4.10 Habitat Mapping Study Plan

This study is designed to provide information regarding stream habitat types and conditions for use in instream flow, geomorphology, aquatic bioassessments, riparian vegetation, and fish survey studies. This information is being developed now to provide the Aquatic TWG a better understanding of habitat types in the various reaches affected by the Sacramento Municipal Utility District's (SMUD) Upper American River Project (UARP) and Pacific Gas and Electric Company's Chili Bar Project. It is anticipated that the information will be used to select reaches in which PHABSIM modeling will be conducted, and to select appropriate transects.

4.10.1 Pertinent Issue Questions

The Habitat Mapping Study Plan will be used, in part, to support other studies that address the following Aquatics/Water Issue Questions:

20. What effect do flows have on species during critical life stages?
25. How do sport fishing releases affect native species and the ability to manage them?
31. How does spill water affect aquatic resources?
35. How are Project releases into Chili Bar affecting aquatic resources?
36. What are the limiting features of a natural (unimpaired/pre-project) hydrograph on aquatic species?
37. Are the minimum stream flows defined under the existing license adequate for protecting aquatic resources?

As described above, this Habitat Mapping Study Plan provides preliminary information for the development of the Instream Flow Study Plan and other study plans (e.g., aquatic bioassessment, fish surveys, and channel morphology). In and of itself, it does not answer the above issue questions.

4.10.2 Background

Habitat mapping information can be used for many purposes, including assessment of channel conditions, substrate characterization, and habitat type assessment. In support of instream flow studies, habitat mapping is typically used to quantify habitat types in a given reach in order to help determine study site locations and transect placement. Following analysis of habitat mapping data, the proportion and type of habitats to place transects in can be determined with greater precision. Weighting of instream flow study results can then be based on the proportion of habitat types in an entire stream reach, rather than just on a representative reach (Morhardt, et al. 1983).

As identified by the Aquatic TWG, the projects contain 14 reaches. A summary of each reach can be found on the UARP Relicensing webpage. Some key characteristics, including gradient and ease of access, of each reach are provided below.

- **Rubicon Dam Reach** - Rubicon River from the base of Rubicon Dam to Miller Creek. This section of river is about 4.1 miles long, extends through a range of elevations from 6,510 feet to 6,100, and has a mean gradient of about 100 feet per mile (1.9%). There are no major tributary inflows. Parts of this river sections are reasonably accessible by foot or by helicopter, and the section is expected to be walkable along the river corridor.
- **Rockbound Dam Reach** - Highland Creek from the outlet of Rockbound Lake to the normal high water line of Buck Island Reservoir. This section of river is 0.4 miles long, extends through a range of elevations from 6,520 feet to 6,440, and has a mean gradient of about 200 feet per mile (3.8%). There are no major tributary inflows. This river section is reasonably accessible by foot or by helicopter, and the section is expected to be walkable along the river corridor.
- **Buck Island Dam Reach** – Little Rubicon River from the base of Buck Island Dam to the Rubicon River. This section of river is 2.8 miles long, extends through a range of elevations from 6,420 feet to 5,940, and has a mean gradient of about 170 feet per mile (3.2%). There are no major tributary inflows. This river section is reasonably accessible by foot or by helicopter, and the section is expected to be walkable along the river corridor.
- **Rubicon Tunnel Outlet Reach** – Rubicon Tunnel Outlet portal to the normal high water line of Rockbound Lake. This section is a partially constructed channel, approximately 0.3 miles long, beginning at an elevation of approximately 6,560 feet. The gradient from the outlet to the lake is relatively flat, estimated to be less than 37

feet per mile (<1%). The reach is located south of the Fox Lake area, but has no direct hydrological connection to Fox Lake. The outlet channel intersects an unnamed lake along its course to Rockbound Lake, but there are no named tributaries to this reach. This river section is reasonably accessible by foot or by helicopter, and the section is expected to be walkable along the river corridor.

- **Loon Lake Dam Reach** - Gerle Creek from the base of Loon Lake Dam to the normal high water line of Gerle Reservoir. This section of river is 8.9 miles long, extends through a range of elevations from 6,310 feet to 5,231, and has a mean gradient of about 122 feet per mile (2.3%). Major inflows to this reach include Jerrett Creek, Barts Creek and Dellar Creek. Parts of this section are reasonably accessible by foot or vehicle, and the section is expected to be walkable along the river corridor.
- **Gerle Creek Dam Reach** - Gerle Creek from the base of Gerle Creek Dam to the South Fork Rubicon River. This section of river is 1.1 miles long, extends through a range of elevations from 5,182 feet to 4,980, and has a mean gradient of about 184 feet per mile (3.5%). There are no major tributary inflows. This section is reasonably accessible by foot or vehicle, and the section is expected to be walkable along the river corridor.
- **Robbs Peak Dam Reach** - South Fork Rubicon River from the base of Robbs Peak Dam to the Rubicon River. This section of river is 5.6 miles long, extends through a range of elevations from 5,190 feet to 3,540, and has a mean gradient of about 293 feet per mile (5.5%). Major inflows to this reach include Gerle Creek and South Creek. This section is largely inaccessible by foot or vehicle, and many areas are not expected to be safely walkable along the river corridor.
- **Ice House Dam Reach** - South Fork Silver Creek from the base of Ice House Dam to the normal high water line of Junction Reservoir. This section of river is 11.5 miles long, extends through a range of elevations from 5,290 feet to 4,450, and has a mean gradient of about 73 feet per mile (1.4%). Major inflows to this reach include Peavine Creek, Winmiller Ravine, and Big Hill Canyon. This section is reasonably accessible by foot or vehicle, and is expected to be walkable along the river corridor.
- **Junction Dam Reach** - Silver Creek from the base of Junction Dam to the normal high water line of Camino Reservoir. This section of river is 8.3 miles long, extends through a range of elevations from 4,300 feet to 2,195, and has a mean gradient of about 167 feet per mile (3.2%). Major inflows to this reach include Gray House Creek, Bear Creek, Davis Creek, and Onion Creek. This section is largely inaccessible by foot or vehicle, and many areas are not expected to be walkable along the river corridor.
- **Camino Dam Reach** - Silver Creek from the base of Camino Dam to the South Fork American River. This section of river is 6.0 miles long, extends through a range of elevations from 2,785 feet to 2,060, and has a mean gradient of about 121 feet per mile (2.3%). The major inflow to this reach is Round Tent Canyon. This section is largely inaccessible by foot or vehicle, and many areas are not expected to be walkable along the river corridor.
- **South Fork American River Reach** – South Fork of the American River from the confluence with Silver Creek to the normal high water line of Slab Creek Reservoir. This section of river is approximately 2.8 miles long, ranging in elevation from 2,040 to 1,850 feet, and has a mean gradient of about 68 feet per mile (1.3%). There are no named tributaries in this reach. This section is largely inaccessible by foot or vehicle, and many areas are not expected to be walkable along the river corridor.
- **Brush Creek Dam Reach** - Brush Creek from the base of Brush Creek Dam to the normal high water line of Slab Creek Reservoir. This section of river is 2.1 miles long, extends through a range of elevations from 2,710 feet to 1,850, and has a mean gradient of about 406 feet per mile (7.7%), although much of the reach is steeper than that. There are no major inflows. Parts of this section are likely to be too steep for safe access along the river corridor, but the upper and lower sections of the reach are lower gradient and may be walkable along the river corridor.
- **Slab Creek Dam Reach** – South Fork of the American River from the base of Slab Creek Reservoir to the normal high water line of Chili Bar Reservoir. This section of river is 8.0 miles long, extends through a range of elevations from 1,620 feet to 990, and has a mean gradient of about 79 feet per mile (1.5%). Major inflows to this reach include Redbird Creek, Iowa Canyon, South Canyon, Mosquito Creek, Jaybird Creek, Rock Creek, and White Rock Creek. This section is largely inaccessible by foot or vehicle, and many areas are not expected to be walkable along the river corridor.
- **Reach Downstream of Chili Bar Dam** – South Fork of the American River from the base of Chili Bar Dam to the normal high water line of Folsom Lake. This section of river is approximately 20 miles long. Elevations range from 960 feet to approximately 470 feet, with a mean gradient of approximately 25 feet per mile (0.5%). There are numerous minor tributaries in this reach, and other small tributaries include Kelsey Canyon Creek,

Dutch Creek, Shingle Creek, Greenwood Creek, Hastings Creek, Norton Ravine, and Weber Creek. There are several vehicular access points at the top and bottom and in the middle third of the reach. Helicopter access may be possible in several locations in the upper and lower sections that are not accessible by vehicle. However, much of the reach is not expected to be safely walkable, particular during periods of flow fluctuation.

4.10.3 Study Objectives

The study objectives are to:

1. Describe the distribution, frequency, and length of different habitat types in reaches of the UARP project area.
2. Characterize various habitat parameters such as substrate, cover, estimated pool depth, and spawning gravel percentage and distribution.
3. Note habitat features such as migration barriers and tributary flows.

4.10.4 Study Area

The study area includes the 14 stream reaches described above.

4.10.5 Information Needed From Other Studies

No information is needed from other studies. Information developed in this study will be useful to the Instream Flow, Fish Surveys, Channel Morphology, Aquatic Bioassessment, Riparian Vegetation and other studies.

4.10.6 Study Methods And Schedule

Two different study methods will be employed.

On-the-Ground Mapping - For those stream reaches where a person can reasonably hike on foot (reasonably means a hiker would be safe, not entering property without a landowners approval, and can complete the survey in one to two days between access points) along the reach for more than 90 percent of the length of the reach, habitat mapping will be conducted on foot by a team of two individuals using a hip chain. For each habitat type described in Table 1, the individuals will record the length of each habitat type unit, which can be referenced back to a known starting point or landmark. Habitat units will be separately identified when the unit length is at least equal to the active channel width (McCain et al. 1990, Flosi and Reynolds 1994), or if the unit is otherwise distinctive. The mapping will be continuous: each habitat unit will abut with another unit. In addition, the individuals will note the following features, record their locations on a topo map or using GPS, and describe them where appropriate: 1) apparent barriers to upstream fish movement, 2) trout spawning habitat, 3) tributaries (for each, estimate inflow to the reach and measure water temperature), and 4) pieces of large wood as defined in the Channel Morphology Study Plan. Relevant incidental observations (fish, vegetation, wildlife, amphibians, amphibian habitat, etc.) will be recorded as well. The reaches where On-the-Ground Mapping will be conducted include 1) Rubicon Dam Reach, 2) Rockbound Dam Reach, 3) Buck Island Dam Reach, 4) Rubicon Tunnel Outlet Reach, 5) Loon Lake Dam Reach, 6) Gerle Creek Dam Reach, 7) and Ice House Dam Reach.

Helicopter Mapping - For those stream reaches where a person can not reasonably hike on foot (a hiker would be safe and can complete the survey in one to two days between access points) along the reach for more than 90 percent of the length of the reach, habitat mapping will be conducted using video from a helicopter and any available low altitude aerial photographs. In this method, a low elevation (tree-top height) video of the reach will be taken from downstream to upstream at a constant slow speed of about 40 knots. In the office, the staff would view the video, and using any available aerial photos and maps, habitat map the reach by identifying habitat unit types, dominant substrates, and other features. Habitat types would be the same as those for On-the-Ground Mapping. Ground-truthing would be conducted in accessible areas, where necessary, to provide supplemental detail (e.g., identify likely trout spawning habitat, etc.). The reaches where Helicopter Mapping will be done include 1) Robbs Peak Dam Reach, 2) Junction Dam Reach, 3) Camino Dam Reach, 4) South Fork American River Reach, 5) Brush Creek Dam Reach, 6) Slab Creek Dam Reach, and 7) the Reach Downstream of Chili Bar Dam. One advantage of the helicopter

mapping is that the Aquatic TWG and Plenary Group will be able to view each reach to confirm the habitat mapping, to assist in initial transect selection for instream flow studies, and for the selection of sampling sites for the Aquatic Bioassessment, Channel Morphology and Fish Survey studies. In addition, other groups can use the helicopter video as a reference tool.

TABLE 1. Habitat types to be used for the UARP Relicensing Habitat Mapping Study. (Adapted from McCain et al. 1990, Armantrout 1998, Payne 1992)

Habitat Type	*Description*
Low Gradient Riffle	Shallow with swift flowing, turbulent water. Partially exposed substrate dominated by cobble Gradient moderate (less than 4%)
High Gradient Riffle	Moderately deep with swift flowing, turbulent water. Partially exposed substrate dominated by boulder. Gradient steep (greater than 4%). Generally not modelable.
Cascade	Steep "riffle" consisting of small waterfalls and shallow pools or pockets, substrate usually composed of bedrock and boulders. Gradient high (more than 4%). Not modelable.
Run/Glide	Fairly smooth water surface, low gradient, and few flow obstructions. Mean column velocity generally greater than one foot per second (fps).
Pocket Water	Swift flowing water with large boulder or bedrock obstructions creating eddies or scour holes. Gradient low to moderate.
Pool	Slow flowing, tranquil water with mean column water velocity less than one fps.

It is anticipated that habitat mapping will begin at the end of August 2002, and a presentation will be made to the Aquatic TWG in fall 2002. During the presentation, needs for additional data collection or analysis will be determined in consultation with the Aquatic TWG.

4.10.7 Analysis

Analytical tasks will include a description of existing aquatic habitat in the project reaches. Frequency distributions of habitat types, by reach, will be presented, along with pertinent habitat parameter values. An appendix will include printouts of sequential habitat units and selected data (unit type, unit length, maximum depth, etc.).
The location of trout spawning habitat, fish barriers and tributaries will be noted on the printouts.

4.10.8 Study Output

The study output will be the habitat printouts for each reach, which will be used in the various studies as described above. It is anticipated that the mapping data will be available by fall 2002.

4.10.9 Preliminary Estimated Study Cost

A preliminary cost estimate for this study will be developed after approval by the Plenary Group.

4.10.10 Plenary Group and Aquatic TWG Endorsement

The Aquatics TWG approved this plan, as amended, on August 5, 2002. The participants at the meeting who said they could "live with" this study plan were California Sportfishing Protection Alliance, US Forest Service, Pacific Gas and Electric, National Marine Fisheries Service, State Water Resources Control Board and SMUD. None of the participants at the meeting said they could not "live with" this study plan. The Plenary Group gave approval of this plan at the August 7, 2002 Plenary Group meeting. The participants at the meeting who said they could "live with" this study plan were Taxpayers of El Dorado County, USFS, El Dorado County Water Agency, State Water Resources Control Board, El Dorado County Citizens for Water, National Park Service, US Bureau of Land Management, Placer County Water Agency, City of Sacramento, PG&E and SMUD. None of the participants at the meeting said they could not "live with" the study plan.

4.10.11 Literature Cited

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Bethesda, Maryland.

Flosi, G., and F.L. Reynolds. 1994. California Salmonid Stream Habitat Restoration Manual. Second Edition. California Department of Fish and Game, Inland Fisheries Division. Sacramento. October.

McCain, M., D. Fuller, L. Decker, and K. Overton. 1990. Stream Habitat Classification and Inventory Procedures for Northern California. FHR Currents, Volume 1. USDA Forest Service, Pacific Southwest Region. June.

Morhardt, J. E., D.F. Hanson, and P.J. Coulston. 1983. Instream Flow Analysis: Increased Accuracy Using Habitat Mapping. Waterpower 83- An International Conference on Hydropower. Conference Proceedings Vol 3: 1294-1304.

Payne, T.R. 1992. Stratified random selection process for the placement of Physical Habitat Simulation (PHABSIM) transects. Paper presented at AFS Western Division Meeting, July 13-16, in Fort Collins, CO.