

Study 3.9

NON-ESA LISTED FISH POPULATIONS DOWNSTREAM OF ENGLEBRIGHT DAM¹

August 2011

1.0 Project Nexus

Yuba County Water Agency's (Licensee or YCWA) continued operation and maintenance (O&M) of the Yuba River Development Project (Project) has the potential to affect fish in the Yuba River downstream of the United States Army Corps of Engineer's (USACE) Englebright Dam.² Alterations in the timing, magnitude, duration and thermal character of flow, as well as flow fluctuations and changes to sediment transport are a result of Project facilities that may cause direct and indirect affects to habitat necessary for support of fish and aquatic life in the lower Yuba River.

This study focuses on the overall fish community and especially special-status³ fishes that occur or may occur in the Yuba River downstream of Englebright Dam. These special-status fishes include hardhead (*Mylopharodon conocephalus*), Sacramento splittail (*Pogonichthys macrolepidotus*) and Sacramento-San Joaquin roach (*Lavinia symmetricus* ssp.), each of which is listed by the California Department of Fish and Game (CDFG) as Species of Special Concern.

Three species listed as threatened under the ESA occur in the lower Yuba River downstream of Englebright Dam: Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*); Central Valley steelhead (*O. mykiss*); and the Southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*). These species are the subject of separate relicensing study proposals, but general information regarding their abundance and distribution is included in this study proposal to provide a comprehensive overview of the fish community in the lower Yuba River downstream of Englebright Dam.

¹ Where this study proposal states that information for the study is being developed by the Lower Yuba River Accord River Management Team (RMT), if the RMT does not develop the information as described in this study proposal, YCWA will develop the information. Also, all information developed as part of the relicensing, whether it is developed in the relicensing process or developed in the RMT process and brought into the relicensing, will be made public when YCWA files its final study report. Further, if this study relies on information from RMT data, report or analytics, YCWA will attach the relevant RMT work product to the relicensing report for this study.

² 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.

³ For the purpose of this study, special-status fish are considered those species: 1) listed under the federal Endangered Species Act (ESA) as Proposed or a Candidate for listing as endangered or threatened or proposed for delisting; 2) listed under the California Endangered Species Act (CESA) as Proposed for listing as endangered or threatened or proposed for delisting; or 3) formally listed by California Department of Fish and Game as a Species of Special Concern. Fish species listed as threatened or endangered under the ESA or CESA are addressed in separate studies.

2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

YCWA believes that four agencies have jurisdiction over fish that could be potentially affected in the geographic area included in this study proposal: 1) United States Department of Interior, Fish and Wildlife Service (USFWS); 2) United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); 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 and management direction, as understood by YCWA at this time, is discussed below.

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 Pre-Application Document (PAD). USFWS's jurisdiction, goals and objectives are not repeated here.

NMFS

NMFS's statutory authorities and responsibilities are described by NMFS in Section 2.0 of Enclosure A in NMFS's March 7, 2011 letter to FERC providing NMFS's comments on YCWA's PAD. NMFS's jurisdiction and responsibilities 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 within the FERC Boundary and downstream of the Project as resources are affected by ongoing Project operations.

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 Study Goals and Objectives

The overall goal of this study plan is to evaluate Project-related effects on non-ESA fish in the Yuba River downstream of Englebright Dam. The objectives of the study are to: 1) characterize the fish community including species composition; 2) estimate species' relative abundance; 3) characterize species relative spatial distribution relating to project flows; and 4) characterize species-specific habitat utilization relating to project flows.

4.0 Existing Information and Need for Additional Information

The Yuba River downstream of Englebright Dam is one of the more thoroughly studied rivers in the Central Valley of California. The fish community in the river has been studied since the mid-1970's, and these studies have shown that the river supports a diverse fish community comprised of anadromous and non-anadromous, native and introduced fish species.

This study plan summarily describes five available source documents regarding fishes in the Yuba River downstream of Englebright Dam (i.e., field studies and data collection reports), four ongoing data collection efforts included in the lower Yuba River Accord Monitoring and Evaluation Program (Yuba Accord River Management Team (2009) referred to herein as the "M&E Program"), and one other data collection and monitoring program.

4.1 Existing Information For Non-ESA listed Fishes Downstream of Englebright Dam

4.1.1 Historic Studies

Although Rotary Screw Trapping (RST) surveys conducted in the Yuba River near Hallwood Boulevard located approximately 7.5 miles upstream of the confluence of the Yuba and Feather rivers focused on juvenile Chinook salmon and steelhead, at least 21 species of fish were captured during 2003-2004 sampling (Massa 2004) and 2004-2005 sampling periods (Massa and McKibbin 2005). Although these data provide information regarding the temporal distributions of fish species, they do not provide information regarding the spatial distribution of them throughout the lower Yuba River. However, extensive fish community surveys in the Yuba River downstream of Englebright Dam have been conducted by electrofishing in shallow water river margins and side channels at 19 sites, river margin snorkeling surveys at the same 19 sites at which electrofishing was conducted, and mid-channel snorkeling surveys in 54 river channel segments (Kozlowski 2004). In addition, electrofishing was conducted at 9 sampling sites, and snorkeling surveys were conducted at 39 sampling sites by Beak (1989). The results of these surveys provide information on the fish community in the Yuba River downstream of Englebright Dam and is consolidated and summarized by general reach in Table 4.1.1-1, below. Each of these studies is described below.

Table 4.1.1-1. Fish community of the lower Yuba River.

Common Name/ Scientific Name	Reach			
	The Narrows (RM 24 to RM 22)	Above DPD (RM 22 to RM 11.5)	Below DPD (RM 11.5 to RM 3.5)	Backwater Reach (RM 3.5 to RM 0)
Species				
prickly/riffle sculpin/ <i>Cottus sp.</i>				
Sacramento sucker/ <i>Catostomus occidentalis</i>				
speckled dace/ <i>Rhinichthys osculus</i>				
steelhead/rainbow trout/ <i>Oncorhynchus mykiss</i>				
Chinook salmon/ <i>Oncorhynchus tshawytscha</i>				
Sacramento pikeminnow/ <i>Ptychocheilus grandis</i>				
American shad/ <i>Alosa sapidissima</i>				
tule perch/ <i>Hysterothorax traski</i>				
striped bass/ <i>Morone saxatilis</i>				
Pacific lamprey/ <i>Lapetra tridentatus</i>				
hardhead/ <i>Mylopharodon conocephalus</i>				
green sunfish/ <i>Lepomis cyanellus</i>				
bluegill/ <i>Lepomis macrochirus</i>				
mosquitofish/ <i>Gambusia affinis</i>				
redeer sunfish/ <i>Lepomis microlophus</i>				
California roach/ <i>Lavinia symmetricus</i>				
smallmouth bass/ <i>Micropterus dolomieu</i>				
Legend				
	Most Abundant			
	Abundant			
	Rare			
	Not Present			

4.1.1.1 California Department of Fish and Game (CDFG) 1991

CDFG (1991) indicates that assessment of aquatic resources in the Yuba River downstream of Englebright Dam began between 1986 and 1988, when CDFG and its contractor (Beak Consultants Inc. 1989) conducted studies addressing fish community structure. The studies were conducted in four reaches: 1) Narrows Reach extending below Englebright Dam at RM 24 to the downstream side of the Narrows 1 and Narrows 2 powerhouses at RM 22; 2) Garcia Gravel Pit Reach beginning downstream of the Narrows Reach at RM 22 and extending to the USACE's Daguerre Point Dam⁴ at approximately RM 11.5; 3) Daguerre Point Dam Reach extending to the

⁴ Daguerre Point Dam was constructed by the California Debris Commission in 1910; 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.

downstream terminus of the Yuba Goldfield at approximately RM 3.5; and 4) the Simpson Lane Reach approximately 3.5 to the confluence with the Feather River at RM 0 in the town of Marysville. The results of the Beak (1989) studies led to the development of CDFG's *Lower Yuba River Fisheries Management Plan Final Report* in 1991.

According to CDFG (1991), electrofishing and snorkel survey techniques were used to gather data on the aquatic community because each method addressed different informational needs of the study. Snorkeling surveys allowed for the characterization of juvenile salmonid habitat during spring months that were otherwise inaccessible to boat electrofishing, such as shallow near shore and riffle areas. Electrofishing was conducted primarily to assess those species that were under-represented in snorkel surveys. Nine sites throughout the four study reaches were electrofished during February 1987 including 1 site in the Narrows Reach, 3 sites in the Garcia Gravel Pit Reach, 2 sites in the Daguerre Point Dam Reach, and 3 sites in the Simpson Lane Reach. All sites except the two Daguerre Point Dam Reach sites were sampled again during May 1987. Snorkel surveys were conducted at 39 sites within the four study reaches including five sites in the Narrows Reach, 10 sites in the Garcia Gravel Pit Reach, 12 sites in the DPD Reach (7 immediately downstream of Daguerre Point Dam and 5 downstream of Hallwood Boulevard), and 12 sites in the furthest downstream Simpson Lane Reach.

Relative abundance estimates from electrofishing indicate Chinook salmon and Sacramento sucker were the most abundant species, comprising 49 percent and 32 percent of total electrofishing catch by number, respectively. Most other species represented less than 1 percent of total abundance, including steelhead/rainbow trout, Pacific lamprey, hardhead, California roach, speckled dace, and centrarchid species (e.g., smallmouth bass, blue gill, and green sunfish). Snorkel survey abundance estimates similarly suggested Chinook salmon was the most abundant fish species representing 49 percent of all fish observed. However, steelhead/rainbow trout comprised 22 percent of total observations, followed by Sacramento sucker (11%) and Sacramento pikeminnow (10%). No American shad were captured or observed by either electrofishing or snorkel surveys, possibly due to low water conditions during the spring of 1987 and 1988 as postulated by CDFG (1991).

CDFG (1991) captured a total of 1,707 fish by electrofishing. Only three fish species (i.e., Chinook salmon, Sacramento sucker and green sunfish) were captured in the Narrows Reach. Diversity was greater in the Garcia Gravel Pit Reach including Chinook salmon, steelhead/rainbow trout, speckled dace, hardhead, Sacramento pikeminnow, Sacramento sucker, green sunfish, bluegill, and riffle sculpin. Six of these 10 species were similarly sampled from the Daguerre Point Dam Reach excluding steelhead/rainbow trout, speckled dace, and the two sunfish species. Pacific lamprey, smallmouth bass, and tule perch were only collected in the most downstream sampling sites.

A total of 8,815 fish was observed during CDFG (1991) snorkeling surveys. Chinook salmon and steelhead/rainbow trout were present in all four reaches and were the only fish observed just below Englebright Dam. Pacific lamprey, Sacramento pikeminnow, Sacramento sucker, smallmouth bass, and riffle sculpin were observed in all sampling sites downstream of the

Narrows Reach. Hardhead and tule perch were only observed downstream of Daguerre Point Dam. CDFG (1991) reported that American shad and striped bass were confined to the area downstream of Daguerre Point Dam, and that few shad appear able to use the fishways at the dam.

According to CDFG (1991) speckled dace and Pacific lamprey densities were highest in the fast flowing riffle and run/glide habitats, whereas, Sacramento sucker and Sacramento pikeminnow were observed in both deep pools (adults and juveniles) and shallow pools (juveniles).

4.1.1.2 Kozlowski (2004)

Kozlowski (2004) conducted electrofishing (early-July and late-August), a river margin survey (mid-August) just prior to the second electrofishing period during 2000, and two mid-channel snorkel surveys (late-July and early-September). In addition, he reviewed 1999-2000 salvage data for the Hallwood-Cordua canal, a diversion canal located at Daguerre Point Dam, and 1999-2001 trapping data for the Hallwood rotary screw trap (RST) near Hallwood Boulevard. Kozlowski (2004) observed a total of at least 12 species including sculpin, speckled dace, Sacramento sucker, Sacramento pikeminnow, Chinook salmon, rainbow trout, hardhead, tule perch, American shad, striped bass, and lamprey. Kozlowski (2004) used “rainbow trout” to refer to *O. mykiss* regardless of the potential presence of forms with different life history patterns involving anadromy or non-anadromy.

The study focused on the portion of the river between Marysville and the Narrows within the following four reaches: 1) the Simpson Lane Bridge (about RM 3.2) to the Yuba Goldfields (about RM 8.3); 2) the western boundary of the Yuba Goldfields (about RM 8.3) to Daguerre Point Dam (about RM 11.5); 3) upstream from Daguerre Point Dam (about RM 11.5) to the upstream side of Long Bar (about RM 16.2); and 4) Highway 20 (about RM 16.2) to the downstream side of the Narrows (about RM 22.2).

A total of 6,224 fish representing 8 taxa in 6 families was collected by electrofishing. All fish collected, with the exception of one green sunfish, were native species. Rainbow trout (3,053) dominated the catch numerically, followed by prickly and riffle sculpins (2,079), speckled dace (730), Sacramento sucker (309), Sacramento pikeminnow (46), Chinook salmon (5), tule perch (1) and green sunfish (1). The majority of fish collected was juveniles, although adult sculpins and speckled dace also were collected. Speckled dace was the numerically dominant species collected in the reach immediately upstream of Daguerre Point Dam. Overall, sculpin was the second most abundant species captured by electrofishing, and was the most abundant species collected downstream of Daguerre Point Dam. Sacramento pikeminnow were distributed throughout the study area, although juvenile Sacramento pikeminnow were never very abundant. Sacramento pikeminnow were collected at sites above and below Daguerre Point Dam, although their distribution was limited to the more downstream sites in both of these reaches.

A total of 10 taxa of fish, representing 7 families, was observed by direct observation during snorkel surveys of mid-channel habitats. Direct observation accounted for an additional four taxa, and three families of fish not collected by electrofishing including American shad, hardhead, striped bass, and Pacific lamprey. Of these four species, only hardhead and lamprey

are native to California. The relative abundance of fish species observed by mid-channel snorkeling, in order of decreasing numerical abundance was Sacramento sucker, adult Chinook salmon, Sacramento pikeminnow, hardhead, American shad, striped bass, tule perch, and adult lamprey. Sacramento sucker was the most abundant species observed during snorkel surveys of mid-channel habitats and was widely distributed throughout all reaches. Kozlowski (2004) observed hardhead in all study reaches between Englebright Dam and the confluence of the Yuba River with the Feather River, although hardhead abundance estimates were generally low, often numbering fewer than 6 individuals. Kozlowski (2004) observed Sacramento pikeminnow in all study reaches during mid-channel snorkel surveys, although Sacramento pikeminnow were more commonly observed downstream of Daguerre Point Dam. Kozlowski (2004) observed one adult lamprey during the first mid-channel snorkel survey (early-August) downstream of the dam. Observations of American shad were limited to only two habitats that each contained a school larger than 25 individuals confined to the area downstream of DPD.

Kozlowski (2004) observed fewer fish during river margin snorkel surveys than the first electrofishing sampling period. River margin snorkel surveys observed a total of 318 fish that represented 5 taxa and 3 families. All fish observed in river margin habitats were native species. Species observed in order of decreasing numerical abundance were rainbow trout, Sacramento pikeminnow, Sacramento sucker, speckled dace, and juvenile Chinook salmon.

Kozlowski (2004) found that native species dominated the fish fauna, and introduced species were typically observed occupying habitats downstream of Daguerre Point Dam as opposed to habitats upstream of the dam. A greater number of species were documented downstream of the dam relative to the number observed upstream of the dam, despite similar sampling effort above and below the dam. According to Kozlowski (2004), Sacramento sucker in the Yuba River had the widest distribution of any species other than rainbow trout. Rainbow trout were the dominant species documented at most of the sites upstream of Daguerre Point Dam. Speckled dace were the dominant species documented immediately upstream of the dam. Sculpin was the dominant species documented at all sites downstream of Daguerre Point Dam. Although rainbow trout and sculpins were documented at sites downstream and upstream of Daguerre Point Dam, respectively, species abundance at these locations was low. No more than 5 striped bass were ever observed within a single habitat and all were observed downstream of the dam.

4.1.1.3 Massa 2004; and Massa and McKibbin 2005

Rotary Screw Traps (RSTs) were installed in the lower Yuba River as part of the Central Valley Project Improvement Act's (CVPIA), Anadromous Fish Restoration Program (AFRP) for gathering information concerning juvenile salmon and steelhead trout life history strategies in the lower Yuba River (Massa 2004; Mass and McKibbin 2005). Although the focus of these studies were on juvenile Chinook salmon and steelhead, at least 21 species of fish were captured during the 2003-2004 sampling (Massa 2004) and 2004-2005 sampling periods (Massa and McKibbin 2005). Data were obtained on the temporal distribution of salmonid and non-salmonid fishes throughout the course of the sampling periods. Abiotic data (e.g., flows, temperature and turbidity) were recorded corresponding to daily observation of downstream movement of fishes.

4.2 Ongoing Data Collection and Monitoring Activities

In addition to the previously conducted studies, numerous data collection and monitoring activities continue to be implemented on the Yuba River downstream of Englebright Dam, including monitoring being conducted by the Yuba Accord RMT, as well as activities being conducted by other agencies and organizations. Several of these activities are obtaining and developing information pertinent to the fish community of the lower Yuba River.

4.2.1 Lower Yuba River Accord Monitoring and Evaluation Program

The Yuba Accord River Management Team (RMT), in collaboration with representatives from University of California at Davis and the Pacific States Marine Fisheries Commission, has developed a Monitoring and Evaluation Program (M&E Program) to guide the efficient expenditure of approximately \$6 million to evaluate the effects of implementation of the Yuba Accord on the aquatic resources of the Yuba River downstream of Englebright Dam over the period extending from 2008 through 2016. The parties to the Fisheries Agreement of the Yuba Accord intended that the monitoring and data collection activities implemented via the M&E Program will supplement information collected for the Federal Energy Regulatory Commission (FERC) relicensing of YCWA's Yuba River Development Project.

The RMT is comprised of representatives of the YCWA; United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); United States Fish and Wildlife Service (USFWS); CDFG; Pacific Gas and Electric Company (PG&E); California Department of Water Resources (DWR) and the non-governmental organizations that are parties to the Fisheries Agreement of the Yuba Accord (i.e., South Yuba River Citizens League, Trout Unlimited, Friends of the River and The Bay Institute). The RMT engaged Pacific States Marine Fisheries Commission (PSMFC) staff to undertake the field study work, with secured funding provided by YCWA under the terms of the Lower Yuba Accord Fisheries Agreement.

In addition to focused studies on anadromous salmonids listed as threatened and endangered under the EA, the M&E Program was designed by RMT to monitor and evaluate the fish community of the Yuba River downstream of Englebright Dam. One of the primary purposes of the M&E Program is to provide the monitoring data necessary to evaluate whether implementation of the Yuba Accord will maintain fish resources (i.e., the fish community including native fish and non-native fish) in good condition, pursuant to Fish and Game Code Section 5937. The M&E Program embraces a monitoring-based adaptive management approach to increase the effectiveness of, and to address the scientific uncertainty associated with, specific monitoring and study activities, and restoration actions. Within the framework of this M&E Program, the RMT retains the flexibility to revise monitoring actions to address specific issues or obtain additional information.

In the Yuba Accord M&E Program, analytical steps ("analytics") are specified to address population metrics of the fish community in the Yuba River downstream of Englebright Dam, and examine potential relationships between measures of population metrics and flows and water

temperatures resulting from implementation of the Yuba Accord. Data for examination of potential relationships between population metrics and flows and water temperatures are obtained from the specific sampling Protocols and Procedures. The Yuba Accord M&E Program includes study plans, referred to as Protocols and Procedures, to obtain data and evaluate and characterize physical habitat conditions including: 1) Flow and Water Temperature Monitoring; 2) Topographic Mapping (Digital Elevation Model, or DEM); 3) Substrate and Cover Mapping; 4) 2-D Hydrodynamic Modeling; 5) Mesohabitat Classification; and 6) Riparian Vegetation Mapping. Each of these protocols and procedures is described in the M&E Anadromous Salmonid Study Plan, and are available for review on the RMT website at www.yubaaccordrmt.com. In addition to the Protocols and Procedures addressing physical habitat conditions in the river, the RMT has developed a suite of Protocols and Procedures in accordance with the M&E Program, several of which will obtain information regarding the fish community of the river downstream of Englebright Dam, including:

- Snorkel Surveys
- Redd Surveys
- Rotary Screw Trapping
- VAKI Riverwatcher Monitoring

The Yuba Accord M&E Program Protocols and Procedures addressing the fish community are summarized below.

4.2.1.1 RMT Snorkel Surveys

The overall goal of the Snorkel Surveys Protocol and Procedure is to study anadromous salmonid diversity and habitat occurrence, in addition to characterizing the fish community in the Yuba River downstream of Englebright Dam. This Protocol and Procedure, currently under development by the RMT, evaluates abiotic variables potentially affecting fish diversity and habitat occurrence including external forces (i.e., daily cycle, time of year, flow, and fluvial landform structure), and internal responses to specific combinations of the external forces (i.e., spatial pattern of water depth, velocity and mesohabitat pattern).

It is anticipated that 2 years of snorkel survey sampling will be conducted, beginning during winter of 2011. Sampling months will be selected so that all juvenile salmonid life stages will be present in the river during the course of snorkeling activities, although sampling may be extended through the summer. The study area for the snorkel surveys is the Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers near Marysville. This study length includes a diverse assemblage of mesohabitat types as indicated by the observed riffle habitat spacing at approximately 4-7 bankfull widths as in most gravel-bed rivers. The rapids in the Narrows will not be sampled due to potential safety issues.

The specific sampling design continues to undergo refinement by the RMT. However, at this time, it is anticipated that a morphological unit (up to 9 in-channel types and 3-5 edge types) oriented sampling strategy, stratified by river reach (up to 8 reaches based on geomorphic

principles) will be employed. The objective of the survey sampling design is to obtain a strong geographical distribution suitable for longitudinal analysis. Prior to each sampling survey, specific localities will be identified using GIS and uploaded to Trimble GPS units for easy field location.

Divers will evaluate visibility by taking NTU measurements before sampling each day to determine if surveying is warranted. For each day of sampling, “effective visibility” will be measured using a standard “4” lure and measured maximum distance for underwater identification of parr marks.

Surveys will be conducted with three people in the river and a fourth on the river bank. A second bank recorder may be necessary for units with high densities of fish. Channel units will be surveyed by divers daily beginning at the downstream end of the channel unit working towards the upstream end of the channel unit whenever possible. This includes working in an upstream direction along channel margins in swift areas. In deep, high velocity areas of the river where snorkelers are physically unable to snorkel upstream, they will survey the area by drifting downstream 3 abreast. In some areas of the river, it may be impossible to conduct snorkel surveys in either direction due to water velocity and in river hazards (i.e., rapids, rocks). In these non-sampled areas, probability statistics may need to be applied. Fish that are disturbed during the survey (i.e., swimming away and/or seeking refuge) will not be considered to be exhibiting normal behavior. When undisturbed fish are located, snorkelers will first take a still image using their mask-integrated digital camera.

Snorkeling effort will not be uniform in all channel units because the river ranges in width from 10-100 meters. Snorkelers will maintain “lanes” during surveys, spaced so that they are 3 meters apart. Snorkelers are responsible for surveying the area 1.5 meter on either side of their path through the river. The snorkeler closest to the bank should maintain a distance 1.5 meters from the bank and is responsible for surveying the area from the bank to an imaginary line 3 meters from the bank. Backwater habitats and off-channel pools will be visually sampled by the nearest surveyor.

Snorkelers will identify species and life stage, estimate fish length, and measure water depth in which a fish is observed. Fish length will be estimated in 20-mm size increments (i.e., 30-50 mm, 50-70 mm, etc.), which is believed to be the smallest interval that trained divers can distinguish. When a group of fish is observed, and it is not possible to characterize them all individually, then counts of the number of fish in habitat “patches” (defined by the area of riverbed that can be effectively observed by a single diver) will be made. A colored weight (large washers, fishing leads) with attached numbered tag will be placed on the bed to mark the location of either a single fish being observed or the central location of a group of fish too numerous to identify each one.

Once the entire channel unit has been surveyed, two divers will walk or drift back downstream with a Trimble Global Positioning Unit (GPS) to relocate and record the GPS location for all bed tags identified during the snorkel survey, in order to be able to characterize water depth, water velocity, proximity to cover, and other geomorphic features.

The area of non-sampled channel resulting from excessive water velocity will be quantified at a representative snorkeling discharge, or range of discharges, and subsequently classified as “swimmable” and “unswimmable” areas, as part of the M&E Program 2D Hydrodynamic Model of the Yuba River downstream of Englebright Dam. The resulting two multi-feature GIS vector polygons will be intersected with the M&E Program Mesohabitat Map, as appropriate for that discharge, and used to determine the relative abundances of non-sampled mesohabitat at the lower Yuba River, and study-site-only spatial scales.

Data obtained during conduct of the Snorkel Survey Protocol and Procedure will be compiled in a Microsoft Access database, and annual data reports will be prepared and made available on the RMT website www.yubaaccdrmt.com.

4.2.1.2 RMT Redd Surveys

The Redd Survey Protocol and Procedure was designed by the RMT for the M&E Program primarily to obtain spatial, temporal, and microhabitat utilization information for anadromous salmonids in the Yuba River downstream of Englebright Dam. However, the redd surveys have and will continue to collect spawning information on non-ESA species during the course of the surveys.

Redd surveys were conducted during the 2008-2009 and 2009-2010 sampling years. Annual study reports that summarize the sample year data are posted on the RMT website (www.yubaaccdrmt.com) as the reports are completed and approved by the RMT. Redd surveys will continue in 2010-2011, and also may be conducted in subsequent years pending results, as evaluated by the RMT.

Reconnaissance-level redd surveys will begin in August and extend to May each year. Prior redd surveys have documented the initiation of Chinook salmon spawning activity from about mid-August to mid-September. Redd surveys will begin the week after a Chinook salmon redd is first observed during the reconnaissance-level redd survey and extend through about May 1 (or until newly constructed steelhead redds are no longer observed). This duration will encompass the spawning seasons of spring-run, fall-run, and late-fall run Chinook salmon, and steelhead, as well as the spawning periods for nest-building non-ESA fishes such as Sacramento sucker and lamprey.

From the 2008-2009 pilot redd survey data and a simulation approach, a weekly sampling frequency was found to result in the most precise and accurate (least biased) estimates of spawning activity. Therefore, weekly redd surveys will be conducted from the initiation of spawning activity until May each year beginning during the 2010-2011 redd survey and subsequent surveys.

Several species of fish exist in the lower Yuba River known to construct redds including Chinook salmon, steelhead, Sacramento sucker (*Catostomus occidentallis*), and Pacific lamprey (*Lampetra tridentata*). Visual differentiation between steelhead redds and Sacramento sucker, and Pacific lamprey spawning nests is of concern because these three species clean the gravel during spawning. Suckers do not typically spawn until late-March and April, and are generally

visible during their spawning season. Steelhead redds are generally easy to distinguish, because they create a noticeable pit and tail spill in the gravel during redd construction. The Oregon Department of Fish and Wildlife (1999) distinguish lamprey spawning nests and steelhead redds using redd/nest dimension measurements. A steelhead redd is distinguished by a longer length than width and the tailings are evenly distributed downstream by the current. Lamprey spawning nests generally have a neat and round appearance, with a conical bowl. The unique characteristic of a lamprey spawning nest is the placement of the tailings upstream from the nest. Lamprey excavate their spawning nests by sucking onto the gravel and then depositing it outside the nest.

Species-specific redd identification will be conducted by comparing the physical dimensions and locations for all known redds (i.e., redds which were positively identified with one species or another building or guarding them). During the redd surveys, each redd observed with an adult building or guarding them will be measured, and the species identified and recorded. Results from the 2008-2009 and 2009-2010 redd surveys in the lower Yuba River indicated that lamprey were observed spawning in late-March and early-April in the most downstream sampling reach of the lower Yuba River, where sand was the subdominant substrate.

Approximately 20.9 miles. of the 24 miles of total length of the Yuba River downstream of Englebright Dam will be surveyed during the redd surveys. About 0.7 mile of the river located immediately below the first set of riffles downstream of Deer Creek to the top of Narrows Pool will not be surveyed due to rugged and dangerous conditions in the steep canyon known as the Narrows. Additionally, an approximate 2 mile section from Simpson Lane Bridge to the confluence with the Feather River will not be regularly surveyed because spawning has not been observed in this location during past surveys.

The 2010-2011 redd surveys, and any subsequent surveys, will be conducted using two catarafts rather than the four kayaks used during the 2008-2009 and 2009-2010 redd surveys. Each surveyor, wearing polarized sunglasses, will scan the river from the shore to the middle of the river, working downstream. Side channels in the survey area may require walking. Visibility will be measured using a Secchi disk at the top of the survey section.

Deep water surveys will be conducted during the 2010-2011 redd survey period in addition to the surveys conducted by cataraft. The specific methods employed for the deep-water surveys are being field tested during the winter and late-summer of 2010.

For each new redd observed throughout the sampling season, the following data will be recorded: 1) a GPS (Trimble GeoExplorer XT) location taken at the center of the redd's pit with a unique identifying number (i.e., date and redd number; i.e. 082908-001); 2) total dimensional area using a GPS for areas appearing to contain multiple redds with no clear boundaries (i.e., mass aggregate spawning); 3) habitat type (i.e., pool, riffle, run, or glide); 4) substrate composition of ambient habitat based on substrate size immediately upstream of the pit; 5) redd species identification; 6) number of fish observed on the redd; 7) location information (i.e., side channel or main channel); 8) comments regarding observable redd superimposition (i.e., redd overlap); and 9) any additional comments.

The path undertaken by each surveyor down the river will be recorded using Garmin GPSMAP 60C x GPS units to document specific locations of the river surveyed. The GPS and a data dictionary will be used to ensure redds counted during the previous survey weeks are not double-counted. In addition, surveyors will mark each redd at the pit with a painted rock.

At each fresh redd located, measurements of mean water column velocity, “nose velocity” (i.e., fish focal point water velocity, which is the water velocity at an observed fish’s position or, when a fish is not observed actively preparing a redd, at the predetermined distance of 0.5 ft above the undisturbed streambed), total water depth and visual estimates of substrate composition will be made to approximate habitat conditions prior to gravel disturbance caused during redd construction. All measurements will be made 0.5 ft upstream of the leading edge of the pit along the mid-line of the redd, unless field personnel determine that measurements adjacent to the mid-point of the pit are more representative of undisturbed conditions for that specific location. The specific location of the measurements will be recorded on the data sheet.

Redd substrate composition will be visually estimated as percentage composition (to the nearest 10 percent) of each of eight size categories. Prior to conducting the redd surveys, the field survey crews will become familiar with visual substrate size estimation by having undergone training by visually estimating substrate size, then comparing those estimates to results obtained by passing those substrate elements through a gravel template. Visual estimation of substrate sizes will be along the B axis of the substrate elements.

Data from the Redd Survey Protocol and Procedure are compiled in a Microsoft Access database, and annual data reports are prepared and available on the RMT website www.yubaaccordrmt.com.

4.2.1.3 RMT Rotary Screw Trapping

The Rotary Screw Trapping Protocol and Procedure was designed by the RMT for the M&E Program primarily to obtain information on emigrant juvenile anadromous salmonids. However, the rotary screw trapping surveys have collected information on non-ESA species during the course of the surveys including species composition, abundance, temporal distribution, and size (length and weight) information.

RST sampling at the Hallwood Boulevard sampling site (approximately 0.5 mi. upstream of Hallwood Boulevard at RM 7.5) has been conducted seasonally on the lower Yuba River from 1999 to 2005 and year-round from 2006 to 2009. RST sampling was suspended in August of 2009 and currently there are no plans to resume RST operations.

The RSTs were fished year-round, with the survey period defined as October 1 through September 31. Interruptions of sampling effort within a particular survey period due to, for example, excessive debris or high streamflow, is recorded and justified.

The M&E Program RST activities have utilized a set of three RSTs near Hallwood Boulevard (approximately 0.5 mi. upstream of Hallwood Boulevard at RM 7.5). A fourth trap was intended for use upstream of Daguerre Point Dam, although the exact location was not chosen. Two of

the RSTs at the Hallwood Boulevard location were conically shaped with a cone diameter of 8 feet. The two 8-ft RSTs (RST 1 and RST 2) are fished in tandem and tethered to a rock anchor and set approximately 100 feet downstream of the 5-ft RST. The third RST at the Hallwood Boulevard location has a cone diameter of 5 feet, tethered by an earth anchor situated toward the downstream end of a large gravel bar.

A field crew of two to three technicians service the RSTs at least once per day to document their operational status, remove trapped fish from the live box, estimate rotation speed, remove debris, and record water temperature (°C), velocity (feet per second), and turbidity (NTUs). During periods of excessive algae growth (June-October), high debris loads, or high river flow events the RSTs are serviced at least twice per day to keep them rotating continuously and reduce fish mortality.

Captured fish are processed on the bank of the river each day of sampling. Species are identified, enumerated, and measurements of fork length (mm) are made.

Data from the RST Protocol and Procedure are compiled in a Microsoft Access database, and annual data reports are prepared and available on the RMT website www.yubaaccordrmt.com.

4.2.1.4 RMT VAKI™ Riverwatcher Fish Counter Monitoring

The VAKI™ Riverwatcher Protocol and Procedure was designed by the RMT for the M&E Program to be used in conjunction with data collected from redd surveys, carcass surveys, and angler surveys to monitor salmonid fish passage and abundance in the lower Yuba River. However, the VAKI™ Riverwater monitoring data set can provide information on non-ESA fishes including species composition, abundance, temporal distribution, and fish passage trends for non-ESA fishes as well. However, because the VAKI™ Riverwatcher units are located in approximately the middle of the lower Yuba River (approximately RM 12) it can be difficult to accurately estimate abundance for any species for the entire lower Yuba River. VAKI™ System down times, a minimum fish size required to activate the system, and high flow events complicate the accuracy in fish identification, estimating abundance, and describing species composition reducing the utility of this tool for monitoring non-ESA fishes.

The VAKI™ Riverwatcher system is operated year-round for monitoring fish migration in the Yuba River downstream of Englebright Dam. The VAKI™ Riverwatcher system began operation during 2003, and is anticipated to be operated continuously at least through 2014. For the FERC Relicensing process, a report summarizing monitoring and evaluation activities will be prepared by October 2012, and available for review.

Fish passage monitoring is conducted using two separate VAKI™ Riverwatcher systems, in conjunction with digital photography or videography, located in the north and south fish ladders at DPD. The VAKI Riverwatcher system records both silhouettes and electronic images or short pieces of video of each fish passage event. By capturing silhouettes and images, fish passage can be accurately monitored even under turbid conditions.

Data collection for individual fish passage events are automatically recorded by the VAKI™ Riverwatcher systems. The VAKI™ Riverwatcher systems record the time/date of each fish passage event, the upstream or downstream direction of passage, the speed of the fish moving through the system (m/sec), the fish's body depth (mm), and logs water temperature every hour. To maximize the accuracy of passage estimates generated by the VAKI™ Riverwatcher systems, a full-time technician is employed to monitor the systems and minimize system off-line events.

Data from the VAKI™ Riverwatcher Monitoring Protocol and Procedure are compiled in the proprietary program Winari, exported and summarized in Microsoft™ Excel, and annual data reports are prepared and available at the RMT website www.yubaaccordermt.com.

4.2.2 Other Data Collection and Monitoring Programs

Several data collection and monitoring activities have been, and continue to be implemented on the Yuba River downstream of Englebright Dam by a variety of agencies and organizations. Information obtained through the following data collection and monitoring activities pertinent to non-ESA fish species are described below.

4.2.2.1 CDFG Angler Surveys

Section 3406(b)(16) of the Central Valley Project Improvement Act (CVPIA) specifies that a monitoring and assessment program would be developed to evaluate the effectiveness of implemented restoration actions. The Comprehensive Assessment and Monitoring Program (CAMP) was established for this purpose. Nine sport fish species found in Central Valley rivers are considered target species and are assessed by the CAMP harvest monitoring including Chinook salmon, steelhead, rainbow trout, striped bass, sturgeon (all species), American shad, catfish (all species), sunfish (all species), and black bass (all species).

CDFG has conducted angler surveys on the Yuba River from 1998 through 2001. Angler surveys on the Yuba River resumed in January 2008 and will be conducted into the future. River sections for the Yuba River downstream of Englebright Dam are surveyed year-round by CDFG (D. Massa, CDFG, pers. comm., 2009). All sample sections are surveyed eight randomly-selected days per month; four weekdays and four weekend days. Weekdays and weekend days are placed in separate strata due to the increase in angling effort commonly associated with weekend days.

Two river sections are surveyed by the Central Valley Angler Survey on the Yuba River including: 1) Marysville to Daguerre Point Dam; and 2) Daguerre Point Dam to 1 mile upstream of the Highway 20 Bridge. These sites are surveyed *via* kayak, so the angler count and interview data are collected in tandem as the surveyor travels downstream with the current. Start time and launch location are randomized using a random number generator.

Field data required to calculate angler use and catch estimates include hourly counts, angler counts, and angler interviews. During the angler count, time and location of anglers is collected, as well as parameters for angler effort such as the number of boats, the number of boat or shore anglers, and the start and finish times. An interview of all anglers observed during the angler count is preferable. However, if not feasible, then every nth angler is interviewed. Data collected

during each interview includes: 1) angler location by river mile; 2) fishing method (boat or shore); 3) number of hours fished to the nearest quarter-hour; 4) number of anglers in group; 5) target species; 6) zip code; 7) whether the trip was completed; and 8) the number of fish kept and/or released by species.

Length is used to differentiate between steelhead and rainbow trout. All rainbow trout 16 inches or greater are considered to be steelhead. Rainbow trout less than 16 inches are recorded as rainbow trout. For Chinook salmon, steelhead/rainbow trout, striped bass, and sturgeon, fish are measured to the nearest ½ centimeter and inspected for any marks or tags.

4.2.3 Need for Additional Information

Because of the information available from previously conducted studies and ongoing data collection and monitoring activities, particularly from the Yuba Accord M&E Program addressing physical habitat and the non-ESA fish community in the lower Yuba River downstream of the Englebright Dam, it is anticipated that little, if any, additional field-based data collection will be needed to describe the non-ESA listed fishes in the Yuba River downstream of Englebright Dam for the purpose of assessing potential Project effects and development of protection, mitigation and enhancement (PM&E) measures to be included in a new license for the Project. However, compilation of the various data into a single report would be useful. For the FERC relicensing process, a report summarizing monitoring and evaluation activities will be prepared by September 2012.

5.0 Study Methods and Analysis

5.1 Study Area

The study area includes the Yuba River from the Englebright Dam downstream to the confluence with the Feather River.

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, NMFS, 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. 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.⁵
- 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 focused study (i.e., no effort in addition to 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) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus, *Didymosphenia geminate* algae, and invasive invertebrates (e.g., zebra mussel, *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

This study will consist of the following four steps: 1) compile data from previously conducted studies; 2) compile ongoing data collection and information; 3) conduct fish community analysis using available information; and 4) prepare report. Each of these steps is described below.

⁵ 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 – Compile Data from Previously Conducted Studies

Information regarding non-ESA fish populations in the Yuba River downstream of Englebright Dam will be obtained from previously conducted RMT studies, (M&E Program through 2011) and other research groups, including the dates and locations of data collection to the extent possible, fish species composition, species diversity, relative abundance, temporal distribution, habitat utilization, and spatial distribution. Additionally, if available, flow and temperature information will be compiled from available records corresponding to dates and locations of non-ESA fish species collections to examine potential relationships between flow and temperature, other abiotic variables, and species-specific population and community metrics including species composition, species diversity, relative abundance, temporal distribution, habitat utilization, and spatial distribution.

5.3.2 Step 2 – Compile Ongoing Data Collection and Information

Data collected during the Yuba Accord M&E Program ongoing monitoring and evaluation studies (through 2011), and CDFG Angling surveys, will be compiled in an electronic Microsoft Access database (M&E Program Snorkel Survey, Redd Survey, Rotary Screw Trapping protocols and procedures, and CDFG Angling Surveys) or in a Microsoft Excel spreadsheet (M&E Program VAKI Riverwater Protocol and Procedure). The Yuba Accord M&E Program will characterize physical habitat conditions including: 1) Flow and Water Temperature Monitoring; 2) Topographic Mapping (Digital Elevation Model); 3) Substrate and Cover Mapping; 4) 2-D Hydrodynamic Modeling; 5) Mesohabitat Classification; and 6) Riparian Vegetation Mapping. Physical habitat information obtained during the conduct of these protocols and procedures also will be compiled in an electronic database. These data will be used to characterize species-specific habitat utilization.

5.3.3 Step 3 – Conduct Fish Community Analysis

The fish community analysis for this study plan will present analysis of the fish community data to characterize species composition, relative abundance (i.e., percent composition by number), diversity, temporal and spatial distribution, and habitat type utilization conducted by the RMT and presented in the draft M&E Program report.

5.3.4 Step 4 – Prepare Report

The report for this study plan will be a synthesis of data presentation and characterization of the analytics included in the Yuba Accord M&E Program (www.yubaaccordrmt.com), as well as from the other relevant ongoing studies described above, pertaining to relevant components associated with the previously stated goals of this study plan. YCWA anticipates that the RMT will complete a draft M&E Program report by October 2012; the RMT is charged, through the fisheries agreement of the Yuba Accord, with the completion of a final M&E Program report prior to 2016. In the event that it becomes apparent that the RMT will not complete the draft report by October 2012, YCWA will undertake the completion of the relevant components of the draft report.

YCWA will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Results; 4) Discussion; and 5) Description of Variances from the FERC-approved study, if any. This Study Plan report will contain relevant summary data, tables, and graphs, and will specifically include:

- fish species composition
- species diversity
- relative abundance
- temporal distribution
- spatial distribution
- habitat utilization
- physical habitat characterization

6.0 Study-Specific Consultation

YCWA will engage in the following study-specific consultation:

- YCWA will consult with Relicensing Participants to determine if data already collected in combination with that anticipated to be collected in 2012 by the RMT and other sources is sufficient to meet the study goals and objectives described above. If YCWA and Relicensing Participants agree that additional data gathering is necessary, YCWA will collaborate with Relicensing Participants to develop a new study proposal and will file the study proposal with FERC. YCWA will perform the additional data gathering as directed by FERC.

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

Compile Data from Previous Studies (Step 1).....	October 2011 - January 2012
Compile Data from Ongoing Studies (Step 2).....	January - March 2012
Develop and implement additional studies, as necessary	March - August 2012
Analysis (Step 3).....	April - October 2012
Prepare Report (Step 4).....	October 2012

8.0 Consistency of Methodology with Generally Accepted Scientific Practices

The study methods discussed above are consistent with the study methods followed in several other relicensings. The methods presented in this study plan also are consistent with other generally accepted scientific study methods concerning fish community assessments, including those conducted by the Resource Agencies 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 \$160,000.

10.0 References Cited

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