

2.1 Channel Morphology Study Plan

This study is designed to provide information regarding the geomorphologic condition of river reaches downstream of Sacramento Municipal Utility District's (SMUD) Upper American River Project (UARP) and Pacific Gas and Electric Company's Chili Bar Project using the Rosgen methodology. The overall approach is to perform Rosgen Level I classification of all river reaches downstream of dams using available maps and photographs, and then to refine this typing by conducting Rosgen Level II classification and Level III condition assessment in sensitive reaches using site-specific measurements. Should any of the reaches seem impaired (e.g., excess sediment, lack of bedload sediment, excessive scouring or channel entrenchment, lack of or excess large woody debris (LWD), poor riparian vegetation, etc.), additional studies will be considered. Field data will only be collected in 2002 unless results indicate additional sampling is warranted.

2.1.1 Pertinent Issue Questions

This Channel Morphology Study Plan addresses the following Aquatic/Water Issue Questions:

5. What effects do project features and operations have on fluvial geomorphology and stream habitat?
6. What are the physical attributes (i.e., available pools and presence of large debris) of the Project? How have they been affected by the Project? What habitat is provided by those attributes (habitat mapping)?
19. Do project features affect distribution of large wood in streams? Do they comply with Forest Service standards?
23. What Project flows affect recruitment and reproduction of riparian plants?
34. How are the Project operations affecting gravel recruitment (related to spawning and macroinvertebrate habitat)?
48. Does operation of the Project affect stream bank stability?
61. Does the existing minimum stream flow requirements adequately protect the fluvial geomorphological processes?

2.1.2 Background

Effects of dams and flow regulation on channel morphology are expected to be more pronounced in alluvial reaches that have bed and banks composed of fluvially-derived sediment, as compared to bedrock channels that remain relatively unaltered due to high sediment transport capacities and resistant substrate (Montgomery and Buffington 1993). Alluvial reaches are characterized by fluvial transport of sediment over a variety of bed morphologies. At the reach-level, channel slope, sediment supply, transport capacity, and (LWD) loading are key determinants of channel form. Broad-level channel classification based on channel slope and confinement can be used to identify "sensitive reaches. "Sensitive reaches" are unconfined, low-gradient alluvial reaches where channel response to changes in sediment supply or transport dynamics is most likely to occur. Detailed field surveys in sensitive reaches downstream of the dams can be used to identify and quantify the effects of the dams and the altered flow regime on channel morphology.

2.1.3 Study Objectives

The study objectives are to identify:

- potential sensitive reaches downstream of the UARP's and Chili Bar Project's dams
- effects of the projects on channel morphology, sediment transport, and LWD dynamics, loading, and function in sensitive downstream reaches
- feasible measures to sustain geomorphic processes such as sediment transport and LWD loading that support aquatic and riparian habitat diversity in downstream reaches.

2.1.4 Study Area

The study area will include all stream reaches identified by the Aquatics TWG. This includes the downstream reaches of all UARP dams and Chili Bar Dam.

2.1.5 Information Needed From Other Relicensing Studies

Information needed from other studies includes: 1) the effects of flow regulation and diversion on flow conditions in the channel, which is necessary for developing hypotheses of anticipated effects of the projects on channel morphology and identifying potential field survey reaches, from the Hydrology Study; 2) results from water quality and turbidity studies from survey and existing data; and 3) the results of the Riparian Vegetation Study to assess linkages between geomorphic processes (and the effects of the Project on geomorphic process) and riparian vegetation. Bathymetric data from UARP reservoirs will also be made available for analysis. Information from the Channel Morphology Study may be useful in the Riparian Vegetation Study, Amphibians and Aquatic Reptiles Study, Aquatic Bioassessment Study, and the Water Quality Study. Information regarding blockage of connectivity of tributaries and side channels from the instream flow habitat mapping will be needed.

2.1.6 Study Methods And Schedule

The study methods will include the following sequential steps:

Rosgen Level I Classification - The first phase will include a Rosgen Level I classification based on available topographic and geologic data. The purpose of the Level I classification is to provide a broad characterization that integrates the landform and fluvial features of valley morphology with channel relief, pattern, shape, and dimension for all stream reaches (Rosgen 1994). The initial evaluation will use material such as low-altitude video of channels in the area of the projects available from SMUD or other sources; USGS maps, historic and current aerial photographs, topographic and geologic maps as well as other available data for rivers affected by the projects to determine channel slope, approximate channel width and cross sectional form, and channel planform morphology (e.g., sinuosity and channel form, etc.). This information is needed to classify all reaches into Rosgen Level I types. The purpose of the Level I classification is to identify potential sensitive reaches and to predict anticipated reach-level morphology in alluvial (non-bedrock) reaches in all Rosgen channel types. Sensitive reaches will be delineated based upon their slope, channel confinement, and bed and bank sediment composition (e.g., alluvial versus bedrock). Using the Rosgen Level I classification, sensitive reaches could occur in type B, C, D, E, and F channels. Based on the results of the Level I effort, a recommendation will be made to the Aquatic TWG regarding the sampling locations for Level II surveys.

Rosgen Level II Typing - Locations for Rosgen Level II surveys will be determined based upon the Level I classification. While the number and distribution of potential sites is unknown at this time, at least one study site will be analyzed in each reach. A study site will be approximately 20 to 30 bankfull widths, where appropriate, in length with upper and lower boundaries geo-referenced. If there is more than one potential study site in each reach, the study site where channel response to operation of the projects is most likely will be analyzed. Additional sites (e.g., near recreation areas) may be considered. Interested parties from the Aquatics TWG and Plenary Group will be invited to visit the sites in the field to concur with or modify the selected survey sites. Level II field surveys will include, but not be limited to, measurements of 1) longitudinal profile (water surface and thalweg), 2) valley width, 3) approximately three monumented channel cross sections (including bankfull indicators, thalweg, water's edge, flood-prone area, where identifiable), and 4) pebble counts (Wolman 1954). Cross sections will be established with a sufficient number of verticals to clearly depict channel geometry (Harrelson, et al. 1994). Each transect will be photo-documented. Wherever possible, study sites for this effort will coincide with instream flow study sites. Based on the results of the Level II effort, a recommendation will be made to the Aquatic TWG regarding the sampling locations for Level III surveys.

Rosgen Level III Condition - It is anticipated that a Rosgen Level III condition analysis will be performed at a subset of the Level II study sites. The Level III analysis will include the following data collection elements: 1) bed surface texture based on facies mapping (stratification and delineation of channel bed features based on particle sizes and organization), 2) sediment deposition in pools will be assessed using an appropriate method (e.g., V*, S*, Q*) (USFS 1997, Lisle and Hilton 1992, Hilton and Lisle 1993). In each reach examined as part of the Level III analysis, large woody debris (LWD) loading in the active channel will be measured and the geomorphic and ecological function of the LWD will be examined. For the purpose of this analysis, LWD is defined as in the USFS Region 5 Stream Condition Inventory (SCI) protocol: all pieces of wood lying within the bankfull width of the channel that measures one half bankfull width or longer. Wood must be both downed,

and with a portion lying within the bankfull channel, and dead or dying to be considered LWD. This will involve dividing the LWD into size classes and tallying the total number of LWD pieces in each size class in the reach. Because some LWD can be suspended over the channel or are too small to alter bed morphology, the interaction between LWD and the bed will be assessed. LWD, as a biological component, will be examined during the habitat mapping component of the instream flow study.

Additional Investigations – Depending upon the results of the above evaluations, additional studies may be conducted in some specific areas (e.g. Rosgen Level IV sediment budget).

It is expected that Rosgen Level I classification will occur in spring/early summer 2002. Selection of Rosgen Level II and III sampling sites and fieldwork will occur in summer 2002/2003. Note that interested parties from the Aquatics TWG and Plenary Group will be invited to visit the sites in the field to concur with or modify the selected survey sites before any fieldwork is conducted. Data analysis will occur in fall 2002/2003, and the results of the study will be presented to the Aquatic TWG in late 2002/2003. Should the data indicate that additional investigation is warranted in specific area (i.e., additional surveys, including identifying reference reaches to help isolate Project impacts, this study plan will be amended, in consultation with the Aquatics/Water TWG and Plenary Group, to include data gathering and analysis in these specific problem areas in 2003.

2.1.7 Analysis

The results would be used to describe the existing channel conditions and to identify effects of the projects on channel morphology. The magnitude of sediment trapping by the reservoirs will be estimated. An incipient motion analysis will be performed using Shield's (and associated sensitivity analysis) equation (also perform sensitivity analyses in conjunction with opportunistic flow events) for each Level III study site. Potential problem areas (excess sediment, lack of bedload sediment, excessive scouring or channel entrenchment, lack or excess of LWD, poor riparian vegetation, etc.) will be identified, and potential mitigation measures will be evaluated.

2.1.8 Study Output

A presentation on the preliminary results from the study will be made to the Aquatics TWG and the Plenary Group in late 2002. The ultimate study output will be a written report that includes the issues addressed, objectives, study area including sampling locations, methods, analysis, results, discussion and conclusions. The report will be prepared in a format so that it can easily be incorporated into SMUD's draft environmental assessment report that will be submitted to FERC with SMUD's application for a new license.

2.1.9 Preliminary Estimated Study Cost

A preliminary study cost estimate will be prepared after the Plenary Group approves this study plan.

2.1.10 TWG Endorsement

The Aquatics TWG approved this plan for the UARP on February 28, 2002. The participants at the meeting who said they could "live with" this study plan were BLM, PCWA, CSPA, SWRCB, USFS and SMUD. None of the participants at the meeting said they could not "live with" this study plan except for the PG&E participant who said PG&E would defer at this time since the plan did not include the Chili Bar Project and downstream. At the April 3, 2002 Plenary Group meeting, the plan was directed back to the Aquatic TWG to include the area below Chili Bar. At the April 11, 2002 Aquatic TWG meeting, the TWG approved the study plan. The participants at the meeting who said they could "live with" this study plan were BLM, SWRCB, USFS, PG&E, Camp Lotus, and SMUD. None of the participants at the meeting said they could not "live with" this study plan, except that PG&E said it needed management approval. PG&E obtained this approval as of April 30, 2002.

On May 1, 2002 the following participants gave Plenary Group approval to the plan: USFS, BLM, USFWS, Taxpayers of El Dorado County, Friends of El Dorado County, Camp Lotus, El Dorado County Water Agency, El Dorado County, Placer County Water Agency, California Department of Fish and Game, California State Water Resources Control Board, Pacific Gas and Electric and Friends of the River. None of the participants at the meeting said they could not "live with" this study plan.

2.1.11 Literature Cited

Harrelson, C., C. Rawlins, and J. Potyondy. 1984. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. USDA Forest Service, Rocky Mountain Forest Range and Experiment Station. General Technical Report RM-245.

Hilton, S., and T. E. Lisle. 1993. Measuring the fraction of pool volume filled with fine sediment. Research Note PSW-RN-414. USDA Forest Service, Pacific Southwest Research Station, Berkeley, California.

Lisle, T.E. and S. Hilton. 1992. The volume of fine sediment in pools: an index of the supply of mobile sediment in stream channels. Water Resources Bulletin 28(2): 371-383.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22: 169-199.

Rosgen, D. L. 1998. Applied River Morphology. Western Hydrology, Lakewood, Colorado

SMUD (Sacramento Municipal Utility District). 2001. Initial Information Package for Relicensing of the Upper American River Project (FERC Project No. 2101). Sacramento, CA.

USFS (U.S. Forest Service) 1997. A reconnaissance level indicator of pool fine sediment. Sierra National Forest, Kings River Ranger District. Unpublished report.

Wolman, G. M. 1954. A method of sampling coarse river-bed material. Transactions of the American Geophysical Union 35: 951-956.

AQUATICS TWG NOTE:

1. *This study area will be revisited once SMUD and the USFS reach agreement regarding responsibility for and potential Project actions in “Defense and Threat” zones as defined in the Forest Service Plan Amendment EIS and Record of Decision*