

Study 7.10
**INSTREAM FLOW
DOWNSTREAM OF ENGLEBRIGHT DAM^{1,2}**
January 2012

1.0 Project Nexus

Yuba County Water Agency's (Licensee or YCWA) continued operation and maintenance (O&M) of the existing Yuba River Development Project (Project) has a potential to affect Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*)³ habitat in the Yuba River downstream of the United States Army Corps of Engineers' (USACE) Englebright Dam.⁴

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

YCWA believes that four agencies may have jurisdiction over Chinook salmon and steelhead/rainbow trout 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 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, or PAD (YCWA 2010). USFWS's goals and objectives are not repeated here.

¹ YCWA included an Instream Flow Downstream of Englebright Dam Study in its August 2011 Revised Study Plan. FERC's September 30, 2011 Study Determination and FERC's December 28, 2011 Resolution of Study Disputes Determination required modifications to the study. Those modifications have been made in this study plan.

² 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.

³ Regarding *O. mykiss*, the physical appearance of adults and the presence of seasonal runs and year-round residents indicate that both sea-run (steelhead) and resident rainbow trout exist in the Yuba River downstream of USACE's Englebright Dam. Thus, it is recognized that both anadromous and resident lifehistory strategies of *O. mykiss* have been and continue to be present in the river, resulting in the use of the term "steelhead/rainbow trout" when referring to *O. mykiss* in this study proposal.

⁴ 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.

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. This information is not repeated here.

CDFG

CDFG's statutory authorities are 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.

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

3.1 Historic Instream Flow Studies

Historically, three instream flow studies have been performed in the Yuba River downstream of Englebright Dam, each of which is discussed below.

3.1.1 Beak 1989

Between 1986 and 1988, CDFG and its contractor (Beak 1989) conducted a one-dimensional (1D) PHABSIM instream flow study that divided the river into four reaches: 1) the Narrows Reach extending from Englebright Dam approximately 2.2 miles downstream to the terminus of The Narrows; 2) the Garcia Gravel Pit Reach extending 10.7 miles from The Narrows to the Daguerre Point Dam; 3) the Daguerre Point Dam Reach extending 7.8 miles to the upstream terminus of the Feather River backwater; and 4) the Simpson Lane Reach extending 3.5 miles from the upstream terminus of the Feather River backwater to the confluence of the Yuba and Feather rivers.

The Beak study used the Physical Habitat Simulation (PHABSIM) system as developed by the United States Department of Interior, Fish and Wildlife Service (USFWS) Instream Flow and Aquatic Systems Group. The total range of flows simulated using PHABSIM for the study reaches were: 100 to 2,500 cfs for The Narrows and Garcia Gravel Pit study reaches, and 50 to 2,500 cfs for the Daguerre Point Dam and Simpson Lane study reaches.

The target species for the CDFG/Beak study was fall-run Chinook salmon and included the fry, juvenile, and spawning lifestages. A total of 31 transects were placed on habitat types such that selected transects represented the range and proportion of habitat types occurring in the study area. Six to nine transects were selected in each of the four reaches. Beak developed site-specific Habitat Suitability Criteria (HSC) for the spawning, juvenile, and fry lifestages and used the non-parametric tolerance limit method to create the HSC curves.

Weighted Useable Area (WUA) results showed that the greatest amount of WUA for spawning in the lower Yuba River occurred at about 600 to 700 cfs. Total WUA for this life stage varied among reaches, with the Garcia Gravel Pit Reach providing the most WUA at 700 cfs, followed by Daguerre Point Dam at 500 cfs, Simpson Lane at 700 cfs, and with little habitat provided by The Narrows Reach at any flow.

Total WUA for juveniles was highest in the Daguerre Point Dam and Garcia Gravel Pit reaches at 200 and 150 cfs, respectively. The Simpson Lane Reach contributed a small amount of WUA, while The Narrows Reach provided virtually no juvenile habitat.

Chinook salmon fry total WUA in each reach was highest at 100 cfs, except in The Narrows where WUA peaked at 300 cfs.

The Beak/CDFG report was widely accepted, and was utilized in the development of the current flow standards for the lower Yuba River (the Yuba Accord, as adopted by the State Water Resources Control Board in 2008).

3.1.2 Gard 2010a

Two more instream flow studies using the 2-dimensional (2D) model were performed by the USFWS (Gard 2010a and 2010b). Gard's 2010a study focused on flow-habitat relationships for spring and fall-run Chinook salmon and steelhead/rainbow trout spawning. Gard's 2010b study focused on flow-habitat relationships for spring and fall-run Chinook salmon and steelhead/rainbow trout rearing.

In the 2010a study, flow-habitat relationships were developed for spring and fall-run Chinook salmon and steelhead/rainbow trout spawning in the Yuba River between Englebright Dam and the Feather River. The 2D hydraulic and habitat model (RIVER2D) was used to model available habitat. Habitat was modeled for five sites upstream of Daguerre Point Dam and five sites downstream of Daguerre Point Dam. These reaches were among those receiving heaviest use by spawning spring-run and fall-run Chinook salmon and steelhead/rainbow trout (Gard 2010a). For each site RIVER2D was used to simulate hydraulic characteristics for 30 simulation flows.

HSC were developed from depth, velocity, and substrate measurements collected on 168 spring-run Chinook salmon redds, 870 fall-run Chinook salmon redds, and 184 steelhead/rainbow trout redds. Logistic regression was used to develop the depth and velocity HSC. Substrate HSC were developed based on the relative frequency of redds with different substrate codes (Gard 2010a).

According to Gard (2010a), the range of Yuba River flows studied was 150 cfs downstream of Daguerre Point Dam (the lowest flow in the Yuba River Accord) and 400 cfs upstream of Daguerre Point Dam (the current State Water Resources Control Board minimum flow) to 4,170 cfs (the combined capacity of Narrows 1 and 2).

Flows with the most amount of spawning habitat ranged from 900 cfs for spring-run Chinook salmon downstream of Daguerre Point Dam to 3,700 cfs for steelhead/rainbow trout downstream of Daguerre Point Dam (Gard 2010a)

Draft versions of the Gard 2010a report received extensive comments from peer reviewers and various stakeholders; it is not clear that the final report addressed all of the comments received to the satisfaction of commentors.

3.1.3 Gard 2010b

In the 2010b Gard study, flow-habitat relationships for spring and fall-run Chinook salmon and steelhead/rainbow trout rearing were developed for the Yuba River between Englebright Dam and the Feather River. A 2-dimensional hydraulic and habitat model (RIVER2D) was used to model available habitat. Habitat was modeled for eight sites above Daguerre Point Dam and ten sites below Daguerre Point Dam which were representative of the mesohabitat types available in the two segments for fall/spring-run Chinook salmon and steelhead/rainbow trout fry and juvenile rearing (Gard 2010b). For each site RIVER2D was used to simulate hydraulic characteristics for 30 simulation flows.

Habitat suitability criteria (HSC) were developed from depth, velocity, adjacent velocity and cover measurements collected at the locations of 178 fall/spring-Chinook salmon fry, 39 fall/spring-Chinook salmon juvenile, 195 steelhead/rainbow trout fry and 74 steelhead/rainbow trout juvenile observations (Gard 2010b).

The peaks of the flow habitat relationship curves developed in this study were as follows. In the Above Daguerre Segment, the 2-D model predicted the highest total WUA for fall/spring-run Chinook salmon fry at 4,300 cfs and for fall/spring-run Chinook salmon juveniles at 1,300 cfs. In the Above Daguerre Segment, the 2-D model predicted the highest total WUA for steelhead/rainbow trout fry at 400 cfs and for steelhead/rainbow trout juveniles at 1,000 cfs. In the Below Daguerre Segment, the 2-D model predicted the highest total WUA for fall/spring-run Chinook salmon fry rearing at 4,500 cfs and for fall/spring-run Chinook salmon juvenile rearing at 2,000 cfs. In the Below Daguerre Segment, the 2-D model predicted the highest total WUA for steelhead/rainbow trout fry rearing at 500 cfs and for steelhead/rainbow trout juvenile rearing at 2,000 cfs (Gard 2010b).

Draft versions of the Gard 2010b report received extensive comments from peer reviewers and various stakeholders; it is not clear that the final report addressed all of the comments received to the satisfaction of commentors.

3.2 Other Relevant Information

YCWA believes that past instream flow studies can be improved on by using information currently being developed by the Yuba Accord River Management Team (RMT). In particular, YCWA believes that, when completed and after review by Relicensing Participants, the hydraulic model being developed by the RMT can be a robust model on which to develop habitat versus flow relationships for Chinook salmon and steelhead/rainbow trout in the lower Yuba River.

As a summary, the geographic scope of the RMT model is from Englebright Dam downstream to the confluence with the Feather River. Five distinct reaches are being modeled: 1) the Englebright Reach; 2) the Timbuctoo Reach; 3) the Hammond Ranch Reach; 4) the Daguerre Reach; and 5) the Feather Reach. The model does not utilize representative reaches or transects; rather, the distinct reaches being modeled can be processed sequentially to produce essentially a single continuous map and model of the entire Lower Yuba River.

The RMT model uses as a platform SRH-2D to simulate hydraulics in each reach. SRH-2D uses a flexible mesh that may contain arbitrarily shaped cells. A hybrid mesh may achieve the best compromise between solution accuracy and computing demand. SRH-2D adopts very robust and stable numerical schemes with a seamless wetting-drying algorithm. The resultant outcome is that few tuning parameters are needed to calibrate the model.⁵

SRH-2D features include: 1) 2D depth-averaged dynamic wave equations (i.e., standard St. Venant equations) are solved with the finite-volume numerical method; 2) steady state with constant discharge, or unsteady flows with flow hydrograph may be simulated; 3) an implicit scheme is used for time integration to achieve solution robustness and efficiency; 4) an unstructured mesh is used, which includes the structured quadrilateral mesh, the purely triangular mesh, a combination of the two, or a Cartesian or raster mesh; 5) all flow regimes (i.e., subcritical, transcritical, and supercritical flows) may be simulated simultaneously without the need for special treatments; 6) robust and seamless wetting-drying algorithm; and 7) solved variables include water surface elevation, water depth, and depth-averaged velocity.

The RMT model is just now being completed, with a draft report due to be completed soon. Various peer-reviewed papers relevant to the development and application of the model to various geomorphologic questions are in press or published.

Other recent and current information being developed by the RMT that would be useful in developing up-to-date habitat versus flow relationships for Chinook salmon and steelhead/rainbow trout in the Yuba River downstream of Englebright Dam include:

⁵ SRH-2D was evolved from SRH-W which had the additional capability of watershed runoff modeling. Many features are improved from SRH-W. As described by the USBR Technical Service Center, Sedimentation and River Hydraulics Group website: <http://www.usbr.gov/pmts/sediment/model/srh2d/index.html>).

- Topographic and geologic maps, including a digital elevation model (DEM) of the Yuba River downstream of USACE's Englebright Dam (M&E Program 2010)⁶
- Hydrologic modeling and statistics for the Yuba River (YCWA 2007)
- Operations procedures for Project facilities (YCWA 2009)
- Low-altitude aerial video of the Yuba River (YCWA 2009)
- Spatial and temporal abundance and distribution of steelhead/rainbow trout and Chinook salmon adult spawning (M&E Program 2010)
- Spring-run and fall-run Chinook salmon and steelhead/rainbow trout redd observations in the Yuba River by the RMT (M&E Program 2010)
- Hydrologic water balance/operations model of the Yuba River (Relicensing Study Proposal 2.2)
- Water temperature simulation model of the Yuba River (Relicensing Study Proposal 2.6)
- Substrate and cover classification maps of the Yuba River downstream of USACE's Englebright Dam to characterize microhabitat and mesohabitat conditions (M&E Program).
- Mesohabitat classification map of the Yuba River (M&E Program)
- Chinook salmon and steelhead redd observations in the Yuba River by the RMT using RMT M&E Program protocols
- Spring/fall-run Chinook salmon and steelhead fry and juvenile rearing observations in the Yuba River by the RMT using RMT M&E Program protocols. Spatial and temporal distributions of steelhead, spring-run and fall-run Chinook salmon in the Yuba River by the RMT (M&E Program).

3.3 Existing Floodplain Inundation Information

The RMT has used its 2D model to assess the amount of floodplain inundation in the Yuba River downstream of Englebright Dam at various flows including flows of 4,000; 5,000; 10,000; 15,000; 30,000; 42,200; 84,400; and 110,400. This information is available to all RMT members as well as the general public.

4.0 Study Goals and Objectives

The goal of the study is to evaluate Chinook salmon and steelhead habitat as a function of flow in the Yuba River downstream of the Englebright Dam.

The objectives of the study include: 1) estimate the habitat index versus flow relationships (Weighted Usable Area, or WUA) using hydraulic and habitat models for Chinook salmon and steelhead in the Yuba River downstream of Englebright Dam; and 2) use WUA versus flow relationships and the hydrologic record to develop a habitat duration analysis of fish habitat over

⁶ M&E Program documents and work products are located at the River Management Team web site, www.yubaaccordrmt.com.

time under the existing operational scenario (i.e., Yuba Accord flow schedules). Another objective of the study is to provide information regarding floodplain inundation.

5.0 Study Methods and Analysis

5.1 Study Area

For the purpose of this study, the study area includes the Yuba River from Englebright Dam to the Marysville gage. The section of the river below the Marysville gage is not included in the study because backwatering effects from the Feather River prohibit reliable hydraulic modeling.

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 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 agrees to or 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.⁷

- 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) moving between basins (e.g., Middle Yuba River, Yuba River, and North Yuba River); and 3) moving between isolated wetlands or ponds and river or stream environments.

5.3 Study Methods⁸

As currently conceived, the study would be performed in six steps, each of which is discussed below.

5.3.1 Step 1 – Hold Workshops to Review Existing Information and RMT Model

In the first step, YCWA will hold one or more workshops with interested Relicensing Participants to: 1) review existing information relevant to the development of WUA versus flow relationships for Chinook salmon and steelhead in the lower Yuba River; and 2) review the RMT SRH-2D model with the goal of coming to agreement on its usefulness as the hydraulic model for developing WUA. During the workshops, YCWA will present details of the model, discuss its strengths and weaknesses relative to other hydraulic models (as utilized in previous instream flow studies), and identify if any additional data collection or model modifications are needed for use in the study.

⁷ The Forest Service and CDFG each requested that a copy of the GIS maps be provided to them when the maps are available.

⁸ Model runs beyond those specifically identified in this study proposal are not part of this study proposal. However, after the study is complete YCWA is willing to make a reasonable number of model runs as collaboratively agreed to between YCWA and Relicensing Participants

5.3.2 Step 2 – Agree on Target Species and Life Stages,⁹ and HSCs¹⁰

In the second step, YCWA will hold one or more workshops with interested Relicensing Participants to agree on: 1) target species and life stages; 2) life history periodicity for the target species and life stages; and 3) appropriate HSCs for each target species and life stage. At the current time, YCWA believes the target species will be Chinook salmon, steelhead/rainbow trout, green sturgeon and Pacific lamprey. YCWA believes HSCs that are currently available for Chinook salmon and steelhead/rainbow trout (e.g., those recently agreed to for the Tuolumne River, or previously developed for the lower Yuba River) will be used. Since limited information exists on the habitat requirements of green sturgeon and if suitable existing HSC for green sturgeon cannot be identified, surrogate HSC for white sturgeon may be used. YCWA proposes to use Lamprey Guild HSCs recently collaboratively developed for the Merced River Hydroelectric Project relicensing. Information being collected by the RMT may help to inform the HSCs. YCWA will consult with USFWS, CDFG, and NMFS on appropriate existing HSC for each of the target species.

5.3.3 Step 3 – Make Model Runs

In this step, YCWA would develop WUA versus flow relationships for the target species and life stages using the information developed in Steps 1 and 2. Additionally, analysis of available habitat area under different flow conditions will be undertaken using the RMT derived DEM and 2D models for shallow water preference life stages (juvenile salmonids). The number of model runs will be that number necessary to accurately calculate WUA within the range of extrapolation.

5.3.4 Step 4 – Develop Floodplain Inundation Information¹¹

In this step YCWA will model the relationship between river flow and the inundation of potential juvenile salmonid floodplain rearing habitat downstream of Englebright Dam. Using the RMT's 2D hydraulic model, YCWA will model the following flows, if they have not already been modeled by the RMT:

⁹ YCWA's Instream Flow Downstream of Englebright Dam Study in its August 2011 Revised Study Plan did not include green sturgeon and Pacific lamprey as potential target species. However, FERC's September 30, 2011 Study Determination stated: "...we recommend that study 7.10 be implemented as proposed by YCWA and include green sturgeon and Pacific lamprey as target species." (Appendix A, p 35). The study plan has been modified accordingly.

¹⁰ YCWA's Instream Flow Downstream of Englebright Dam Study in its August 2011 Revised Study Plan did not address HSC for green sturgeon or Pacific lamprey. However, FERC's September 30, 2011 Study Determination stated: "...we recommend that YCWA consult with FWS, Cal Fish and Game, and NMFS on appropriate existing HSC for each of the target species. We recognize that limited information exists on the habitat requirements of green sturgeon, and as such, if suitable existing HSC for green sturgeon cannot be identified, surrogate HSC for white sturgeon may be used." (Appendix A, p 35). The study plan has been modified accordingly.

¹¹ FERC's December 28, 2011 Resolution of Study Disputes Determination stated "...we now recommend that YCWA's Study 7.10, Instream Flow Downstream of Englebright Dam, be modified to require YCWA to: Model the following flows (in cfs) through the RMT's 2-D Hydraulic Model: 4,000; 5,000; 7,500; 10,000; 15,000; 21,100; 30,000; 42,200; 84,400; and 110,400; Report all model results of for the above flow set and include the following: spatially divided floodplain inundated areas by geomorphic reach type and categorize by depth and velocity; for each modeled run, include the area of floodplain inundation (broken down by depth and velocity bins and by geomorphic reach); curves that relate inundation areas, depth, and velocity to discharge levels (e.g., hydraulic geometry relationships); and maps showing the spatial relationship of inundated areas, depth, and velocity." (Appendix A, pp 16 & 17). YCWA has included this analysis in Section 5.3.4.

- 4,000 cfs
- 5,000 cfs
- 7,500 cfs
- 10,000 cfs
- 15,000 cfs
- 21,100 cfs
- 30,000 cfs
- 42,200 cfs
- 84,400 cfs
- 110,400 cfs

For each of the above model runs, YCWA will report:

- Spatially divided floodplain inundated areas by geomorphic reach type and categorize by depth and velocity
- The area of floodplain inundation, broken down by depth and velocity bins and by geomorphic reach
- Curves that relate inundation areas, depth, and velocity to the flows modeled (e.g., hydraulic geometry relationships)
- Maps showing the spatial relationship of inundated areas, depth, and velocity.

This information is specifically related to floodplain inundation, and it is not intended that the PHABSIM analysis (Steps 1 through 3) will be used to model WUA up to the levels specified in Step 4.

5.3.5 Step 5 – Collaborate Regarding New Study

YCWA does not anticipate the need for any supplemental data collection for this study. However, if YCWA and Relicensing Participants collaboratively agree that additional data might be useful in relation to this study, YCWA will collaborate with Relicensing Participants to develop a new study plan and file it with FERC for consideration. YCWA will perform the study approved by FERC.

5.3.6 Step 6 – Prepare Study 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 proposal, if any. The report will include for habitat analysis:

- WUA versus flow tables and graphs (tables will include indicators of peak and 80% of WUA and graphs will include normalized percent of WUA) for different species and their life stages.

- Habitat duration analyses of fish habitat over time under the existing operational scenario.

YCWA will consult with Relicensing Participants regarding the output tables and graphics to be included in the report.

The report will also include the results of the floodplain inundation analysis as specified in Step 4.

6.0 Study-Specific Consultation

The following are specific areas for which the YCWA will consult with the Relicensing Participants:

- YCWA will hold a workshop with Relicensing Participants with the goal of coming to agreement on using the RMT 2D hydraulic model for developing WUA (Step 1).
- YCWA will consult with interested and available Relicensing Participants regarding target species and HSC (Step 2).
- If YCWA and Relicensing Participants collaboratively agree that additional data might be useful in relation to this study, YCWA will collaborate with Relicensing Participants to develop a new study plan and file it with FERC for consideration. YCWA will perform the study approved by FERC. (Step 5.)
- YCWA will consult with Relicensing Participants regarding the PHABSIM output tables and graphics to be included in the report (Step 6).

7.0 Schedule

YCWA anticipates the schedule to complete the study as follows.

Workshop (Step 1)	January – March 2012
Agreement on Target Species/Life Stages and HSC (Step 2).....	January – March 2012
Make Model Runs (Step 3)	March – June 2012
Develop Floodplain Inundation Information (Step 4)	March – June 2012
Collaborate Regarding New Study (Step 5).....	March – June 2012
Report Preparation (Step 6)	July - September 2012

8.0 Consistency of Methodology with Generally Accepted Scientific Practices

Instream flow studies conducted using 2D hydraulic models are common in California hydropower relicensings.

9.0 Level of Effort and Cost

YCWA estimates the cost to complete this study in 2012 dollars is between \$220,000 and \$340,000.¹²

10.0 References Cited

Beak 1989. Yuba River Fisheries Investigations, 1986-88. Summary Report of Technical Studies on the Lower Yuba River, California. Prepared by Beak Consultants, Inc. for State of California Resources Agency, Department of Fish and Game.

Gard, Mark. 2010a. Flow-habitat relationships for spring and fall-run Chinook salmon and steelhead/rainbow trout spawning in the Yuba River, August 2010. US Fish and Wildlife Service, Energy and Instream Flow Branch.

Gard, Mark. 2010b. Flow-habitat relationships for spring and fall-run Chinook salmon and steelhead/rainbow trout rearing, October, 2010. US Fish and Wildlife Service, Energy and Instream Flow Branch.

Yuba County Water Agency (YCWA). 2010. Yuba River Development Project relicensing Pre-Application Document. Yuba County Water Agency, Marysville, CA. <http://www.ycwa-relicensing.com>.

¹² YCWA's Instream Flow Downstream of Englebright Dam Study in its August 2011 Revised Study Plan had an estimate cost range of between \$200,000 and \$300,000. With the modifications required by FERC in its September 30, 2011 Study Determination and December 28, 2011 Resolution of Study Disputes Determination, the estimated cost range is between \$220,000 and \$340,000.