

Study 1.2
CHANNEL MORPHOLOGY
DOWNSTREAM OF ENGLEBRIGHT DAM
November 2010

1.0 Project Nexus

The Yuba River below the United States Army Corps of Engineer's (USACE) Englebright Dam¹ has an extensive history of impacts to channel morphology resulting from hydraulic mining activities in the Yuba River watershed. From the late 19th Century through to the early part of the 20th Century, vast amounts of hydraulic mining debris and sediment was deposited in the Yuba River from the confluence of the Feather River upstream for more than 20 miles. Sediment depths at The Narrows were more than 75 feet deep, and more than 15 feet deep near Marysville in the early 20th Century (CDC 1906). While degradation of the river bed commenced in the early 20th Century with the decline in hydraulic mining activity and the construction of various debris dams, several million cubic yards of sediment remain in the Yuba River below Englebright Dam (James 2009). Channel process and changes over the course of the next several decades will largely be a function of the continued degradation of the river bed through layers of mining debris.

The Englebright Dam has been completely effective in blocking the downstream movement of sediment. It is estimated that as much as 17,500 acre feet (over 28 million cu yards) of sediment is impounded behind Englebright Dam (Childs 2003).

Given the severely altered character of the Yuba River below Englebright Dam prior to the construction of the Yuba County Water Agency's (Licensee or YCWA) construction of the Yuba River Development Project (Project), determining impacts of the Project becomes somewhat more opaque than evaluating potential Project impacts on unaltered environments. However, the Project has the potential to affect channel morphology due to changes in hydrologic regime caused by operation of the Project storage reservoir.

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

[Relicensing Participants - This section is a placeholder in the Pre-Application Document (PAD). Section 5.11(d)(2) of 18 CFR states that an applicant for a new license must in its proposed study "*Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*" During 2010 study proposal development meetings, agencies advised License that they would provide a brief written description of their jurisdiction over the resource to be addressed in this study. If provided before Licensee files its

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.

Proposed Study Plan and Licensee agrees with the description, Licensee will insert the brief description here stating the description was provided by that agency. If not, prior to issuing the Proposed Study Plan, Licensee will describe to the best of its knowledge and understanding the management goals of agencies that have jurisdiction over the resource addressed in this study. Licensee]

3.0 Study Goals and Objectives

The goal of the study is to quantify or characterize river form and process in the Yuba River downstream of the Englebright Dam, and to assess potential impacts to the river form and process due to continued operation of the Project.

The objectives of the study are to develop information necessary to meet the study goal. Specifically, the study objectives includes development of a quantitative and qualitative understanding of Project effects on substrate mobility, particle size distribution, salmonid spawning gravel distribution, and spill flow effects on channel morphology in the Yuba River downstream of Englebright Dam.

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. A considerable amount of information relating to the impacts of hydraulic mining and the operation of the Yuba River as an element of the state flood control system have been developed. Additionally, extensive information regarding: 1) geomorphic drivers; 2) landforms and boundary conditions; 3) hydrogeomorphic dynamics; 4) physical habitat and ecological dynamics; and 5) river management actions have been developed through time, and a compendium of the existing information specific to the Yuba River downstream of USACE's Englebright Dam is included as Attachment 1 to this study proposal.

Information is available from both previously conducted studies dating back to the early 1900s through current information from ongoing data collection, monitoring, and evaluation activities, particularly from the Yuba Accord M&E Program (M&E Program). A summary list of recent information currently available includes, but is not limited to:

- Topographic and geologic maps, including a digital elevation model (DEM) of the Yuba River downstream of USACE's Englebright Dam (M&E Program 2010)²
- Hydrologic modeling and statistics for the Yuba River (YCWA 2007)
- Operations procedures for Project facilities (YCWA 2009)
- PHABSIM habitat modeling of the Yuba River conducted by Beak Consultants for the California Department of Fish and Game (Beak 1989)

² M&E Program documents and work products are located at the River Management Team web site, www.yubaaccordrmt.com.

- Two-dimensional hydrodynamic habitat modeling (River2D) of the Yuba River conducted by the U.S. Fish and Wildlife Service (Gard 2007; 2008)
- Two-dimensional hydrodynamic modeling (SRH-2D) of the Yuba River by U.C. Davis for the River Management Team (M&E Program 2010)
- Low-altitude aerial video of the Yuba River (YCWA 2009)

Information from ongoing data collection, monitoring, and evaluation activities, particularly from the Yuba Accord M&E Program (M&E Program) addressing geomorphological conditions and physical habitat conditions in the Yuba River downstream of Englebright Dam that will be available for the conduct of this study includes, but is not limited to:

- Yuba River Development Project Water Balance/Operations Model (Study 2.2)
- 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)

Licensee believes that sufficient information generally exists to characterize the geomorphologic conditions for the Yuba River downstream of Englebright Dam without the undertaking of additional field study effort.

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 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, 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.
- 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 (i.e., 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) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus, 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 consists of the following four steps: 1) compile data from previously conducted studies; 2) compile ongoing data collection and information; 3) conduct the analyses necessary to accomplish the previously stated goals and objectives; and 4) prepare report.

5.3.1 Step 1 – Compile Data from Previously Conducted Studies

Information regarding geomorphology in the Yuba River downstream of Englebright Dam will be obtained from previously conducted studies, including the dates and locations of data collection to the extent possible.

5.3.2 Step 2 – Compile Ongoing Data Collection and Information

Data collected during the Yuba Accord M&E Program will be compiled for this study plan report. Data compilation and analyses conducted by the RMT for the Yuba Accord M&E

Program will be obtained and utilized from the following ongoing monitoring and evaluation activities associated with the M&E Program Protocols and Procedures:

- Flow and Water Temperature Monitoring
- Topographic Mapping (Digital Elevation Model) – physical habitat assessment
- Substrate and Cover Mapping – spawning/juvenile rearing habitat characterization
- 2-D Hydrodynamic Modeling – physical habitat dynamics and availability
- Mesohabitat Classification – physical habitat characterization
- Riparian Vegetation Mapping

5.3.3 Step 3 – Analyze Data

The goal of the study is to quantify or characterize river form and process. Table 5.3-1 presents the relationship between potential channel morphology issues, data to be compiled by this study, and data analysis that will occur as part of this study.

Table 5.3-1. Relationship between perceived channel morphology issues, data to be compiled by this study, and data analysis that will occur as part of this study.

Issue	Data	Analysis
Project effects on channel morphology and channel condition below Project facilities	<ul style="list-style-type: none"> • Longitudinal profile • Cross sections or contours • Substrate map • Stage-discharge relationship • Hydrologic information – regulated by Project, non-regulated by Project, and unimpaired • Riparian map • Review of historical aerial photographs • Sediment mobility assessment 	<ul style="list-style-type: none"> • Longitudinal profile, cross sections, substrate will be used in the sediment transport model to show at what point the existing bed is mobile; combining with hydrology data provides the frequency of mobility under regulated and unimpaired conditions. • Stage-discharge relationship provides at what flow various surfaces in the riparian zone are inundated; combining with hydrology data provides the frequency of inundation for regulated by Project, non-regulated by Project, and unimpaired conditions. • Assessment of channel and bank stability provides how likely the channel is to move from its current form • Historical photos show the relationship of current form and prior form (depending upon the photos available) • Sediment mobility analysis will show the flows at which the existing bed is mobile in regulated by Project, non-regulated by Project, and unimpaired conditions.
Project effects on floodplains	<ul style="list-style-type: none"> • Terrain map of river • Stage-discharge relationship • Hydrologic information • Riparian Map • Historical aerial photographs 	<ul style="list-style-type: none"> • Terrain map of river provides the location and elevation of floodplains & stranded terraces • Stage-discharge relationship provides at what flow various surfaces are inundated; combining with hydrology data provides the frequency of inundation for regulated by Project, non-regulated by Project, and unimpaired conditions. • Historical photos show the history and interaction of the active channel with floodplains, conversion to or from terraces; changes in vegetation; disturbance history.

Table 5.3-1. (continued)

Issue	Data	Analysis
Project effects on bedload distribution	<ul style="list-style-type: none"> • Channel armoring 	<ul style="list-style-type: none"> • Ratio of surface to sub-surface particles - surface layer is commonly coarser than the sub-surface, and the size distribution of the sub-surface gravel is often similar to that of the transported bedload. Low values of $D_{50\text{surface}} : D_{50\text{subsurface}}$ (e.g., less than 1.3 means relatively weak armoring) are generally indicative of relatively high mean annual sediment transport rates, whereas high values of $D_{50\text{surface}} : D_{50\text{subsurface}}$ (e.g., greater than 4 means relatively strong armoring) are generally indicative of relatively low mean annual sediment transport rates.
Project effects on particle size and composition from minimum flow & uncontrolled spill	<ul style="list-style-type: none"> • Summary of spill history 	<ul style="list-style-type: none"> • Discussion of channel form, sediment size and distribution as it relates to hydrology created by releases from minimum flow releases flow, and erosion and/or hydrology due to spill releases from Project dams

5.3.4 Step 4 – Prepare Report

At the conclusion of the study, 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 include the following attachments:

- Map of river (*.PDF format) including topography, substrate, riparian vegetation, and other river features
- Floodplain inundation map, showing inundation area at 1:1, 1:2, 1:5, 1:10 and 1:20 return interval flood flows
- Summary of riparian condition.
- The hydraulic/sediment transport model input and output files.

6.0 Study-Specific Consultation

This study does not require any study-specific consultation.

7.0 Schedule

Licensee anticipates the schedule to complete the study as follows assuming the PAD is filed on November 1, 2010, and FERC issues its Study Determination by October 4, 2011:

Compile Data from Previous Studies (Step 1)..... October 2011 - May 2012
Compile Data from Ongoing Studies (Step 2)..... May - August 2012
Analysis (Step 3)..... August - September 2012

Prepare Report (Step 4)..... September - October 2012

8.0 **Consistency of Methodology with Generally Accepted Scientific Practices**

The methods presented in this study plan are consistent with other generally accepted scientific study methods concerning geomorphological function assessment, including those conducted by the Resource Agencies in California.

9.0 **Level of Effort and Cost**

[Relicensing Participants – Licensee will include a cost range estimate for this study in its Proposed Study Plan. Licensee]

10.0 **References Cited**

- California Debris Commission (CDC), 1906, Map of the Yuba River, California from the Narrows to its mouth in the Feather River. Made under direction of Major Wm. W. Harts, U.S. Army Corps of Engineers, by G.G. McDaniel, Jr., August to Nov., 1906: scale 1:9,600.
- Childs, J.R., N.P. Snyder, and M.A. Hampton. Bathymetric and geophysical surveys of Englebright Lake, Yuba-Nevada Counties, California US Geological Survey Open-File Report 03-383
- James, L.A., M.B. Singer, S. Ghoshal and M. Megison. 2009. Historical channel changes in the lower Yuba and Feather Rivers, California: Long-term effects of contrasting river-management strategies, in James, L.A., Rathburn, S.L., and Whittecar, G.R., eds., Management and Restoration of Fluvial Systems with Broad Historical Changes and Human Impacts: Geological Society of America Special Paper 451, p. 57–81, doi: 10.1130/2008.2451(04).

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Attachment 1
to
Channel Morphology Downstream of Englebright Dam Study Proposal
Existing Information Summary

