA, and any other applicable state law.

3.0 Existing Information and Need for Additional Information

Some information regarding the stream fish communities in the vicinity of Project facilities is available. Based on a review of existing and available information, fish species listed as threatened or endangered under the federal Endangered Species Act (ESA) or California Endangered Species Act (CESA) do not occur in any Project-affected stream reaches upstream of Englebright Dam. California Department of Fish and Game (CDFG) does not stock fish in any Project-affected stream reaches, however New Bullards Bar Reservoir and Englebright Reservoir have been planted with hatchery stock Kokanee, Eagle Lake trout, and rainbow trout. Most existing stream fish information is not current or quantitative.

3.1 Middle Yuba River and Yuba River Upstream of Englebright Reservoir

A transition fishery[2] occurs in the vicinity Our House Diversion Dam. As described in Section 7.3.4.1 of the Pre-Application Document, 2004 snorkeling surveys in the Middle Yuba River about 0.5 mile upstream of Our House Diversion Dam found rainbow trout (*Oncorhynchus mykiss)* and Sacramento pikeminnow/hardhead (*Ptychocheilus grandis/Mylopharodon conocephalus)* (the snorkelers were unable to distinguish between the two species); while about 0.5 mile downstream of the dam, the snorkelers found rainbow trout, Sacramento pikeminnow, hardhead, smallmouth bass (*Micropterus dolomieui*), and various sucker species (Family Catastomidae) (Gast et al. 2005). The general species composition upstream of Our House Diversion Dam was confirmed by Nevada Irrigation District (NID) in 2008 and 2009 when its snorkeling surveys in the Middle Yuba River about 0.5 mile upstream of Our House Diversion Dam found Sacramento suckers, rainbow trout, and Sacramento pikeminnow (NID and PG&E 2010). Hardhead is a Forest Service sensitive species and is a Species of Concern for CDFG.

Additional information regarding stream fish in the Yuba and Middle Yuba River between Our House Diversion Dam and Englebright Reservoir is available from Gast et al. (2005) and is summarized in Table 3.0-1.

[2] A transition fishery is one that includes both coldwater and warmwater fishes and is typically found in the Sierra in lower elevations where the fish community transitions from a coldwater fishery dominated by trout in the higher elevations to a warm water fishery in the lower elevations.

Table 3.0-1. Distribution of fish species relative to river mile and stream temperature observed during 2004 Middle Yuba River snorkel surveys downstream of Our House Diversion Dam. Note that RM is 12.6 is about 0.5 mile upstream of Our House Diversion Dam.

River Mile (beginning at head of Englebright Reservoir)	Tributary Inflow	Middle Yuba Water Temperature (°C)	Rainbow Trout	Brown Trout	Pikeminnow Hardhead[1]	Pikeminnow	Hardhead	Suckers	Smallmouth Bass	Rainbow (Fry Lane)	Non-game (Fry Lane)
0.0	--	--	--	--	--	--	--	--	--	--	--
0.1	--	23.1°	●	--	--	●	--	--	●	--	--
1.8	Yellowjacket Creek	--	--	--	--	--	--	--	--	--	--
2.6	--	20.4°	●	--	--	●	--	●	●	--	--
4.8	Oregon Creek	21.4°	--	--	--	--	--	--	●	--	--

Source: Gast et al. 2005
[1] Pikeminnow and hardhead less than 4" in length not discernible.

According to Gast et al. (2005), tributaries to the mainstem, having cooler summertime water temperatures and likely provide refuge for salmonids from higher than optimum mainstem water temperatures. Oregon Creek was cooler than the mainstem, appeared to provide good habitat, and was inhabited by rainbow trout. The North Yuba River, at the confluence with the Middle Yuba River also provides ample cool-water trout habitat. At the time of observation, water temperature in the North Yuba River at the confluence with the Middle Yuba River was 18.6°C, which was 4.5°C cooler than the Middle Yuba River water temperature at that time (23.1 °C).

3.2 Oregon Creek

YCWA was unable to find any existing information regarding the fish community in Oregon Creek near Log Cabin Diversion Dam, but the fish community is likely similar to that at Our House Diversion Dam. Historic samples indicate that there was a hardhead fish population in the diversion pool as recent as 2001 (personal communication, Dan Teater, Forest Service).

3.3 North Yuba River

Recent fisheries information for the North Yuba River upstream of New Bullards Bar was collected in 2008 and 2009 for the Yuba-Bear Hydroelectric Project and Drum-Spaulding Project relicensings (NID and PG&E 2010). Snorkeling surveys approximately 6.5 miles upstream of New Bullards Bar Reservoir found rainbow trout, brown trout (*Salmo trutta*), Sacramento sucker (*Catostomus occidentalis*), and Sacramento pikeminnow/hardhead (the snorkelers were unable to distinguish between the two species). Snorkelers did not find any species listed as threatened or endangered under the federal Endangered Species Act or California Endangered Species Act. In addition, hardhead could not be confirmed to be present or absent due to the snorkeling methodology. Two additional sites further upstream were electrofished and resulted in the capture of only rainbow and brown trout.

YCWA was unable to find any existing information regarding the fish community in the North Yuba River downstream of New Bullards Bar Dam, but the community is likely similar to that at Our House Diversion Dam.

4.0 Study Goals and Objectives

The goal of the study is to provide current information on fish in Project-affected streams.

The objectives of the study are on a site and species specific basis: 1) characterization of fish species composition and relative spatial distribution; 2) estimate of total or relative abundance of fish by species; 3) analysis of fish population size-structure and age-class structure; 4) calculation of fish condition factor; and 5) fry emergence timing.

5.0 Study Methods and Analysis

5.1 Study Area

For the purpose of this study, the study area includes: 1) the Middle Yuba River from and including Our House Diversion Dam Impoundment to the confluence with the North Yuba River; 2) Oregon Creek from and including the Log Cabin Diversion Dam Impoundment to the confluence with the Middle Yuba River; 3) the North Yuba River from and including New Bullard's Bar Dam Reservoir to the confluence with the Middle Yuba River; and 4) the portion of the Yuba River from the confluence of the North and Middle Yuba rivers to the confluence with the normal maximum water surface elevation of the USACE's Englebright Reservoir.

If YCWA proposes an addition to the Project, the study area will be expanded if necessary to include areas potentially affected by the addition.

5.2 General Concepts and Procedures

The following general concepts and practices apply to the study:

- Personal safety is the most important consideration of each fieldwork team.
- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of entering the property.
- Field crews may make minor variances to the FERC-approved study in the field to accommodate actual field conditions and unforeseen problems. When minor variances are made, Licensee's field crew will follow the protocols in the FERC-approved study.
- When Licensee becomes aware of major variances to the FERC-approved study, Licensee will issue an e-mail to the Relicensing Contact List describing the variance and reason for the variance. Licensee will contact by phone the Forest Service (if the variance is on National Forest System land), USFWS, SWRCB and CDFG to provide an opportunity for input regarding how to address the variance. Licensee will issue an e-mail to the Relicensing Contact List advising them of the resolution of the variance. Licensee will summarize in the final study report all variances and resolutions.

- Licensee's performance of the study does not presume that Licensee is responsible in whole or in part for measures that may arise from the study.
- Global Positioning System (GPS) data will be collected using either a Map Grade Trimble GPS (sub-meter data collection accuracy under ideal conditions), a Recreation Grade Garmin GPS unit (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 Licensee's relicensing GIS analyst. Metadata will be developed for deliverable GIS data sets. Upon request, GIS maps will be provided to agencies in a form, such as ESRI Shapefiles, GeoDatabases, or Coverage with appropriate metadata, that is useful for interactive data analysis and interpretation. Metadata will be Federal Geographic Data Committee (FGDC) compliant.[3]
- Licensee's field crews will record incidental observations of aquatic and wildlife species observed during the performance of this study. All incidental observations will be reported in the appropriate Licensee report (e.g., incidental observations of special-status fish recorded during fieldwork for the Special-Status Turtles – Western Pond Turtle Study will be reported in Licensee's Stream Fish Populations Study report). The purpose of this effort is not to conduct a focus study (no effort in addition the specific field tasks identified for the specific study) or to make all field crews experts in identifying all species, but only to opportunistically gather data during the performance of the study.
- Field crews will be trained on and provided with materials (e.g., Quat-128 [didecyl dimethyl ammonium chloride], scrub brush, etc.) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), and invasive invertebrates (e.g., zebra mussels, *Dreissena polymorpha*). This is of primary importance when moving: 1) between tributaries and mainstem reaches; 2) between basins (e.g., Middle Yuba River, Yuba River and North Yuba River); and 3) between isolated wetlands or ponds and river or stream environments.

5.3 Study Methods

The study will be performed in four steps: 1) select sampling sites; 2) collect data; 3) perform a quality assurance/quality control review of the data and analyze the data; and 4) prepare the report. Each of these steps will be repeated for two years, and described below.

Fish sampling is predicated on YCWA obtaining necessary federal and State of California permits for sampling. Required permits include a CDFG scientific collecting permit (SCP) as well as an MOU if handling species listed as threatened or endangered under the Endangered Species Act. The study plan will be attached to the SCP submittal for reference. Given the current sampling area, ESA fishes are not expected to be present. YCWA has provided 135 days in the schedule for processing the scientific collecting permit.

[3] The Forest Service and CDFG each have requested that a copy of the GIS maps be provided to them when the maps are available.

5.3.1 Step 1 – Select Sampling Sites

Sampling will occur at the eleven sites described in Table 5.3.1-1.

Table 5.3.1-1. Eleven sampling sites by reach.

Stream	River Reaches	Reach Length (mi)	General Location
North Yuba River	New Bullard's Bar Dam Reach	2.3	Site located below but in the vicinity of the USGS gaging station downstream of New Bullard's Bar Dam. Site will be determined based on reasonable access and appropriate sampling area (e.g., avoid large substrate and interstitial flowing water common for this section of the river).
			Site located near the confluence of the North Yuba River with the Middle Yuba River.
Oregon Creek	Upstream of Log Cabin Diversion Dam Reach – Non-Project	Not Applicable	Site located proximally to Log Cabin Diversion Dam, if possible within 0.5 mile.
	Log Cabin Diversion Dam Reach	4.1	Site located near the confluence of Oregon Creek with the Middle Yuba River.
Middle Yuba River	Upstream of Our House Diversion Dam Reach – Non-Project	n/a	Site located within 0.5 mile upstream of Our House Diversion Dam Reach.
	Our House Diversion Dam Reach	7.5	Site located within 0.5 mile downstream of Our House Diversion Dam.
			Site located upstream of the Highway 49 Bridge Crossing near RM 4.5.
	Oregon Creek Reach	4.5	Site located proximally to Moonshine Creek near RM 3.4.
Yuba River	Middle/North Yuba River Reach	5.8	Site located near the confluence of the Middle Yuba River in an accessible location. Access within the reach is limited.
			Site located proximally upstream of the New Colgate Powerhouse (RM 34) where access is available. Site may be quantitatively snorkeled due to the larger stream channel.
	New Colgate Powerhouse Reach	1.7	Site located upstream of the influence of the reservoir, but downstream of the influence of the powerhouse. Sites will likely be quantitatively snorkeled due to the larger stream channel. Limited access may be available at Rice Crossing or from access roads of the powerhouse.

Where possible and appropriate, sites will: 1) include habitat representative of the overall reach; 2) be located at any known historic sampling sites; 3) be co-located with sampling sites for YCWA's Instream Flow Upstream of Englebright Dam Study, Special-Status Aquatic Mollusks Study and Benthic Macroinvertebrates Study; 4) be selected using mesohabitat mapping information available when the sites are selected to help identify sampling sites with mesohabitat types in similar proportion to the larger geomorphic reaches of the river; 5) 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; and 6) where comparisons likely are to be made between sampling locations, comparison study sites will be located in sections of river with similar habitat types and similar sampling methods will be used.

Final sampling sites will be selected in consultation with relicensing participants and YCWA will collaborate with interested and available Relicensing Participants regarding sampling locations for each methodology. YCWA will make a good faith effort to schedule the consultation on a day or days convenient to YCWA and interested Relicensing Participants, and will provide an email notice *at least* 14 days in advance of the meeting or site visit. If collaborative agreement is not reached, YCWA will note the disagreements in its final report, including why YCWA did not adopt the recommendation.

5.3.2 Step 2 – Collect Data

5.3.2.1 Preferred Method - Electrofishing

YCWA's preferred sampling method is electrofishing using three-pass-depletion.

At least three passes will be made at each site using backpack electrofishing units. Sample sites vary in length, and will range at a minimum, between 100 and 300 meters (m), unless Relicensing Participants and the YCWA both agree to a shorter length based on available habitat. Upstream and downstream ends will be blocked with fine mesh nets or a fish passage barrier. YCWA'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, glide). Exact site length will be determined in the field by the YCWA.

Block nets will span the full width and depth of the stream. 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.

Field crews will consist of at least two netters for each shocker. YCWA will follow Temple, et al. (2007), who recommends one backpack electroshock crew for streams less than 7.5 m wide and two backpack electrofish crews for streams 7.5 - 15 m wide. In wadeable streams wider than 15 m the number of electroshocking crews will be expanded as necessary to assure effective and accurate sampling.

Captured fish will be retained in aerated buckets and/or live cars until each pass is completed. As described above, fish will be sedated as necessary and with appropriate approvals. 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. Effort will be made to evenly represent all size classes collected within the subsample of the measured species. The actual number of measured species will be determined through professional judgment based upon the size class homogeneity of the sample (i.e., number of size classes represented). Scale samples will be taken on a subsample of larger, less abundant select fish (hardhead, rainbow trout, and brown trout) for validating length-age indices. All fish removed from the reach will be held in live cars downstream of the sampling site and redistributed evenly across the sampling reach following completion of the final pass for the survey. Mortalities and fish condition (spinal trauma, 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 (vishualy estimated as low, moderate, or high), discharge (measured prior to sampling if a stream gage is not available), crew members,

number of shockers, date and time, air temperature, weather conditions, and GPS location. Additionaly, water temperature, conductivity, and DO will be collected with a YSI or equivalent water quality instrument. 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. Habitat data collected will be consistent with that collected in habitat mapping studies.

Prior to electrofishing at a site that has been previously selected; YCWA will walk the stream-bank to directly observe the presence of any western pond turtles (WPT) or foothill yellow-legged frog (FYLF). If a WPT or FYLF is observed, YCWA 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 if either is observed). If WPT or FYLF is not observed, YCWA will commence electrofishing. YCWA will adhere to accepted decontamination guidelines to minimize the likelihood of transmitting diseases (USFWS 2005).

5.3.2.2 Alternative or Supplemental Method – Snorkeling

As stated above, YCWA's preferred sampling method is electrofishing. However, as described by O'Neal (2007), snorkeling is often feasible in places where other methods are not; for example, deep, clear water with low conductivity makes quantitative electrofishing prohibitive. Species composition, presence/absence, relative abundance, general size class and habitat use information can be obtained with snorkeling techniques (Slaney and Martin 1987; O'Neal 2007).

Snorkeling will only be used by YCWA to replace electrofishing if the entire sampling site is too deep to electrofish. Qualitative electrofishing will occur on the margins of quantitatively snorkeled sites following the snorkel assessment. A single pass qualitative approach will be utilized to provide length and weight data that will be used to develop a condition factor and included in the report.

Snorkeling may be used by YCWA to supplement electrofishing in habitat types that do not lend themselves to electrofishing, if portions of a site do not lend themselves to electrofishing based upon depth, current velocity, and other physical considerations (e.g., access or safety).

If used, 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 (generally late summer).

If snorkeling surveys are to be performed within a section of stream where electrofishing has occurred, snorkeling surveys will be conducted immediately after electrofishing is complete. Snorkel lanes will run the full length of each sample unit within the survey site. 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 (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. All snorkelers will be equipped with mask-integrated video cameras during each pass[4]. Captured video will be transferred to a DVD and made available on request. The DVD will be viewable with media player software. Although the video will not be edited or enhanced with special menus, each stream unit snorkeled will begin with a sign board indicating the date, time, and habitat unit number that will correspond with snorkeler's observation notes. Two to 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 and attached to the electrofishing form for the site. The site information and habitat metrics collected for the electrofishing prior to snorkeling will be used for the snorkel datasheet. Snorkeling data will be analyzed separately from the electrofishing data.

5.3.2.3 Rainbow Trout Fry Emergence Sampling

The timing of rainbow trout fry emergence was identified by agencies during study plan development as an area of interest to better define fry periodicity in the study area. Oregon Creek and the Middle Yuba River above Our House Dam were selected as reference sites for this study. The location of the study sites will be in the vicinity of Log Cabin Diversion Dam on Oregon Creek and Our House Diversion Dam on the Middle Yuba River proximally above the diversions. The study area for the fry emergence data gathering will extend no more than 1 mile upstream of each Project diversion. A one-year (2012) qualitative assessment with one to two field technicians (depending on flow runoff) and a field lead will be implemented primarily utilizing backpack electrofishing. Snorkeling will be applied during high flow events when safety is a concern or in challenging habitat (i.e., undercut banks, etc.) where electrofishing may be ineffective. The sampling method will be at the discretion of the field crew lead. Effort will be made to identify any redds that are visible from shore. Any identified redds will be marked with GPS and documented.

A total of eight sampling events will occur every two weeks from March 15 to June 30, 2012. The sampling events are expected to take 1 to 2 days depending upon flow runoff. When lower flows are present, electrofishing both reaches (which are 20 minutes travel apart) on the same day will be feasible; however, when spring runoff is occurring 2 days will be needed to accommodate access issues. If an event is missed due to unsafe flows, it will be re-attempted at the next available weekday. If multiple events are missed they will be evenly redistributed into the sampling schedule to achieve eight events.

Data collection will follow a similar methodology to that described above for electrofishing and snorkeling. An active collecting or searching qualitative approach will be applied to locate fish. Collected fish will be identified to species and measured in length to the nearest millimeter.

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[4] Licensee will not repeat or terminate a day of sampling at a site due to video camera failure or malfunction. Upon identifying video camera failure malfunction, Licensee will repair the mask to limit any lost video in a timely manner.

Observed fish will be identified to species, and length will be estimated in half-inch length-classes. If young fry become challenging to identify, voucher species may be collected to confirm identification after the sampling event using a microscope.

5.3.3 Step 3 – QA/QC Analysis and Information Analysis

Following a quality control/quality assurance review, data will be entered into and organized in an Excel spreadsheet. Some parameters may be analyzed in 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.

5.3.3.1 Individual Fish Condition Factor

Fish size and weight data will be summarized by species and by sample site. Standard scientific software outputs including minimum, maximum, and mean fork length and weight will be calculated. Length and weight data will be used to calculate a relative condition factor (K_n) (Anderson and Gutreuter 1983) and to provide a general indication of the health of individuals; relative condition factors near a value of 1 indicate more healthy individuals. Relative condition factors for electrofishing sites will be stream and species specific, for length and weight data collected at all quantitative electrofishing sites.

5.3.3.2 Fish Species Populations and Biomass

Standing stock estimates in terms of fish population numbers and biomass will be calculated by species for each site and analyzed by age class. Electrofishing data will be analyzed using a scientific software package (e.g., Microfish or other similar program). Capture probabilities (the proportion of fish captured on a given electrofishing pass), size statistics, and biomass will be generated for each sample site using fish capture data. Biomass will be calculated based upon total weight measured for each species. Standing stock estimates will be reported as: 1) numbers and weight (g) of fish by species per 100 m of stream; 2) numbers of fish by species per mile; 3) pounds of fish by species per acre of stream surface; and 4) kilograms of fish by species per hectare.

Fish species population analysis will include size structure based on relative stock densities. To provide an index of size structure for each site, traditional relative stock densities (RSD) of each species will be calculated. The RSD will be presented on a scale of 0 to 100 (Anderson and Neumann 1996). RSD will be calculated as the proportion of fish sampled greater than 6 inches, i.e., RSD = (# of fish >6-inch in sample) / (# of fish in sample) x 100. The 6-inch length was chosen because it is often used as the smallest size where fish are desired by anglers. A high RSD indicates that a greater proportion of the population consists of fish in the size class desirable to anglers.

Fish species population will also include an analysis by age class. Existing length-age indices will be used to determine the age class. Length-age indices are relatively accurate for smaller

fish; however, confidence intervals reduce with larger fish. Scales collected as described above will be read to assist in identifying larger fish age class breaks. Regression analysis will be used to analyze the data and if necessary, adjust the indices.

5.3.3.3 Fish Community Analysis

Analysis will also include species composition and relative abundance of the fish community (i.e., percent composition). The diversity of fish species will be assessed in Project reaches as the data allows. Possible statistical analysis could include the Shannon Weaver Diversity Index, a means of characterizing the evenness of species diversity.

The condition of fish communities will also be evaluated based on the rigor of the collected data described above at three levels of biological organization: individual level, population level, and community level. Moyle et al. (1998) and Moyle and Marchetti (1998) provided the following descriptions of fish health at these levels:

5.3.3.3.1 Individual Level

Most fish in a healthy stream should: 1) have a robust body; 2) be free of disease, parasites, and lesions; 3) demonstrate reasonable growth rates for the region; and 4) exhibit appropriate behavioral patterns.

5.3.3.3.2 Population Level

Fish populations in healthy stream environments: 1) exhibit multiple age classes indicating that reproduction is regularly occurring; 2) achieve a viable population size (i.e., occur in adequate numbers to maintain a self-sustaining population and the long-term persistence of the population); and 3) consist of mostly healthy individuals.

5.3.3.3.3 Community Level

Fish communities considered in good health in California: 1) are typically dominated by co-evolved species; 2) have a predictable structure as indicated by limited niche overlap among species and trophic levels; 3) are resilient in recovering from extreme events; 4) consist of a persistent species membership; and 5) are replicated geographically (i.e., can be found in similar habitats within the drainage or in other similar drainages).

5.3.3.4 Use of Fry Emergence Sampling Information

Trout egg development is primarily dependent on water temperature. By recording the water temperature during the incubation period, the date of spawning, or emergence can be estimated if the date of one of the two events is known. Water temperature, however, is highly variable, so average daily temperatures are used in this calculation. Each degree Fahrenheit over 32 degrees of the daily average water temperature is one temperature unit (e.g., 55°F would equate to 55-32=23 units), or Daily Temperature Unit (DTU)). These units are tallied daily until they meet the

species specific criteria for hatching or emergence. For example, if water temperature was held constant at 55°F it would take 24 days for hatching (i.e., 552 DTU criteria for hatching, divided by 23 daily units recorded equates to 24 days).

The daily temperature unit criteria will be used from Piper et al. 1982 and Senn et al. 1984 and is displayed in Table 5.3.3-1. The end product of the analyses will be to establish the periodicity for rainbow trout spawning and hatching.

Table 5.3.3-1. Daily Temperature Units required from spawning to emergence for rainbow trout (Piper et al. 1982 and Senn et al. 1984).

Average Incubation Temperature	Daily Temperature Units Required For Hatching	Daily Temperature Units Required For Emergence
45°F	624	1,029
50°F	558	963
55°F	552	957

Agencies agreed that the measured spawning periodicity developed from this sampling and analysis effort will be used to set the rainbow trout spawning period in the relicensing Instream Flow Study Upstream of Englebright Reservoir (Study 3.10) and subsequent discussions in relicensing.

5.3.4 Prepare Report

YCWA 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 FERC-approved study proposal, if any. The report will also contain GIS maps of sampled areas, organized and labeled photos of each site, and relevant summary tables and graphs. The reported data will be organized by basin, reach, and site to allow for a spatial presentation of the findings. At the end of each sampling year, raw QA/QC'd data will be made available to Relicensing Participants.

6.0 Study-Specific Consultation

This study proposal includes the following study-specific consultation:

- Invite interested and available Relicensing Participants into the field to comment on selection of sampling sites.

7.0 Schedule

YCWA anticipates the schedule to complete the study as follows, assuming FERC issues its Study Determination by September 16, 2011 and the study is not disputed by a mandatory conditioning agency:

Project Preparation and Site Selection ..... October - November 2011
Field Sampling ..... June - August 2012 & 2013

Data QA/QC..... September 2012 & 2013
Prepare Report ..... September 2013

8.0 Consistency of Methodology with Generally Accepted Scientific Practices

The methodologies described above for stream fish population data collection are typical of recent relicensings in California.

9.0 Level of Effort and Cost

YCWA estimates the cost to complete this study in 2011 dollars is between $125,000 and $175,000.

10.0 References Cited

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