Amended Application for New License
Major Project – Existing Dam

Upper Yuba River
Aquatic Monitoring Plan

Security Level: Public

Yuba River Development Project
FERC Project No. 2246

June 2017

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GLOSSARY - DEFINITION OF TERMS, ACRONYMS AND ABBREVIATIONS

BMI	benthic macroinvertebrates
Cal Fish and Wildlife	California Department of Fish and Wildlife, formally California Department of Fish and Game, or CDFG
cm	centimeters
dbh	diameter at breast height
FL	fork length (millimeters)
FERC	Federal Energy Regulatory Commission
Forest Service	United States Department of Agriculture, Forest Service
ft	feet
FYLF	Foothill yellow-legged frog
GIS	Global Information System
GPS	Global Positioning System
in.	inch
LWM	Large woody material: un-rooted wood meeting minimum size requirements of greater than 3 feet in length and 4 inches in diameter at the large end, fully in the active channel.
mi	miles
m	meter
mm	millimeter
NFS	National Forest System
Plan	Upper Yuba River Aquatic Monitoring Plan
PNF	Plumas National Forest
Project	Yuba River Development Project, FERC Project No. 2246
QA/QC	Quality Assurance/Quality Control
RM	river mile
RSD	Relative stock densities
RWB	reachwide benthos
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
Upper Yuba River	Collectively, the following stream segments: Middle Yuba River from Our House Diversion Dam to the confluence with the North Yuba River; Oregon Creek from Log Cabin Diversion Dam to the confluence with the Middle Yuba River; the North Yuba River from New Bullards Bar Dam to the confluence with the Middle Yuba River and the Yuba River from the North and Middle Yuba rivers to the normal maximum water surface elevation of Englebright Reservoir.
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VES	Visual encounter surveys
WPT	Western pond turtle
YCWA	Yuba County Water Agency
YOY	Young-of-year

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SECTION 1.0

INTRODUCTION

In April 2014, the Yuba County Water Agency (YCWA), pursuant to Section (§) 5.18 of Title 18 of the Code of Federal Regulations (C.F.R.), filed with the Federal Energy Regulatory Commission (FERC) an Application for a New License for Major Project – Existing Dam - for YCWA's 361.9 megawatt Yuba River Development Project, FERC No. 2246 (Project). In June 2017, YCWA amended its April 2014 Application for a New License (Amended FLA). The initial license for the Project was issued by the Federal Power Commission (FERC's predecessor) to YCWA on May 16, 1963, effective on May 1, 1963. The Federal Power Commission's May 6, 1966, Order Amending License changed the license's effective date to May 1, 1966, for a term ending on April 30, 2016.

YCWA included this Upper Yuba River[1] Aquatic Monitoring Plan (Plan) in its June 2017 Amended FLA.

The United States Department of Agriculture, Forest Service's (Forest Service) Federal Power Act (FPA) Section 4(e) authority only applies in this Plan to monitoring sites on National Forest System (NFS) lands. The Forest Service administers the Plumas National Forest (PNF) in conformance with the PNF Land and Resource Management Plan (USDA Forest Service 1988), as subsequently amended, and administers the Tahoe National Forest (TNF) in conformance with TNF Land and Resource Management Plan (USDA Forest Service 1990), as subsequently amended. When the TNF or PNF Forest Plan revisions occur, those revised plans will supersede the 1990 TNF and 1988 PNF plans.

1.1 Background

1.1.1 Yuba River Development Project

The Project is located in Yuba, Sierra and Nevada counties, California, on the main stems of the Yuba River, the North Yuba River and the Middle Yuba River, and on Oregon Creek, a tributary to the Middle Yuba River. Major Project facilities, which range in elevation from 280 feet (ft) to 2,049 ft, include: 1) New Bullards Bar Dam and Reservoir; 2) Our House and Log Cabin diversion dams; 3) Lohman Ridge and Camptonville diversion tunnels; 4) New Colgate and Narrows 2 power tunnels and penstocks; 5) New Colgate, New Bullards Minimum Flow and Narrows 2 powerhouses; and 6) appurtenant facilities and features (e.g., administrative buildings, switchyards, roads, trails and gages). The existing Project does not include any aboveground open water conduits (e.g., canals or flumes) or any transmission lines.

[1] For the purposes of this Plan, "Upper Yuba River" means the collective stream segments: Middle Yuba River from Our House Diversion Dam to the confluence with the North Yuba River; Oregon Creek from Log Cabin Diversion Dam to the confluence with the Middle Yuba River; the North Yuba River from New Bullards Bar Dam to the confluence with the Middle Yuba River and the Yuba River from the North and Middle Yuba rivers to the normal maximum water surface elevation (NMWSE) of Englebright Reservoir.

In addition, the Project includes 16 developed recreation facilities. These include: 1) Hornswoggle Group Campground; 2) Schoolhouse Campground; 3) Dark Day Campground; 4) Cottage Creek Campground;[2] 5) Garden Point Boat-in Campground; 6) Madrone Cove Boat-in Campground; 7) Frenchy Point Boat-in Campground; 8) Dark Day Picnic Area; 9) Sunset Vista Point; 10) Dam Overlook; 11) Moran Road Day Use Area; 12) Cottage Creek Boat Launch;[3] 13) Dark Day Boat Launch, including the Overflow Parking Area; 14) Schoolhouse Trail; 15) Bullards Bar Trail; and 16) floating comfort stations.[4] All of the recreation facilities are located on NFS land, with the exception of the Dam Overlook, Cottage Creek Boat Launch and small portions of the Bullards Bar Trail, which are located on land owned by YCWA. All of the developed recreation facilities are located within the existing FERC Project Boundary, except for a few short segments of the Bullards Bar Trail to the east of the Dark Day Boat Launch. In addition, the Project includes two undeveloped recreation sites at Our House and Log Cabin diversion dams, both located on NFS lands and within the existing FERC Project Boundary.

Figure 1.1-1 shows the Project Vicinity,[5] proposed Project, and proposed FERC Project Boundary.[6]

[2] Cottage Creek Campground was burned in 2010 and has not been rebuilt. YCWA is in discussions with the Forest Service regarding rebuilding the burned campground.

[3] Emerald Cove Marina provides visitor services at Cottage Creek Boat Launch, including houseboat and boat rentals, boat slips and moorings, fuel and a general store. The marina is operated under a lease from YCWA by a private company.

[4] The Project recreation facilities included one campground that is no longer part of the Project. Burnt Bridge Campground was closed initially by the Forest Service in 1979 due to low use levels. FERC, in an August 19, 1993 Order, which approved YCWA's Revised Recreation Plan, directed YCWA to remove all improvements and restore the Burnt Bridge Campground to the condition it was in prior to development of the facility. YCWA consulted with the Forest Service and all that remains of Burnt Bridge Campground today is the circulation road and vehicle spurs; all other facilities were removed.

[5] For the purpose of this Plan, "Project Vicinity" refers to the area surrounding the proposed Project on the order of United States Geological Survey (USGS) 1:24,000 quadrangles.

[6] The FERC Project Boundary is the area that YCWA uses for normal Project operations and maintenance. The Boundary is shown in Exhibit G of YCWA's Amended FLA and may be changed by FERC with cause from time to time during the term of the new license.

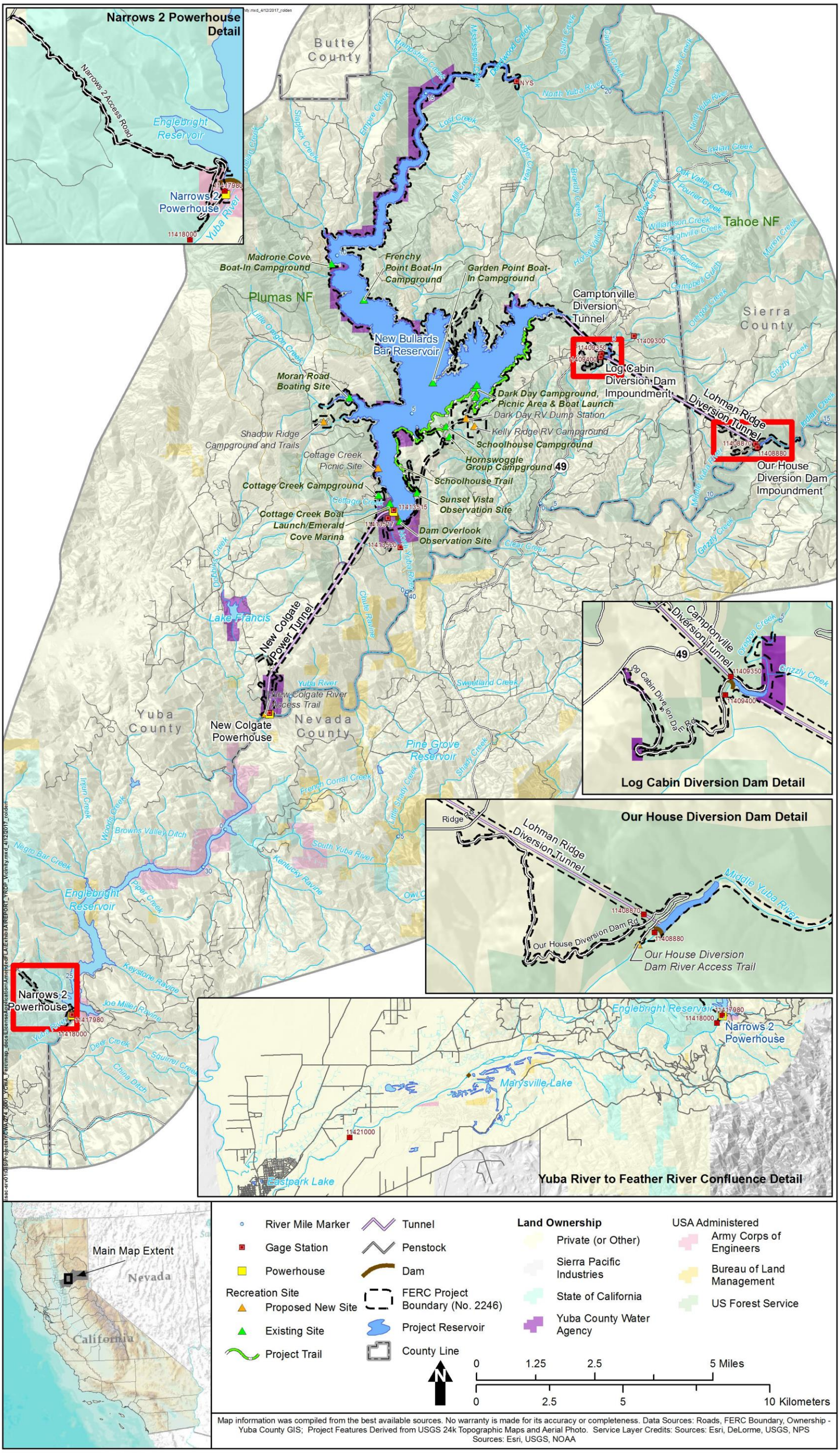

Figure 1.1-1. Yuba County Water Agency's Yuba River Development Project and Project Vicinity.

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1.2 Purpose of the Upper Yuba River Aquatic Monitoring Plan

The purpose of the Plan is to develop information regarding aquatic resources in response to changes in flow conditions from the initial license to the new license.

YCWA will coordinate, to the extent appropriate, the efforts required under this Plan with other Project resource efforts, including implementation of other resource management plans and measures included in the new license.

1.3 Goals and Objectives of the Upper Yuba River Aquatic Monitoring Plan

The primary goal of the Plan is to collect data under the new license, relative to previous license conditions, on the distribution, abundance, and condition of stream fish, especially rainbow trout (*Oncorhynchus mykiss*), benthic macroinvertebrates (BMI), foothill yellow-legged frogs (FYLF, *Rana boylii*), western pond turtle (WPT, *Actinemys marmorata*), channel morphology in Our House and Log Cabin diversion dam impoundments, stream channel morphology, riparian vegetation, and large woody material (LWM).

The Plan objectives to help achieve the Plan goal are:

- Describe where monitoring will occur
- Identify the resources that will be monitored and the frequency that monitoring will occur
- Describe the methods YCWA will follow to monitor identified resources
- Describe how the collected data will be analyzed
- Describe how the data will be made available to FERC, agencies and the public
- Describe how this Plan may be revised, as needed

1.4 Contents of the Upper Yuba River Aquatic Monitoring Plan

This Plan includes the following:

- Section 1.0. Introduction. This section includes introductory information, including the purpose and goals of the Plan.
- Section 2.0. Monitoring Methods and Analysis. This section describes the methods that will be used to monitor aquatic resources. The methods are divided into the following resource areas: 1) stream fish; 2) benthic macroinvertebrates (BMI); 3) FYLF; 4) WPT; 5) channel morphology; 6) riparian vegetation; and 7) LWM.

- Section 3.0. Monitoring Locations and Frequency. This section describes the location and frequency of monitoring for each resource area.
- Section 4.0. Consultation, Reporting and Plan Revisions. This section details consultation and reporting commitments under the Plan, and how revisions to the Plan, if needed, would be made.
- Section 5.0. References Cited. This section provides a list of the references cited in the Plan.

SECTION 2.0

MONITORING METHODS AND ANALYSIS

This section describes, by resource area, the methods that will be used to monitor aquatic resources.

2.1 Concepts That Apply to All Aquatic Monitoring

The following concepts and practices apply to all aquatic monitoring:

- Personal safety is the most important consideration of each fieldwork team.
- Prior to performing fieldwork, YCWA will obtain all necessary permits and approvals required to perform the fieldwork (e.g., scientific collection permits). All fieldwork will be performed by individuals who hold the necessary current permits to perform the fieldwork.
- All fieldwork will occur under normal operating flow conditions (i.e., requests for variance to minimum streamflow requirements not needed).
- YCWA will make a good faith effort to obtain permission to access private property, where needed, well in advance of entering the property.
- Prior to performing fieldwork, YCWA shall notify the Forest Service; United States Department of Interior, Bureau of Land Management (BLM); USDOI, Fish and Wildlife Service (USFWS); California Department of Fish and Wildlife (Cal Fish and Wildlife); and State Water Resources Control Board (SWRCB).
- YCWA's performance of the monitoring does not presume that YCWA is responsible in whole or in part for measures that may arise from the monitoring.
- Where required by this Plan, 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 YCWA's GIS analyst. Metadata will be developed for GIS data sets.
- YCWA's field crews will record incidental observations of aquatic and wildlife species observed during the performance of the monitoring. 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. In particular, all incidental observations of at least the following species will be recorded: American bullfrog (*Lithobates catesbeianus*), California red-legged frog (*Rana draytonii*), FYLF, WPT, western ridge mussel (*Gonidea angulate*), beaver (*Castor canadensis*), river otter

(*Lontra canadensis*), didymo (*Didymosphenia geminata*), invasive centrarchids (e.g., bluegill, crappie, yellow perch, largemouth bass and smallmouth bass), striped bass, and giant reed (*Arundo donax*), and field crews will be trained on the identification of these species. Any fish species easily distinguishable, but previously not observed in the study reaches will also be noted. The incidental observation records will include the species, location, and an estimate of number of individuals per observation. Records of special-status species observations will be submitted to the California Natural Diversity Database (CNDDB), and included in the appropriate monitoring reports.

- Field crews will be trained on and provided with materials (e.g., Quat) for decontaminating their boots, waders and other equipment between monitoring sites. Major concerns are amphibian chytrid fungus and invasive invertebrates (e.g., zebra mussel [*Dreissena polymorpha*]). Field crews will adhere to accepted decontamination guidelines to minimize the likelihood of transmitting diseases (USFWS 2005), as appropriate.
- During each monitoring event in this Plan at each monitoring site, YCWA will collect *in situ* water quality measurements in flowing water at one location within the monitoring site. The measurements will include water temperature (±0.1°C), dissolved oxygen (DO) (±0.2 mg/L), specific conductance (±0.001 micromhos per centimeter [µomhos/cm]), pH (±0.1 units) and turbidity ((±0.1 Nephelometric Turbidity Units, NTU). These will be measured using a Hydrolab DataSonde 5 or other similar instrument that has equivalent precision and accuracy. Prior to and after each use, the instrument will be calibrated using manufacturer's recommended calibration methods, and any variances will be noted on the field data sheet and final report and recalibration or repair done as necessary. In addition, site identification including GPS coordinates at top and bottom of a site, air temperature, weather conditions, date and time of the monitoring, and field crew members will be recorded on the field data sheet. The measurements will be taken at the beginning of the monitoring event and, if the monitoring takes more than 3 hours, at the end of the monitoring event.

2.2 Resources Monitored

2.2.1 Stream Fish

To allow for comparison of post-license issuance stream fish information with pre-license issuance information, generally the post-license issuance monitoring will use the same methods and be at the same locations as the pre-license issuance sampling. Stream fish monitoring methods are described below and the locations and frequency of stream fish monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.1.1 Field Methods

Fish monitoring fieldwork will occur once in the late September/early October period during daylight hours, and be coordinated (i.e., may occur at the same time where monitoring sites overlap) with the BMI (Section 2.2.2) monitoring. For each monitoring, general information and habitat/channel metrics will be collected, and transcribed on the appropriate field data sheet.

General information regarding the monitoring site to be visually estimated by the field crew at the time of monitoring will include: mesohabitat type, estimated average and maximum water depth, estimated average wetted and bankfull width, dominant cover type, estimated percent gradient, estimated percent canopy, estimated flow, and dominant and subdominant substrate. Attachment A to this Plan is a field data sheet for electrofishing and fish snorkeling.

Stream fish monitoring will be conducted by either backpack electrofishing or snorkeling methods, depending on the monitoring site.

2.2.1.1.1 Electrofishing

In general, electrofishing field methods will use procedures identified by Meador et al. (1993), Reynolds (1996), and Temple and Pearsons (2007). Electrofishing manpower needs will follow Temple and Pearsons (2007), who recommend one backpack electrofishing crew for streams less than 7.5 meter (m) wide and two backpack electrofishing crews for streams from 7.5 to 15 m wide. In streams wider than 15 m, the number of electrofishing crews will be increased as necessary to ensure effective fish monitoring. Multiple pass depletion sampling (i.e., generally a minimum of three passes, with a maximum of six passes if judged necessary by the field crew leader and if that can be accomplished at the monitoring site in the same day) with backpack electrofishing equipment will be used with the goal of obtaining population estimates with less than a 10 percent standard error. The intent is to conduct at least three passes and obtain good population estimates for the dominant fish species. In situations where a poor removal pattern occurs for a given species (e.g., 1 fish in pass one, 0 fish in pass two, and 1 fish in pass three) YCWA is not required to conduct four or more passes. The field crew leader will be responsible for determining the total number of passes. The backpack electrofishing units used will be Smith-Root Model Type 12 and Model 24, or similar equipment.

The upstream and downstream ends of the monitoring sites will be blocked with 0.25- or 0.37-inch (in.)-diameter mesh block nets spanning the full width and depth of the stream, except where an upstream fish passage barrier obviates the need for head-end blocking. If necessary, salt blocks will be placed in the stream immediately above the electrofishing station to increase electrical conductivity. Salt blocks will generally be used when fish are observed escaping the direct path of the electric field generated by the electrofishing unit at elevated settings or when specific conductivity is below 40 to 50 µomhos/cm.

Collected fish will be retained in aerated buckets or plastic tubs until each pass is completed. When encountered with large numbers of fish where sedation is necessary for safe and efficient handling, a sedative will be used. Measures to ensure that sampling activities minimize the potential for injury or mortality to aquatic organisms will include aeration, addition of PolyAqua® (i.e., a water conditioner and complex polymucosaccharide) to the holding water, frequent water changes, and strict limits on maximum fish holding densities. Numbers of any fish that die during collection and holding will be recorded.

All collected fish will be identified to species and counted. Each fish will be measured to the nearest millimeter (mm) fork length (FL) or total length (TL), as appropriate, and weighed with a digital scale to the nearest 0.1 gram (g). Fish will then be held in small portable net pens until

ready for release in the vicinity of the monitoring area. Fish condition (e.g., spinal trauma, burning and parasites) will be recorded prior to release.

The first time electrofishing occurs at a monitoring site, YCWA will collect scale samples from a subsample of rainbow trout and brown trout (*Salmo trutta*) each for validating length-age indices. Specifically, YCWA will collect scale samples from up to five fish of that species in the 75 to 140 millimeter (mm) FL range, up to five fish in the 150 to 220 mm FL range, up to five fish in the 221 to 300 mm FL range, and from all fish larger than 301 mm FL. Thereafter, YCWA will repeat this process every fourth monitoring event at that site.

2.2.1.1.2 Snorkeling

In general, snorkeling techniques will follow those outlined by Thurow (1994), Dolloff et al. (1996), and O'Neal (2007). The snorkeling surveys will be scheduled during the middle of the day to minimize periods when canyon walls or riparian vegetation shade the stream. The number and width of snorkeling lanes will be determined by the width of the wetted channel and visibility at each sample monitoring site. Sites will range from 4 m to 24 m in width, which generally will have 1 to 5 lanes of snorkelers. Snorkeling lanes will run the full length of the monitoring site. One observer will be assigned to a single lane to record species, size, and abundance. Fish will be identified, counted, and visually categorized into predefined 2-in. length classes (e.g., ≤2, 2–4, >4–6, …, >14 in.). Observers will calibrate their fish length determination by viewing painted wooden dowels with 2-in.-length increments underwater and periodically comparing length estimations with other crew members and crew leads. Visual estimates of fish lengths in inches will later be converted to millimeters during data entry for comparison with measured FL and reporting.

Maximum visual distance for accurate determination of fish species will be recorded on the field data forms. Three or more replicate snorkeling surveys will be performed using the same observers to assess efficiency, obtain an estimate of survey variance, and determine a level of confidence for use in abundance estimation (Hankin and Reeves 1988; Slaney and Martin 1987; Snedecor and Cochran 1980). In most cases, replicate surveys will be conducted no sooner than 1 hour after the initial survey to allow for fish to resume undisturbed positions and activity within the monitoring site. An exception to the 1-hour interval between survey passes may be made for smaller, isolated pools where fish movement is unlikely, or when light conditions limit the period of maximum visibility.

2.2.1.2 Quality Assurance/Quality Control

Prior to use, each piece of equipment will be calibrated to manufacturer's recommended specifications. Any variances will be noted and final report and recalibration or repair done as necessary.

YCWA will subject all data to quality assurance and quality control (QA/QC) procedures including, but not limited to spot-checking data. If any datum seems inconsistent during the QA/QC procedures, YCWA will investigate the problem. Values that are determined to be anomalous will be removed from the database if the reason for the reading cannot be identified.

For all monitoring sites, following the QA/QC review, field data will be entered into and organized in a Microsoft™ Excel spreadsheet, or a similar spreadsheet format, and will have an additional QA/QC review to assure data have been transcribed accurately.

2.2.1.3 Data Analysis

Some parameters may be analyzed in Excel, or a similar spreadsheet format, while other parameters will be analyzed using published public domain scientific software for calculating stream fish population statistics. While all species will be recorded, small sample sizes of some species may limit some statistical analyses. Specific metrics are described below.

Each monitoring site will be compared with prior monitoring results for that site. The focus will be on changes in fish composition, density, and age-class structure at the monitoring site in relation to water year (WY) type as defined in the new license, water temperature, operations, or other pertinent Project-related factors. Attachments to the monitoring report will include datasheets, maps of sample locations, and a digital database of entered data.

2.2.1.3.1 Age Structure

Analysis matrices will be based on age classes. Existing length-age indices and scale samples will be used to determine the age class. Length-age indices are relatively accurate for smaller fish; however, confidence intervals reduce with larger fish. Regression analysis will be used to analyze the data and if necessary, adjust the indices. All age classes will be indicated to the extent possible based on the length-frequency histograms and scale samples.

2.2.1.3.2 Fish Populations and Biomass

Where data are available (e.g., detailed fish weight data will not be available at snorkeling sites), standing stock estimates in terms of fish population numbers and biomass will be calculated by species, including young-of-the-year (YOY) and age 1 and older (1+) age groups for each monitoring station and analyzed by age class. Electrofishing data will be analyzed using a scientific software package (e.g., MicroFish or other similar program). Capture probabilities (i.e., the proportion of fish captured on a given electrofishing pass), size statistics, and biomass will be generated for each sample monitoring site using fish capture data. Biomass will be calculated based upon total weight measured for each species. Standing stock estimates will be reported as: 1) numbers and weight (grams) of fish by species per 100 m of stream; 2) numbers of fish by species per mile (mi); 3) pounds of fish by species per acre (ac) of stream surface; and 4) kilograms (kg) of fish by species per hectare (ha) of stream surface.

Fish population analysis will include species composition, relative abundance, and an analysis of size structure based on relative stock densities. To provide an index of size structure for each monitoring site, traditional relative stock densities (RSD) of each species will be calculated. The RSD will be presented on a scale of 0 to 100 (Anderson and Neumann 1996). RSD will be calculated as the proportion of fish sampled greater than 6 in. (i.e., RSD = (number of fish >6-in. in sample) / (number of fish in sample) x 100). The 6-in. length was chosen because it is often used as the smallest size of fish that is desired by anglers.

2.2.1.3.3 Fish Size and Condition

At all sites, fish size in mm and weight in g will be summarized by species and by monitoring site. Standard scientific software outputs including minimum, maximum, and mean FL and weight will be calculated.

For electrofished sites where detailed data are expected to be available, length and weight data will be used to calculate a relative condition factor (K_n) (Anderson and Gutreuter 1983) and to provide a general indication of the health of individuals, where factors greater than 1 indicate more healthy individuals. Relative condition factors for electrofishing monitoring sites will be calculated for length and weight data collected at all quantitative electrofishing monitoring sites.

2.2.2 Benthic Macroinvertebrates

To allow for comparison of post-license issuance BMI information with pre-license issuance information, generally the post-license issuance monitoring will use the same methods and be at the same locations as the pre-license issuance sampling. BMI monitoring methods are described below and the locations and frequency of BMI monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.2.1 Field Methods

BMI monitoring will occur in the late September/early October period, and be coordinated, and will be coordinated with the stream fish (Section 2.2.1) monitoring. One BMI monitoring event will be conducted in late September/early October period during daylight hours during base flow. BMI samples will be collected and analyzed following the Surface Water Ambient Monitoring Program (SWAMP) (Ode 2007) protocols.

2.2.2.1.1 Field Data Collection

SWAMP includes one of two BMI sampling methods: 1) reachwide benthos (RWB); or 2) targeted riffle composite (TRC). The RWB method, which was used during relicensing, does not target any specific type of mesohabitat at a monitoring site. RWB samples at a site are a composite of 11 sub-samples, each taken from one of 11 equally spaced transects. Transects are spaced 15 m apart, or 25 m if the wetted width of the channel is greater than 10 m wide. Sub-sampling alternates between left-center, center, and right-center locations on each sequential transect. In contrast, the TRC sample consists of a composite of eight sub-samples randomly selected from the riffle habitats within the monitoring site. Unless otherwise agreed to by the Forest Service, USFWS, SWRCB and CDFW at a monitoring site, the RWB method will be used.

Samples will be taken moving upstream from the most downstream transect to minimize instream disturbance. Samples will be collected by rubbing cobble and boulder substrates and disturbing finer substrate upstream of a D-frame kicknet fitted with a 0.02-in diameter mesh net. Each of the 11 subsamples collected that form the composite sample will cover 1 square-ft of the stream bottom. A 1-square-ft grid will be used when taking samples to ensure consistency of

sample area. The subsamples will be combined in a jar, preserved with 95 percent ethanol, and labeled to form a single composite sample for that monitoring site.

Physical habitat will be characterized at each monitoring site. The habitat scoring criteria outlined by the SWAMP provides a measure of the physical integrity of a stream. The following list of quantitative measures of chemical and physical/habitat characteristics will be collected at each monitoring site:

1. Reach-wide Parameters
    a. Total length and gradient (percent slope) and average width and depth
2. Transect-specific Parameters
    a. The wetted width of each riffle will be taken at a minimum of three cross-sectional transects and averaged.
    b. Water velocity (using a topset rod and flowmeter) will be measured at each of the 11 sample points.
    c. Substrate composition will be visually estimated at each sample point (i.e., area disturbed in front of the net) using the following categories: fines (<0.25 cm), gravel (0.25–0.8 cm), cobble (0.8–25 cm), boulder (>25 cm), and bedrock.
    d. A pebble count will also be conducted along a single transect established from each sample point. This parameter will be measured by randomly choosing 10 points along each transect, reaching down to the point at the end of a wooden dowel or tip of the boot, and measuring the width of the particle along the intermediate axis. "Pebble count" in this context is in reference to the sample approach first described by Wolman (1954) and adapted for use (including reduced sample size) in the SWAMP protocol. It does not refer to a specific size class of sediment.
    e. Substrate consolidation and percent embeddedness will also be characterized while conducting the pebble count. Estimates will be obtained while collecting the BMI sample by noting whether the substrate is lightly, moderately, or heavily surrounded by fine sediment.
    f. Average canopy cover will be estimated at each riffle sampled using a densiometer four times from the center of habitat unit.

Attachment B to this Plan is a field data sheet that will be used for BMI monitoring.

2.2.2.1.2 Laboratory Methods

Each composite sample will be rinsed in a standard number 35 sieve (0.5 mm) and transferred to a tray with 20 4-in-square grids for sub-sampling. Sub-sampling will be performed using a stereomicroscope with magnifications of 10 to 20 times magnification.

Subsamples will be transferred from randomly selected grids to Petri dishes where the BMI will be removed indiscriminately with the aid of a stereomicroscope and placed in vials containing 70 percent ethanol and 2 percent glycerol. In cases where BMI abundance exceeds 100 organisms

per grid, half grids will be delineated to assure that a minimum of three discreet areas within the tray of benthic material is subsampled. At least 500 BMI specimens will be subsampled from a minimum of five grids, or five half grids.

The debris from the processed grids will be placed in a remnant jar and preserved in 70 percent ethanol for later QC testing.

All BMI retained on a 0.5-mm screen will be removed from the subsample and a standard level one taxonomic effort will be used as specified by the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) (Richards and Rogers 2006). Identification will be by a taxonomist approved by Cal Fish and Wildlife for U.S. Environmental Protection Agency (EPA) evaluations using standard BMI identification keys (e.g., Kathman and Brinkhurst 1998, Merritt and Cummins 1996, Stewart and Stark 1993, Thorp and Covich 2001, Wiggins 1996) and other appropriate references. The approval process will be consistent with Cal Fish and Wildlife approval of taxonomists for BMI work on other projects at that time.

2.2.2.2 Quality Assurance/Quality Control

YCWA will follow the QA/QC procedures described in Section 2.2.1.2. In addition, all QA procedures for the field and the laboratory, as described in the SWAMP protocol, will be followed. A chain-of-custody record form will be completed for the purpose of tracking BMI samples from the field to the laboratory and then to their final storage/disposition.

YCWA will provide to Cal Fish and Wildlife Aquatic Bioassessment Laboratory 15 to 20 percent of randomly selected samples for the overall monitoring in that period (i.e., 15 to 20% of the total BMI samples that were processed by YCWA in that calendar year under this Plan), and request that the Laboratory perform a QA review. YCWA will provide the results of the Laboratory review in the report if available at the time the report is filed with FERC.

2.2.2.3 Data Analysis

Analytical methods will conform to the standard methods describing BMI assemblages and physical habitat outlined by SWAMP. Standard biological metrics will be calculated for each monitoring site and presented in graphical or tabular form. BMI metrics outlined in Rehn et al. (2007) will be calculated. Metrics will be used to formulate the Hydropower IBI described by Rehn (2009).

2.2.3 Foothill Yellow-Legged Frog

To allow for comparison of post-license issuance FYLF information with pre-license issuance information, generally the post-license issuance monitoring will use the same methods and be at the same locations as the pre-license issuance sampling. FYLF monitoring methods are described below and the locations and frequency of FYLF monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.3.1 Field Methods

At each monitoring site, one visual encounter surveys (VES) during daylight hours will be conducted to determine the distribution and relative frequency of FYLF individual detections. Surveys will follow the VES protocols described in Seltenrich and Pool (2002), Pacific Gas and Electric Company and Nevada Irrigation District (2009), and Yarnell et al. (2014), except that microhabitat data will be collected as shown in the FYLF field data sheet in Attachment C to this Plan. As detailed below, these protocols provide for multiple surveys that are timed to document different FYLF life stages from spring to late summer/early fall.

Specifically, two surveyors working in tandem will search both stream banks if the stream can be safely crossed by wading, back channel areas, and potential instream habitats for FYLF walking slowly while one observer scans ahead 30 to 60 ft. To aid in the detection of FYLF eggs and larvae, surveyors will use a viewing box in shallow margin areas. In water too deep to survey by wading, snorkeling will be employed in appropriate habitats during searches where safely accessible. The walking surveyors and snorkelers will attempt to find egg masses that have been deposited underneath boulders or bedrock shelves by looking underwater or gently feeling under these substrates. Observations of post-metamorphic individuals (i.e., juveniles and adults) will be recorded during each survey, and the surveyors will scan upstream for frogs basking on exposed substrates or partially hiding under cover, although cover objects will not be routinely turned during searches.

The surveyors will record the number, size or estimated size, life stage, and geographic coordinates of each FYLF observed, except where the number of tadpoles or post-metamorphic YOY are too numerous to measure individually. In the latter cases, a subset of tadpoles will be measured in TL with a hand ruler. For egg masses, eggs will be staged using Gosner (1960). For tadpoles, the following simplified stages will be recorded: 1) no limb buds or limb buds without separated toes; 2) hind legs with separated toes; 3) hind legs, with front limbs evident as bulges, but not yet emerged through skin; or 4) all four legs fully developed, but with finned tail still present. At least 10 post-metamorphic YOY from different parts of the monitoring site will be measured, if found. Surveyors will also record the number of individual bullfrog juveniles and adults seen or heard (i.e., “chirp hops”) during the surveys, and will estimate the number of bullfrog tadpoles within the monitoring site using the following broad categories: 0-10, 11-100, 100-500, 500+, differentiating between YOY and year 1+ individuals.

To document representative conditions at the site, during each survey at least one photograph will be taken from the top of the site looking downstream; one from the bottom of the site looking upstream; and several facing upstream and downstream from the middle of the site. The geographic locations of these photo-points will be recorded and subsequent photographs will be taken from these same locations. Additional photographs will be taken to document typical edgewater and backwater habitats, with geographic locations recorded, examples of breeding habitat (i.e., occupied or otherwise), and any other interesting or unique habitat features. Photo file names will include the stream reach, time, date, and the mean daily streamflow as recorded for that date from the nearest upstream gage. This file name data will be included with photos published in the report.

Unless otherwise specified in Section 3.3, four survey visits will be conducted at each monitoring site during a year when monitoring occurs: two visits in the spring/early summer will be for the detection of eggs and early tadpoles; one in the mid-summer when tadpoles are larger and have dispersed from egg mass locations; and one in the late summer/early fall to detect older tadpoles and recently metamorphosed frogs.

To ensure that the spring/early summer monitoring schedule coincides with the FYLF breeding season in stream reaches where surveys will occur, stream temperatures will be monitored where water temperature recorders are installed under the Water Temperature Monitoring Plan, which is part of the new license, prior to the anticipated commencement of surveys. Site visits to look for evidence of impending FYLF breeding will be performed after continuous real-time water temperature data collected on the Middle Yuba River downstream of Our House Diversion Dam at river mile (RM) 12.6 indicate that mean daily water temperatures have reached a minimum threshold of 10 degrees Celsius (°C) for at least two consecutive days and there is a corresponding reduction in spring high flows. This threshold is likely to occur before any oviposition has commenced. One or more inspections will be performed at easily accessible, known or suspected breeding sites (i.e., sentinel sites) on the Middle Yuba River and Oregon Creek to search for egg masses and FYLF in breeding condition. Unless otherwise agreed to by the Forest Service, USFWS, SWRCB and CDFW, the sentinel sites will be located on the Middle Yuba River 0.2 mi downstream of Our House Diversion Dam and on Oregon Creek upstream of Celestial Valley at RM 3.2. The formal monitoring on these streams will be scheduled based on the findings of these sentinel site inspections or will occur following May 1, whichever occurs first (Wheeler et al. 2015).

2.2.3.2 Quality Assurance/Quality Control

YCWA will follow the QA/QC procedures described in Section 2.2.1.2.

2.2.3.3 Data Analysis

VES results will be summarized in the monitoring report, which is described in Section 4.1. At a minimum, the following analysis/reporting will be provided, along with the supporting data in Microsoft™ Excel spreadsheet or a similar spreadsheet format, and in GIS layers, as appropriate:

- Information on survey effort (length and area surveyed, and duration of each survey) and timing
- Number of FYLF by lifestage (i.e., egg mass, early stage tadpole, late stage tadpole, YOY, juvenile and adult) at each monitoring site during each survey visit and total numbers each year
- Number of egg mass detections and stage of development (Gosner 1960) plotted by survey date
- GIS maps showing the number and locations of FYLF detections
- Tables and graphs that relate FYLF survey results to the nearest available streamflow, stage and water temperature data for individual survey dates and the survey year

A discussion of the findings will be presented from the data analysis. The discussion will focus on observed changes or trends in the abundance and population structure, and life stage timing from current and past monitoring for each monitoring site in relation to water year, water temperature, operations, or other pertinent Project-related factors. This will include reviewing flow information for high-flow fluctuations based on using the nearest streamflow monitoring gage to the monitoring site.

2.2.4 Western Pond Turtle

To allow for comparison of post-license issuance WPT information with pre-license issuance information, the post-license issuance monitoring will occur at the same locations as the pre-license issuance sampling or where incidental observations of WPT were reported, and will generally use the same methods, but with a greater emphasis on trapping in order to better collect information on age, size, and number of WPT encountered. WPT monitoring methods are described below and the locations and frequency of WPT monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.4.1 Field Methods

Potential WPT habitat was identified along project-associated river reaches and around Project reservoirs based on analyses completed for the TM 3-6 – Special-Status Turtles-Western Pond Turtles (YCWA 2012). A combination of Geographic Information System (GIS), aerial photography, and field-verification were used to identify areas with suitable habitat conditions for WPT. Monitoring surveys will be conducted at selected sites where WPT was found during the relicensing studies or where suitable WPT habitat was identified.

Two trapping periods will be conducted at each of the monitoring sites between late May and the end of July. At the stream reach monitoring sites, at least 250 meters (m) will be surveyed in each monitoring site (including the mouth of tributaries near their confluence with the mainstem). In New Bullards Bar Reservoir at least three 250-m-long sites will be surveyed. In Our House and Log Cabin impoundments, approximately 250-m will be surveyed in each impoundment.

Trapping is the preferred method for monitoring WPT at all sites. If suitable trapping sites cannot be found (e.g., traps at sites within New Bullards Bar Reservoir could be disturbed due to high public use), then visual basking site surveys will be used (see below). Specific survey methods for each location will be determined in collaboration with the Forest Service and Cal Fish and Wildlife in license Year 1.

The methods used for trapping will be consistent with recommendations for WPT (Bury et al. 2012). Baited funnel traps of various designs have proven effective in capturing WPT, including commercially available “hoop traps” with round or D-shaped metal hoops and oval or semi-oval fish and crab traps (e.g., Memphis Net and Twine models FT-D and FT-FA). These traps are collapsible and fitted with non-stretch, mesh netting.

Traps will be set at each site in the late afternoon or evening (e.g., between 4:00 PM and 7:00 PM) and checked the following morning. At sites where human activity poses a high risk of

theft or vandalism of traps or trap contents, traps may be set in the early morning or late afternoon and the trapping period shortened to 4 hours, and traps will be visually monitored at a distance after being set.

Traps will be baited with sardines packed in oil, cat food (salmon or tuna), canned tuna in oil, or fresh mackerel, or a combination of these baits. Cans of bait will be punctured and suspended at the back of the trap to release the oils to attract the turtles while preventing the consumption of the bait. Because some turtles may become "trap-shy" after first capture, the type of bait or combination of baits may be changed periodically.

Within the Project reservoir and impoundments, a minimum of six (4 moderate-sized and 2 large-sized collapsible traps) traps should be spaced about 10 meters apart along shorelines at each monitoring site. The monitoring site located on the Middle Yuba River will use a minimum of four (3 moderate-sized and 1 large-sized collapsible traps) traps spaced 5 meters apart within the backwater riverine habitats. Traps should be placed near habitat features likely to be used by pond turtles, usually basking sites or aquatic hiding places, such as logs, undercut banks, submerged root wads, aquatic vegetation, and crevices between boulders. In stream environments, traps will be set with the opening facing downstream, allowing easier access for turtles as they swam upstream following the scent of the bait. The top of each trap must be raised above the water surface with floats to allow captured turtles (and other animals) to surface for air. Traps need to be anchored to the bank to prevent drifting or loss. During the first monitoring year (license Year 3), in each of the two sampling periods, trapping will be operated for five days. For all subsequent monitoring years, during each of the two sampling periods, trapping will be operated for two days. If any WPT are captured on Day 1 or 2, trapping will continue for a third day.

The location, date, time, carapace length, width, and height, plastron length, weight, sex, and age class for all individuals WPT captured in the turtle traps will be recorded and all captured WPT will be photographed. Additionally, the number of marginal scutes, signs of shell damage, injuries, and annuli counts of juveniles shall be recorded. To identify individual WPT and differentiate WPT that are subsequently recaptured, captured WPT will be permanently and uniquely marked by notching of the marginal scutes in a unique pattern or through the use of passive integrative transponder (PIT) tagging.

If visual surveys are used instead of trapping, surveys will be based on the visual survey techniques described in the United States Geological Survey (USGS) western pond turtle visual survey protocol for the southcoast ecoregion (USGS 2006). Two surveyors will search aquatic habitat both with and without binoculars looking for the presence of basking or underwater WPTs. Open pools or possible basking areas will first be observed from a distance and then approached slowly and quietly to help prevent disturbance of basking turtles. If a splash of water is heard (i.e., possible unseen turtles entering the water), then additional time will be spent observing the area for a turtle to resurface. A minimum time of two hours (four-person hours) will be spent observing each site. Observations will occur on sunny days between 9 AM and 5 PM. If no basking areas and no WPT are observed at a study site, then two basking platforms (Alvarez 2006) will be placed in two pools at least one week prior to surveying and revisited. At each monitoring site, the time of each survey (start, end, and total search effort) and Global

Positioning System (GPS) locations (start and end of reach) will be recorded. Photographs will be taken of each surveyed pool and potential basking sites.

The size and age of WPT observed during visual surveys will be estimated, if possible, during the surveys. Any WPT encountered during the surveys will (if possible) be captured and photographed. WPT body weight and carapace length and width will be determined. Sex will be determined by tail shape/length and plastron structure, and age will be determined by scute annular ring counts.

2.2.4.2 Quality Assurance/Quality Control Review Methods

YCWA will follow the QA/QC procedures described in Section 2.2.1.2.

2.2.4.3 Data Analysis

The survey data, including data from any incidental sightings during other monitoring surveys and from previous studies (e.g., YCWA 2012), will be used to develop a distribution map for WPT. Abundance and age/size structure will be summarized for each monitoring site in each location. Information on the number of turtles marked and recaptures will also be presented. Recent hydrology, water temperature, and other data collected as part of the surveys will be reviewed, summarized, and presented in relation to distribution, abundance, and age/size structure data, as appropriate.

2.2.5 Sediment in Our House and Log Cabin Diversion Dams

To allow for comparison of post-license issuance channel morphology in the Our House Diversion Dam impoundment and in the Log Cabin Diversion Dam impoundment information with pre-license issuance information, generally the post-license issuance monitoring will use the same methods and be at the same locations as the pre-license issuance sampling (YCWA 2016). Additionally, sediment in the pool below the weir downstream of Our House Diversion Dam will be monitored. Monitoring methods are described below and the locations and frequency of monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.5.1 Field Methods

Monitoring in Our House and Log Cabin Diversion Dam impoundments and the pool downstream of Our House Diversion Dam will occur once between end of spring runoff and November 1.

Three cross-sections in the Log Cabin Diversion Dam impoundment and four cross-sections in the Our House Diversion Dam impoundment that were established for implementation of YCWA's *Log Cabin and Our House Diversion Dams Sediment Management Plan* will be used YCWA will identify original rebar or headpins, or GPS coordinates of headpins used to measure cross-sections at each of the transects. If "permanent" cross-sections were not established, YCWA will establish permanent cross-sections by monumenting ends of the cross-section with bedrock headpins or rebar. Each cross-sections will incorporate the width of the impoundment at

full pool (i.e., up to an elevation of 2,030 ft at Our House Diversion Dam and up to an elevation of 1,970 ft at Log Cabin Diversion Dam).

YCWA will survey the bottom topography along each cross-section to a precision of ±2 to 10 centimeters (cm) using standard differential survey techniques such as a total station instrument (e.g., Harrelson et al. 1994), an acoustic Doppler current profiler (ADCP), single beam echo sounder or a combination of the these. Every break in slope will form a vertical point on the graph, and what the breaks represent will be noted (e.g., top of bank, extent of right or left bank). The top of the rock elevation for bedrock within the impoundment, and the thalweg will be included. Surveyors will record positions approximately every 3 ft, being sure to capture any significant changes in slope. Where an echo sounder is used, a point will be recorded every three seconds along each cross-section. Bathymetric methods may be considered in the future if it is collaboratively agreed to among YCWA, the Forest Service, Cal Fish and Wildlife, USFWS, and SWRCB that the objectives for this monitoring can be met.

Additionally, sedimentation in the pool below the weir downstream of Our House Diversion Dam will be monitored via bathymetry. YCWA will use a remote controlled vessel (or small manned boat), an echosounder, and a GPS to measure water depths with precise horizontal and vertical positioning throughout the pool. Surveyors will record positions approximately every 3 feet to get an accurate record of all changes in slope.

2.2.5.2 Quality Assurance/Quality Control

YCWA will follow the QA/QC procedures described in Section 2.2.1.2.

2.2.5.3 Data Analysis

Data analysis will include:

- Tabular and graphical summary of each cross-section and comparison to the previous monitoring events at that cross-section for the impoundments, and tabular and graphical summary of the pool with comparison to the previous monitoring events.
- A description of implementation of sediment passage events, described in the relicensing *Log Cabin and Our House Diversion Dams Sediment Management Plan* since the last monitoring report, including periods that the low-level outlet valve was opened and flows prior to, during and after the valve opening as measured at the nearest downstream flow gage.

2.2.6 Stream Channel Morphology

To allow for comparison of post-license issuance stream channel morphology information with pre-license issuance information, generally the post-license issuance monitoring will use the same methods and be at the same locations as the pre-license issuance sampling. There are some changed locations and changes in methodology that are noted below. Monitoring methods are described below and the locations and frequency of stream channel morphology monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.6.1 Field Methods

Stream channel morphology monitoring will occur once between spring runoff and November, and be coordinated with the riparian (Section 2.2.7) and LWM (Section 2.2.8) monitoring.

2.2.6.1.1 Monitoring Sites

Each monitoring site will generally be 20 bankfull widths in length, but may have to be truncated slightly due to major changes in morphology (e.g., major break in slope or long, deep pool), and will have the same beginning and ending locations as that established during YCWA's relicensing Channel Morphology Upstream of Englebright Dam Study (YCWA 2013), if the monitoring site is located at the same location. Unless otherwise stated below, each monitoring site will include the floodprone zone. The floodprone zone is the width of the water level at twice the maximum bankfull. Bankfull, though difficult to define in regulated streams, uses evidence from:

> 1) topographic break from vertical bank to flat floodplain, 2) topographic break from steep bank to more gentle slope, 3) change in vegetation from bare to grass, from moss to grass, from grass to sage, from trees to grass, or from no trees to trees, 4) change of texture of deposited material from clay to sand, or sand to pebbles, or boulders to pebbles, 5) highest elevation below which no fine debris of needles, leaves, pine cones, or seeds occur; in some instances is the upper limit of such fine debris; and 6) change in texture (size) of fine material lodged between cobbles or rocks. This change is often from fine sand to fine gravel (Dunne and Leopold 1978).

<u>To-Scale Study Site Map</u>
For each monitoring site, YCWA will establish a to-scale study site map identifying locations of cross-sections, bedrock, bankfull flow, facies (i.e., areas with collections of like-particles), pools as defined below for the length and width of each monitoring site, LWM, and spawning gravel. The base map will be loaded onto a mobile device (e.g., tablet or laptop) and be utilized along with data collection software that can collect features (e.g., polygons, lines, areas, points) from an external GPS source. All data will be collected with a differential GPS antenna capable of 1 meter or better accuracy.

Facies will be defined by dominant and sub-dominant particle type (e.g., boulder, cobble and gravel) according to the modified Wentworth scale. YCWA will perform a Wolman pebble

count on each facies. A minimum of 100 pebbles will be measured for each facies and particles may be counted from among several patches that represent the textural facies. Particles will be measured using a gravel template, also known as a gravelometer (i.e., a square grain-size template), and a particle size distribution by number, not weight, will be created. If particles can not be lifted to pass through the gravelometer, size class will be estimated using a ruler along what is perceived as the intermediate axis (also known as the b-axis). When facies are composed of uniform sand or boulders, D_{50} (i.e., median particle size, or the particle size at which 50 percent of the particles are finer) will be assumed based on the particle size (e.g., 1 millimeter [mm] for sand and 512 mm for boulders). The percentage of the reach composed of 512 mm particles or larger will be estimated based on bedrock and particles greater than 512 mm from the pebble counts, as well as an estimate of the area composed of boulders and bedrock within the bankfull width as characterized and mapped upon the study site map. Areas of gravels within the bankfull channel, which are a suitable size for rainbow trout spawning, will be identified, where rainbow trout spawning gravel is defined as a relatively homogeneous patch of particles 0.5 to 7.6 cm in diameter with a minimum area of 1 m. Locations of key pieces of large woody material and log jams (methodology described in Section 2.2.8) will be included on this study site map as well.

Residual Depth in Pools

For each monitoring site, YCWA will measure residual depth for pools that meet the minimum criteria for a pool as set forth by Pleus et al. (1999). These criteria are provided in Figure 2.2-1. Each pool will be drawn as a polygon onto the basemap using a mobile device as stated above.

Table 2. Minimum surface area and residual pool depth criteria by segment mean bankfull width - metric units.

Mean Segment Bankfull Width (m)	Minimum Unit Size (m^2)	Minimum Residual Pool Depth (m)
0 to < 2.5	0.5	0.10
≥ 2.5 to < 5.0	1.0	0.20
≥ 5.0 to < 10.0	2.0	0.25
≥ 10.0 to < 15.0	3.0	0.30
≥ 15.0 to < 20	4.0	0.35
≥ 20	5.0	0.40

Table 3. Minimum surface area and residual pool depth criteria by segment mean bankfull width - English units.

Mean Segment Bankfull Width (feet/tenths)	Minimum Unit Size (feet/tenths^2)	Minimum Residual Pool Depth (feet/tenths)
> 0 to 8.2	5.4	0.33
≥ 8.2 to 16.4	10.8	0.66
≥ 16.4 to 32.8	21.5	0.82
≥ 32.8 to 49.2	32.3	0.98
≥ 49.2 to 65.6	43.1	1.15
≥ 65.6	53.8	1.31

Figure 2.2-1. Minimum surface area and residual pool depth criteria by mean bankfull width (FROM: Pleus et al. 1999)

Residual Fine Sediment in Pools

For each pool, as defined above in three monitoring sites, YCWA will measure residual fine sediment (i.e., fine gravel and sand less than 4 mm in diameter) using V* as set out in Hilton and Lisle (1993). V* is a ratio of the volume of residual fine sediment deposited in a pool divided

by the total residual pool volume. "Residual" refers to the pool dimensions at the point of zero flow. The monitoring sites are defined on Table 3.2-6 and include only the sites named 1) Middle Yuba upstream of Oregon Creek, 2) Middle Yuba downstream of Oregon Creek, and 3) Oregon Creek Upper Log Cabin.

A rough sketch map of the pool will also be made showing the grid used to measure the residual fine sediment, the riffle crest, pool head, pool margins, and sediment accumulations. If the residual fine sediment depth is determined to be only a thin coating over coarser material that cannot be accurately measured with a probe, then it will be described as "<0.1 foot" average thickness in the field notes. Because a calculated volume of residual fine sediment is not possible with such thin layers of sediment, the results will be described as "trace" amounts of residual fine sediment.

Rainbow Trout Spawning-size Gravel

For each monitoring site, particle size distribution and fine sediment content of rainbow trout spawning gravels will be determined using bulk sampling techniques (McNeil and Ahnell 1960). Trout spawning gravel will be defined as particles 0.5 to 7.6 cm measured along the intermediate axis that encompass a minimum area of 1 square m at a minimum water depth at time of monitoring of 10 – 15 cm, and will be sampled from locations drawn as polygons on the to-scale site map, if accessible (e.g., in less than 2 ft of water). Three bulk samples will be collected within suitable gravel patches using a modified McNeil sampler (i.e., bottomless bucket; based on design presented by Watschke and McMahon [2005]). Samples will be taken to a depth of 10 to 15 cm, which approximates the depth of a rainbow trout egg pocket in a redd (Watschke and McMahon 2005). All sampled sediments will be placed in a woven plastic bag that allows drainage of water and a slight amount of the wash load (i.e., particles less than 2 mm), and delivered to a lab for dry-sieve analysis.

2.2.6.1.2 Cross-Sections

Cross sections at each of the monitoring sites have been agreed to and are presented in Table 3.2-6. Where cross sections are not those established during YCWA's relicensing Channel Morphology Upstream of Englebright Dam Study or Instream Flow Upstream of Englebright Dam (YCWA 2013), new cross sections must be established at or near the Universal Transverse Mercator (UTM) coordinates in Table 3.2-6. If cross sections had been measured previously, YCWA will identify original rebar or headpins, or GPS coordinates of headpins used to measure cross-sections, to the extent possible. If "permanent" cross-sections were not established, YCWA will establish permanent cross-sections by monumenting ends of the cross-section with bedrock headpins or rebar and taking a GPS coordinate of each headpin. In addition, YCWA will establish a benchmark for each cross-section so that if headpins or tailpins are lost, elevations can still be re-established.

The cross-sections established during the initial setup and monitoring may be used during subsequent monitoring.

Bottom Topography

Data collected at each cross-section will include: 1) water surface elevation; 2) thalweg; 3) breaks in slope; 4) bankfull location; 5) floodprone location; and 6) at least 30 locations between

bankfull and every 4-ft beyond bankfull to the edge of the alluvial valley, unless there is a restriction that inhibits the extent of the survey (e.g., private land). Attachment D is the form that will be used to document cross-section data in the field.

Pebble Counts

YCWA will measure at least 100 particles within the bankfull channel at each cross-section using methods described in Wolman (1954). Particles will be measured using a gravel template, as with the pebble counts for facies (see Section 2.2.6.1.1 above, to provide a percent-finer distribution by size.

Photographs

YCWA will take digital photographs from each endpoint of each cross-section (i.e., from valley wall and near-channel endpoints) from downstream looking upstream, and from upstream looking downstream. During the initial monitoring event, YCWA will take the GPS location of each photo point and photo point markers (e.g., stakes or pins) will be placed. Markers will be as inconspicuous as possible to minimize the potential for vandalism. Additional photo points will be established at features particularly likely to change over time, such as mid-channel or lateral bars composed of 64 mm diameter or less particles. For those locations where more than one view is taken from the same photo point location, all the views can be recorded on the same datasheet. Attachment E is a field datasheet that will be filled out for each photo point location.

During the initial monitoring, the following procedure will be followed:

- The photographer will stand immediately over the photo point site marker, if possible. If this is not possible, the location of the photographer relative to the marker will be recorded on the datasheet (distance and angle from the marker).
- The time of the photograph, camera type, height of the camera above the ground, and compass bearing and vertical angle of the view will be recorded on the datasheet.
- At least one reference point will be established for each photo point marker. The reference point will be within 200 ft of the photo point marker. A reference point could be a large tree outside of the flood zone or a large rock. The distance, compass bearing, and vertical angle will be measured and recorded from the reference point to the photo point marker. The reference point will be described on the datasheet and a monitoring site sketch will be drawn showing major landmarks and the locations of the photo points markers. The information from the initial sketch with the reference and photo point locations identified will be recorded on the study site map using the mobile device as above, and transferred to a GIS for display over a high resolution aerial image and stored electronically.
- Additional photographs will be taken of the reference point and the photo point marker. The locations of each will be marked and labeled on the photographs for future use in the field. All information on the location of the photo points and reference points will be stored electronically.
- Each photo point marker will be given an identification number, which will be used through the duration of the monitoring.

During subsequent monitoring, the following procedures will be used:

- The field crew will take copies of the original photo point documentation on the locations of the photo and reference point markers, and take copies of the photographs and maps. The type(s) of cameras used to take the photos will be noted on the datasheet.
- The photographer will stand at the same place and height as that which the first photographs were taken. The camera will be aligned with the view at the same compass bearing as recorded during the initial photographs. The view will be compared with the previous photographs to ensure that it is as close as possible to the original.
- The time of the photograph, camera type, focus distance, height of the camera above the ground, compass bearing and vertical angle of the view will be recorded for this monitoring period.
- If the photo point marker cannot be located, an attempt will be made to locate a new photo point as close as possible to the original location using the reference point documentation, maps and previous photographs.

All photographs will be catalogued and stored electronically.

2.2.6.2 Quality Assurance/Quality Control Review Methods

YCWA will follow the QA/QC procedures described in Section 2.2.1.2.

2.2.6.3 Data Analysis

The area that is contained within each monitoring site facies will be quantified using the to-scale site map. Reach-average pebble size D_{50} and D_{50} of each facies and cross-section will be estimated, along with a particle size distribution. Monitoring site-averaged D_{50} will be calculated by estimating the area for each facies, multiplying the fractional area of the facies by the D_{50} of that facies, and summing the products for the monitoring site. The average D_{50} of the bankfull channel will also be calculated from the pebble count information collected for each cross-section.

Particle size composition of rainbow trout spawning-size gravel samples will be plotted as cumulative distribution curves and frequency histogram. Particle size composition as represented by the D_{16}, D_{50}, and D_{84} will be determined from the frequency histogram and cumulative distribution curve. Raw data results for each sample will be presented in the graphs and tables.

Photographs will be organized into a Microsoft™ Word document.

Each monitoring site will be compared with prior monitoring results for that monitoring site, but comparisons will not be made among monitoring sites. The comparison will focus on changes in cross-section, channel location and orientation, substrate/facies, pool depth, fine material in rainbow trout spawning-sized gravel, or other pertinent Project-related factors that affect the monitoring site.

2.2.7 Riparian Vegetation

To allow for comparison of post-license issuance riparian information with pre-license issuance information, generally the post-license issuance monitoring will use similar methods as the pre-license issuance sampling, except that the LWM monitoring will occur as described in Section 2.2.8. Monitoring methods are described below and the locations and frequency of riparian monitoring are described in Sections 3.2 and 3.3, respectively.

2.2.7.1 Field Methods

Riparian monitoring will occur once between spring runoff and October 31, and will be coordinated with the stream channel morphology (Section 2.2.6) and LWM (Section 2.2.8) monitoring.

2.2.7.1.1 Monitoring Sites

The riparian monitoring sites will be the same as the monitoring sites described for stream channel morphology in Section 2.2.6.6.1. Cross sections will be as stated in Table 3.2-6.

2.2.7.1.2 Cross-Sections

For each cross-section, information collected will include two types of plots: 1) herbaceous vegetation (i.e., a plot 1 m square), and 2) woody (trees and shrubs) vegetation (i.e., a plot 5 by 2 m). Plots will be nested, with herbaceous plots occurring within the woody vegetation plots. Two herbaceous plots will be located within a woody plot. Both the woody and herbaceous cover plots will be located perpendicular to the cross-section, and located on the downstream side of the ross-section. At a minimum, each cross-section will have at least two nested plots: one woody plot on each side of the stream at the start of vegetation, and within each woody plot, two herbaceous plots located side by side. Additional fluvial features (i.e., floodplains and terraces) that are at least 2 m wide and are intersected by a vegetative transect will have a minimum of one nested plot. The following information will be collected in the plots:

- Herbaceous Vegetation Plots
  - Signs of disturbance, disease, insect infestation and leaf drop will be noted
  - All vascular plant species cover in percent; woody species to be estimated at base of trunk/stem
  - List all plants present in each plot and provide an indication of whether they are native and/or special-status or have a current rating as an A or B non-native invasive plants by the California Department of Food and Agriculture (CDFA 2015), or listed as NNIP in the current TNF NNIP Management Plan.
  - Count of woody riparian plant seedlings (i.e., less than 1 m tall) or recruits (i.e., greater than 1 m tall but less than 3 inches in diameter at breast height [DBH])
  - United States Army Corps of Engineers (USACE) National Wetland Inventory current status of each species (USACE 2014)

- Woody Vegetation Plots
  - Signs of disturbance, disease, insect infestation and leaf drop will be noted
  - Over-story canopy coverage class in percent
  - Dominant species coverage in percent
  - Stem count per species
  - Count of tree (greater than 3 in at DBH, regardless of height) DBH
  - Dominant species relative decadence in percent
  - Open ground or other cover in percent (i.e., boulders, open water, or LWM)
  - USACE national wetland indicatory status of each species (USACE 2014)
  - Photograph of the plot

Attachment F is the form that will be used to record riparian data in the field.

2.2.7.2 Quality Assurance/Quality Control

YCWA will follow the QA/QC procedures described in Section 2.2.1.2.

2.2.7.3 Data Analysis

The data collected for monitoring will allow comparisons of the percent coverage of the riparian vegetation along each cross-section from each year would be compared to the time period since the last monitoring and since Year 1. All of the information collected from the herbaceous and woody vegetation plots will be used to determine changes over time in lateral distribution of riparian species, richness, and abundance, by comparing the species lists from each plot. In addition, YCWA will make available streamflow and stage information from the nearest existing streamflow gage and discuss the general relationship between flow, stage and changes in riparian vegetation at the plots, since the previous monitoring event. The ratio of woody riparian seedlings/young to mature individuals will be calculated as one measure of riparian health over time. Other observations of riparian health, such as premature leaf drop, insect infestation, trampling from animals or people, and disease will also be documented, based on visual observations at the time of monitoring, and reported. Of particular interest will be the presence/absence of woody riparian recruits in areas with substrates capable of supporting them (e.g., a bedrock bank is unlikely to support recruits, whereas a sandy bank is more likely to allow for germination).

During each monitoring period after the monitoring in License Year 1, the hydrology from the nearest streamflow gage, and other environmental factors of which YCWA is aware that may affect the trends in riparian resource condition (upward or downward) since the previous monitoring period will be assessed. General climate changes (i.e., no specific data collection required) will also be evaluated, such as distribution of particularly wet or dry years, as defined in the license in between monitoring periods. Other activities or changes in the magnitude of activities within the watersheds, such as recreation and fire of which YCWA is aware, will also

be assessed. Other trends also will be evaluated, such as the distribution of high and non-spill years in between monitoring periods.

In addition to the data analysis, an observational description will be developed to illustrate the general state of the riparian community. The description will be inclusive of the data collected in the vegetation plots (i.e., richness and abundance), but will also focus on factors considered in riparian assessments, including the lateral and horizontal distribution of plant groups, diversity in age of woody riparian species, presence or absence of invasive or special-status plants, bank protection (e.g., tree roots or sod-forming herbaceous plants), and the general health of the riparian community (e.g., % cover over time, diversity of species and recruitment). Any additional factors contributing to the condition of the riparian community (e.g., impacts from recreational users or sediment from an upslope fire) will be included in the description.

2.2.8 Large Woody Material

To allow for comparison of post-license issuance LWM information with pre-license issuance information, generally the post-license issuance monitoring will use similar methods as the pre-license issuance sampling. LWM monitoring methods are described below and the locations and frequency of LWM monitoring are described in Sections 3.2 and 3.3, respectively.

For the purpose of this Plan, LWM is defined as woody material within the floodprone area, greater than 3 ft in length with a diameter of at least 4 in on the large end. Key LWM are defined as pieces either longer than 0.3 times the bankfull width, or have a root wad, or are >50% buried at one end, or of sufficient size and/or are deposited in a manner that alters floodplain, channel morphology and aquatic habitat (e.g., trapping sediment or altering flow patterns).

2.2.8.1 Field Methods

2.2.8.1.1 Monitoring Sites

The LWM monitoring site will be the same as the monitoring site described for stream channel morphology in Section 2.2.6.6.1.

2.2.8.1.2 LWM Counts and Measurements

LWM monitoring will occur once between spring runoff and November, and will be coordinated with the stream channel morphology monitoring (Section 2.2.8) and riparian monitoring (Section 2.2.7) monitoring.

<u>All LWM Pieces</u>
YCWA will count LWM pieces within each monitoring site described for stream channel morphology in Section 2.2.6.6.1. LWM pieces will be grouped into five length bins (i.e., 3-10 ft, 10-25 ft, 25-50 ft, 50-75 ft, and greater than 75 ft) and four diameter bins (i.e., 4-12 in, 12-24 in, 24-36 in, and greater than 36 in), and the total number of LWM pieces in each combination of bins (e.g., the number of 10-25 ft long LWM with a diameter of 12-24 in) will be reported. In

addition, surveyors will estimate within each bin the number of LWM that has evidence of being cut.

Key LWM Pieces:
YCWA will note locations on the study site map (using mobile device and differential GPS antennae, as above) and assign an identifying number to up to 30 Key LWM pieces within the monitoring site, and recording the following for each:

- Estimated length (ft) (total and in channel)
- Estimated diameter (in) at both ends
- Orientation (angle from bank [deg], looking downstream)
- Bank (L/R bank looking downstream)
- Age Class (0 – rotten; 1 – decayed; 2 – bare; 3 – limbs attached; 4 – bark; or 5 – needles)
- Stability Class (0 = no end, 1 = one end, 2 = no ends)
- Rootwad attached (yes or no)
- Source (e.g., riparian, hillslope, flooded, avalanche, unknown)
- Cut end (yes, no, uncertain)
- Structural association (e.g., large wood jam, boulder, meadow, bar and ditch, none)
- Association with rainbow trout spawning gravels (yes or no)
- Association with woody riparian vegetation establishment (yes or no)

If more than 30 Key pieces are found, any additional Key pieces will be tallied and noted as Key pieces, however the above measurements will not be recorded. For the structural association, log jams are defined as three or more Key pieces in contact with each other. Locations of all log jams and key pieces should be recorded on the site map (described under the Stream Channel Geomorphology section above).

A minimum of four photo points, using the methods described in Section 2.2.6.1.2, will be taken.

Attachment G includes a field data sheet that will be used to record LWM and Key LWM information in the field.

2.2.8.2 Data Analysis

Following a QA/QC review, field data will be entered into and organized in a Microsoft™ Excel spreadsheet, or a similar spreadsheet format, and will have an additional QA/QC review after data entry.

The LWM results will be summarized in the monitoring report. At a minimum, the following summaries/data presentations will be provided, along with the supporting data (in Excel spreadsheet, or a similar spreadsheet format, and GIS layers showing Key LWM pieces, as appropriate):

- Number of LWM pieces by bins at each monitoring site
- GIS map of Key LWM pieces with identification number shown
- Tables and graphs of LWM summarized by the data metrics
- Comparison to License Year 1 and subsequent years monitoring for each of the data elements collected.

A discussion of the findings will be presented from the data analysis. The discussion will focus on observed changes or trends in the amount of LWM and Key LWM, and any associated riparian and rainbow trout spawning substrate, since the last monitoring last occurred, and overall trend since License Year 1. The discussion will mention events that occurred since the last monitoring that may have had a significant effect on LWM (e.g., high flow events, which is defined as > 10 year return interval, wildfires or landslides).

SECTION 3.0

MONITORING LOCATIONS AND FREQUENCIES

3.1 Monitoring Area

The Study Area includes: 1) the Middle Yuba River from and including Our House Diversion Dam Impoundment to the confluence with the North Yuba River; 2) Oregon Creek from and including the Log Cabin Diversion Dam Impoundment to the confluence with the Middle Yuba River; 3) the North Yuba River from and including New Bullards Bar Reservoir to the confluence with the Middle Yuba River; and 4) the Yuba River from the confluence of the North and Middle Yuba rivers to Englebright Reservoir (Figure 1.1-1).

3.2 Monitoring Locations

To allow for comparison of post-license issuance of aquatic monitoring information with pre-license issuance information, the post-license issuance monitoring locations, to some extent, use the same monitoring locations as the pre-license issuance sampling locations. Tables 3.2-1 through 3.2-6 list monitoring sites, including Universal Transverse Mercator (UTM) coordinates, for: 1) stream fish; 2) BMI; 3) FYLF; 4) WPT; 5) sediment in Our House and Log Cabin diversion dam impoundments; and 6) stream channel morphology, riparian vegetation and LWM.

Figure 3.2-1 shows the location of each monitoring site in relation to Project facilities and features.

3.3 Monitoring Frequency

The monitoring frequencies in this Plan use "License Years," with "License Year 1" designating the first full calendar year in which the new license is effective. While YCWA has requested FERC issue a new license with a term of 50 years, for planning purposes this Plan assumes FERC will issue a new license with a term of 30 years. Regardless, monitoring under this Plan is intended to cover the period from License Year 1 until the time FERC issues a new license (i.e., through the term of the new license and any annual licenses issued by FERC until a new license is issued).

Tables 3.2-1 through 3.2-6 list the frequency of monitoring for: 1) stream fish; 2) BMI; 3) FYLF; 4) WPT; 5) sediment in Our House and Log Cabin diversion dam impoundments; and 6) stream channel morphology, riparian vegetation and LWM.

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Table 3.2-1. Location and Frequency of Stream Fish Monitoring

Monitoring Site					Monitoring Methods	Relicensing Results	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.) [1]																														Possible Number of Sampling Events for License with a 30-Year Term
Stream	River Mile	Location Based on Upstream Edge of Site	UTM Coordinates				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
			Upstream	Downstream																																	
Middle Yuba	13.3	Upstream of OH Impoundment	E 673325, N 4364411	E 673223, N 4364439.9	Electrofishing	2012: rainbow trout (495 fish/mi), smallmouth bass (88 fish/mi) 2013: Sacramento sucker (160 fish/mi); Sacramento pikeminnow (16 fish/mi)	1	1	1	1	1	1	1	1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		22
Middle Yuba	12.5	0.1 mi below OH Dam	E 672096, N 4364098	E 672207, N 4364176	Snorkeling	2012: rainbow trout (495 fish/mi), smallmouth bass (88 fish/mi) 2013: smallmouth bass (708 fish/mi), rainbow trout (453 fish/mi), Sacramento sucker (11 fish/mi), Sacramento pikeminnow (11 fish/mi)			1	1				1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		17
Middle Yuba	5.0	0.5 mi above Oregon Cr	E 665535, N 4362225	E 665448, N 4362196	Electrofishing	2012: smallmouth bass (1,915 fish/mi), rainbow trout (155 fish/mi), Sacramento sucker (141 fish/mi) 2013: smallmouth bass (1,282 fish/mi), rainbow trout (90 fish/mi), Sacramento sucker (45 fish/mi)	1	1	1	1	1	1	1	1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		22
Middle Yuba	3.3	0.1 mi below Moonshine Creek	E 663859, N 4361336	E 663743, N 4361200	Snorkeling	2012: rainbow trout (613 fish/mi), smallmouth bass (126 fish/mi); Sacramento sucker (91 fish/mi) 2013: rainbow trout (350 fish/mi), smallmouth bass (212 fish/mi), Sacramento sucker (65 fish/mi)			1	1				1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		17
Oregon Creek	0.3	0.3 mi above MYR	E 665262, N 4362725	E 665213, N 4362705	Electrofishing	2012: rainbow trout (2,266 fish/mi), Sacramento sucker (169 fish/mi), smallmouth bass (24 fish/mi) 2013: rainbow trout (1,430 fish/mi), Sacramento sucker (286 fish/mi), smallmouth bass (44 fish/mi)			1	1				1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		17
North Yuba	--	One Location ~5 mi Upstream of the NMWSE of New Bullards Bar Reservoir to be Selected by the Ecological Group	--	--	Electrofishing	Not sampled during relicensing.	1	1	1	1	1	1	1	1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		22
North Yuba	0.2	0.2 mi above MYR	E 660200, N 4359507	E 660291, N 4359441	Snorkeling	2012: Sacramento sucker (3,203 fish/mi), rainbow trout (567 fish/mi), Sacramento pikeminnow (14 fish/mi) 2013: rainbow trout (534 fish/mi), Sacramento sucker (181 fish/mi)	1	1	1	1	1	1	1	1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		22
Yuba	35.0	0.8 mi above New Colgate PH	E 656540, N 435541	E 656555, N 4355651	Snorkeling	2012: smallmouth bass (1,409 fish/mi), rainbow trout (108 fish/mi) 2013: smallmouth bass (1,257 fish/mi), rainbow trout (16 fish/mi)			1	1				1	1		1 [2]		1	1		1 [2]		1	1	1 [2]		1 [2]	1	1			1 [2]	1	1		17
Total	**7 Sites**				--	--	**3**	**3**	7	7	**3**	**3**	**3**	7	7	**0**	7	**0**	7	7	**0**	7	**0**	7	7	7	**0**	7	7	7	**0**	**0**	7	7	7	**0**	**134**

[1] If FERC issues to YCWA a new license with a term of more than 30 years, monitoring will continue at a pattern shown for Years 13 through 30 (i.e., 2 years of monitoring followed by 3 years of no monitoring, and the conditional monitoring (footnote 2 in this table)) beginning in License Year 31.

[2] The specific License Years shown in this table are placeholders to represent back-to-back dry year conditional monitoring. Specifically, monitoring will occuin the second year of two consecutive Dry/Critically Dry WYs (i.e., two back-to-back Dry WYs, two back-to-back Critically Dry WYs, or one Dry WY and one Critically Dry WY combination), as determined by the May Water Year type, unless monitoring will otherwise occur in that year (i.e., regularly scheduled monitoring, such as in License Year 4). The number of placeholders in this table is based on the fact that back-to-back Dry/Critically Dry Water Years occurredbur times from 1981 through 2010. The number and specific License Years to be conditionally monitored depends on when and how often back-to-back Dry/Critically Dry Water Years occur in the new license term.

Table 3.2-2. Locations and frequency of benthic macroinvertebrate monitoring. The number in the cell is the number of sampling events in that License Year.

Monitoring Site					Monitoring Methods	Relicensing Results	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License for This Exercise. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.) [1]																															Possible Number of Sampling Events for License with a 30-Year Term
Stream	River Mile	Location Based on Upstream	UTM Coordinates Upstream	UTM Coordinates Downstream			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Middle Yuba	5.0	5.1 mi above NYR	E 665664, N 4362241	E 665429, N 4362184	SWAMP	2012: SWAMP Scores for 3 Habitat Characteristics - Suboptimal; IBI - 64, MMI - 62	1	1	1					1					1					1					1					1			8
Middle Yuba	0.1	0.1 mi above NYR	E 660719, N 4359466	E 660574, N 4359341	SWAMP	2012: SWAMP Scores for 3 Habitat Characteristics - Suboptimal for 2 and Optimal for 1; IBI - 59, MMI - 52	1	1	1					1					1					1					1					1			8
Oregon Creek	0.2	0.2 mi above MYR	E 665345, N 4362773	E 665218, N 4362699	SWAMP	2012: SWAMP Scores for 4 Habitat Characteristics - Suboptimal for 2 and Optimal for 2; IBI - 61; MMI - 56	1	1	1					1					1					1					1					1			8
North Yuba	0.3	0.3 mi above MYR	E 660048, N 4359501	E 660285, N 4359441	SWAMP	2012: SWAMP Scores for 4 Habitat Characteristics - Suboptimal for All 4; IBI - 21; MMI - 16	1	1	1					1					1					1					1					1			8
Yuba	35.0	0.8 mi above New Colgate PH	E 656541, N 4355628	E 656559, N 4355374	SWAMP	2012: SWAMP Score for 3 Habitat Characteristics - Optimal for All 3; IBI - 30, MMI - 26	1	1	1					1					1					1					1					1			8
Total	**5 Sites**				--	--	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**	**0**		**24**

[1] If FERC issues a new license with a term longer than 30 years, the pattern shown above beginning with License Year 13 will be repeated beginning in License Year 31 (i.e.,1 year of monitoring followed by 4 years of no monitoring).

Table 3.2-3. Location and frequency of foothill yellow-legged frog monitoring.

Monitoring Site					Monitoring Methods	Relicensing Results	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License for This Exercise. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.)[1]																														Possible Number of Sampling Events for License with a 30-Year Term
Stream	River Mile	Location Based on Upstream Edge of Site	UTM Coordinates				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
			Upstream	Downstream																																							
Middle Yuba	12.2 - 12.5	0.4 mi below OH Dam	E 672312, N4364261	E 672101, N 4364083	Visual Encounter Survey	2012 (4 surveys): 0 egg masses, 0-24 tadpoles/survey, 1-3 juveniles/survey, 1-3 adults/survey [Relicensing Site MYR-4]	4		4[2]	4[2]				4	4				4	4				4	4				4	4				4	4				52
Middle Yuba[3]	4.4 - 5.8	1.3 mi above Oregon Cr	E666434, N4362032	E 664871, N4361912	Visual Encounter Survey	2012 at upper site (4 surveys): 0 egg masses, 15-50 tadpoles/survey, 1-11 juveniles/survey, 5-6 adults/survey 2012 at lower site (4 surveys): 1 egg mass, 0 tadpoles, 0-1 juveniles/survey, 0 adults/survey [Combination of Relicensing Sites MYR-3A and 3B]	4	4	4	4	4	4	4	4	4				4	4				4	4				4	4				4	4				68
Oregon Creek	3.2 - 3.3	3.3 mi above MYR [upstream of Celestial Valley]	E 666493, N 4366134	E 666396, N 4366009	Visual Encounter Survey	Not surveyed during relicensing.	4	4	4	4	4	4	4	4	4				4	4				4	4				4	4				4	4				68
Oregon Creek	0.0 - 0.6	0.6 mi above MYR [at OC/MYR]	E 667271, N 4367704	E 667286, N 4367454	Visual Encounter Survey	2012 (3 surveys): 0 egg masses, 0 tadpoles, 0-2 adults/survey [Relicensing Site OC-1]	4		4[2]	4[2]				4	4				4	4				4	4				4	4				4	4				52
Middle Yuba / North Yuba/ Yuba[3]	0.0 - 0.3 on MYR, 0.0 - 0.55 on NYR, and 40.0 - 40.1 on YR	0.3 mi above NYR and 0.55 mi above MYR	E 660720, N 4359637 (MYR) E 659828, N 4359705 (NYR)	E 660521, N 4359293	Visual Encounter Survey	2012 at MYR-1 (3 surveys): no FYLF of any lifestage observed 2012 on NY-1 (3 surveys): no FYLF of any lifestage observed [Combination of Relicensing Sites MYR-1, NYR-1 and YR-2]	3		3[2]	3[2]					3					3					3					3					3				24
Yuba	34.3 - 34.9	0.7 mi above New Colgate PH	E 656535, N4355580	E 656534, N4355578	Visual Encounter Survey	2012 (3 surveys): no FYLF of any lifestage observed [Relicensing Site YR-1]	3		3[2]	3[2]					3					3					3					3					3				24
Total	**6 Sites**				--	--	**22**	**8**	**22**	**22**	**8**	**8**	**8**	**16**	**22**	**0**	**0**	**0**	**16**	**22**	**0**	**0**	**0**	**16**	**22**	**0**	**0**	**0**	**16**	**22**	**0**	**0**	**0**	**16**	**22**	**0**	**288**

[1] If FERC issues a new license with a term longer than 30 years, monitoring will continue at a pattern shown for Years 13 through 30 (i.e., 2 years of monitoring followed by 3 years of no monitoring) and the conditional monitoring (footnote 2 in this table) beginning in License Year 31.

[2] The specific License Years shown in this table are placeholders to represent conditional monitoring in License Years 2 through 5. Specifically, monitoring will occur at the sites indicated once during the first Wet or Above Normal Water Year type and once during the first Dry or Critically Dry Water Year Type so that monitoring occurs up to twice in License Years 2 through 4 as determined by the April Water Year type. If either or both of these do not occur in through 4 , then monitor will occur in License Year 5 regardless of Water Year type. The number of placeholders in this table assumes these will both occur. The number and specific License Years to be conditionally monitored in Years 2 through 4 depends on when the Dry/Critically Dry and Above Normal/Wet years occur.

[3] YCWA will survey as much of this site as possible in one 8-hour work day, including travel time.

Table 3.2-4. Location and frequency of the western pond turtle monitoring.

Monitoring Site				Monitoring Methods	Relicensing Results	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License for This Exercise. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.) [1]																															Number of Sampling Events for License with a 30-Year Term
Stream	Reservoir/Impoundment or River Mile	Location Based on Upstream Edge of Site	UTM Coordinates			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
North Yuba	New Bullards Bar Reservoir	Tractor Cove; NBBR-18/19	E 662797, N 4368487	E 662804.5, N 4368242	2012 (2 surveys/site) : 0-3 adults observed/site/survey [Relicensing Sites NBBR-18/19 Willow Creek Outlet, NBBR-25 Tractor Cove, and NBBR-64 Moran Cove]			2					2					2					2					2				2			12
North Yuba	New Bullards Bar Reservoir	Willow Creek; NBBR-25	E 665434, N 4368943	E 665180, N 4368951				2					2					2					2					2				2			12
North Yuba	New Bullards Bar Reservoir	Moran Cove; NBBR-64	E 658449.4, N 4365833	E 658672.6, N 4365906				2					2					2					2					2				2			12
Oregon Creek	Log Cabin Diversion Dam Impoundment	LCDD-1 to LCDD 4	E 667055, N 4367424	E 667226, N 4367366	2012 (3 surveys/site): 0-1 adult observed/site/survey [Relicensing Sites LCDD-1 through -4]			2					2					2					2					2					2			12
Middle Yuba	Our House Diversion Dam Impoundment	OHDD-1 to OHDD-4	E 672448, N 4364401	E 673728, N 4364668	2012 (3 surveys/site): no WPT of any lifestage observed [Relicesning Sites OHDD-1 through -4]			2					2					2					2					2				2			12
Middle Yuba	3.5	OC-2 (downstream side of mouth of Moonshine Creek)	E 663896, N 4361482	E 663945, N 4361521	2012 (2 surveys/site): 0-2 adults observed/site/survey [Relicensing Site MYROC-1 by VES]			2					2					2					2					2				2			12
Total	**6 Sites**			--	--	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**72**

[1] If FERC issues a new license with a term longer than 30 years, monitoring will continue at a pattern shown from License Years 8 through 30 (i.e., once every 5 years) beginning in Licene Year 31.

Table 3.2-5. Location and frequency of channel morphology monitoring in Project impoundments and in a pool in the Middle Yuba River below Our House Diversion Dam.

Monitoring Site					Monitoring Methods	Relicensing Results	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License for This Exercise. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time (Year 25) to Enter Relicensing Process for New License.) [1]																														Possible Number of Sampling Events for License with a 30-Year Term
Stream	Location or River Mile	Location Based on Upstream Edge of Site	UTM Coordinates				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
			Headpin	Tailpin																																	
Middle Yuba	Our House Diversion Dam Impoundment	--	E 672385, N 4364387 E 672405, N 4364420 E 672467, N 4364468 E 672600, N 4364564	E 672542, N 4364345 E 672465, N 4364365 E 672522, N 4364425 E 672616, N 4364511	4 Transects (or Bathymetry, if Agreed to by Agencies)	Not surveyed during relicensing		1 [2]				1 [2]				1 [2]				1 [2]						1 [2]										5
Oregon Creek	Log Cabin Diversion Dam Impoundment	--	E 667040, N 4367461 E 667099, N 4367442 E 667144, N 4367395	E 667073, N 4367407 E 667073, N 4367407 E 667126, N 4367363	3 Transects (or Bathymetry, if Agreed to by Agencies)	Not surveyed during relicensing			1 [3]				1 [3]		1 [3]							1 [3]									1 [3]						5
Middle Yuba	Pool Downstream of Streamflow Gage Weir below Our House Dam		Bottom of pool: E 672230, N 4364203	Top of pool: E 672319, N 4364203	Bathymetry	Not surveyed during relicensing		1 [2]				1 [2]				1 [2]				1 [2]						1 [2]										5
Total	**3 Sites**				--	--	**0**	**2**	**1**	**0**	**0**	**2**	**1**	**0**	**1**	**2**	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**13**

[1] If FERC issues a new license with a term longer than 30 years, monitoring will continue at a pattern shown for Years 1 through 30 (See footnotes 2 and 3 in this table) beginning in License Year 31.

[2] The specific License Years shown in this table are placeholders to represent conditional monitoring in the Our House Diversion Dam impoundment and in the pool downstream of Our House Diversion Dam. Specifically, monitoring would occur in the License Years when the first, third, fifth, seventh and ninth Our House Diversion Dam sediment pass through events occur (i.e., YCWA opens the Our House Diversion Dam low level outlet in compliance with the *Log Cabin and Our House Diversion Dams Sediment Management Plan* in the license). The years are placeholders in this table, and are meant to be representative; the number and specific License Years to be conditionally monitored depends on when the trigger is met.

[3] The specific License Years shown in this table are placeholders to represent conditional monitoring in the Log Cabin Diversion Dam impoundment. Specifically, monitoring would occur in the License Years when the first, third, fifth, seventh and ninth Log Cabin Diversion Dam sediment pass through events occur (i.e., YCWA opens the Log Cabin Diversion Dam low level outlet in compliance with the *Log Cabin and Our House Diversion Dams Sediment Management Plan* in the license). The years are placeholders in this table, and are meant to be representative; the number and specific License Years to be conditionally monitored depends on when the trigger is met.

Table 3.2-6. Location and frequency of channel morphology, riparian and large woody material monitoring in streams.

Monitoring Site								Monitoring Methods (See Text for Specific methods)	Relicensing Studies		Site Wide Assessment	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.) [1]																																Possible Number of Sampling Events for License with a 30-Year Term
Stream	Site Name	River Mile	Location Based on Upstream Edge of Site	UTM Coordinates Site		Cross Section			Method	Year(s)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
				Upstream	Downstream	Previous Study Cross Section Number	UTM																																					
Middle Yuba [2]	Middle Yuba upstream of Oregon Creek	5.05	0.5 mi above Oregon Cr	E 665105, N 4362264	E 665473, N 4362208	Instream Flow 7	E 665331, N 4362183	Channel Morph	Instream Flow 1D Survey	2012	Sitewide Channel Morphology Parameters & Large Woody Material	1		1 [2]			1 [2]						1 [2]					1 [2]				1 [2]			1 [2]							7
						Channel Morph 12	E 665473, N4362208	Channel Morph & Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
						–	E 666630, N 4366338	Channel Morph	–	–																																			
						Channel Morph 2	E 665135, N 4362241	Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
						Channel Morph 9	E 665399, N 4362166	Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
Middle Yuba [2]	Middle Yuba downstream of Oregon Creek	3.46-3.63	3.6 mi above North Yuba	E 664063, N 4361451	E 663888, N4361323	–	E 663877, N 4361425	Channel Morph	--	–	Sitewide Channel Morphology Parameters & Large Woody Material	1		1 [2]			1 [2]						1 [2]					1 [2]				1 [2]			1 [2]							7
						Channel Morph 9	E 663878, N 4361460	Channel Morph & Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
						–	E 663889, 4361476	Channel Morph	–	–																																			
						Instream Flow 11	E 663934, N 4361494	Channel Morph	Instream Flow 1D Survey	2012																																			
						Channel Morph 13	E 664014, N 4361443	Channel Morph & Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
						Channel Morph 12	E 663988, N 4361471	Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012																																			
Oregon Creek [3]	Oregon Creek Upper Log Cabin	3.3-3.5	3.5 mi above MYR [upstream of Celestial Valley]	E 666650, N 4366341 (30' u/s of XS8)	E 666585, N 43661917 (30' d/s of XS3)	Instream Flow 3	E 666581, N4366211	Channel Morph & Riparian	Instream Flow 1D & FYLF 2D Survey	2012	Sitewide Channel Morphology Parameters & Large Woody Material	1	1 [3]			1 [3]								1 [3]		1 [3]					1 [3]					1 [3]						7
						Instream Flow 4	E 666608, N 4366228	Channel Morph & Riparian																																			
						Instream Flow 8	E 666645, N4366327	Channel Morph & Riparian																																			
North Yuba River	North Yuba	0.25-0.42	0.42 mi above MYR	E 659925, N 4359566	E 660224, N 4359489	Channel Morph 7	E 660113, N 4359510	Channel Morph & Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012	Sitewide Channel Morphology Parameters & Large Woody Material	1				1					1					1				1					1				1		7
						Channel Morph 8	E 660076, N 4359523	Channel Morph & Riparian																																			
						Channel Morph 10	E 660047, N 4359505	Channel Morph & Riparian																																			

Table 3.2-6 (continued)

Monitoring Site								Monitoring Methods (See Text for Specific methods)	Relicensing Studies		Site Wide Assessment	License Year (Year 1 is First Full Calendar Year After License Issuance and Year 30 Is Assumed Term of New License. Assumes YCWA Files with FERC NOI/PAD at Earliest Possible Time [in Year 25, 5.5 years prior to license expiration] to Enter Relicensing Process for New License.) [1]																															Possible Number of Sampling Events for License with a 30-Year Term
Stream	Site Name	River Mile	Location Based on Upstream Edge of Site	UTM Coordinates Site		Cross Section			Method	Year(s)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
				Upstream	Downstream	Previous Study Cross Section Number	UTM																																					
Yuba	Yuba upstream of Colgate PH	34.9-34.95	0.8 mi above New Colgate Powerhouse	E 656784, N 4355898	E 656529, N 4355605	Channel Morph 8	E 656653, N 4355661	Channel Morph & Riparian	Channel Morphology, Riparian Habitat & Instream Flow 1D Survey	2012	Sitewide Channel Morphology Parameters & Large Woody Material	1				1					1					1					1				1					1		7
						Channel Morph 11	E 656697, N 4355826	Channel Morph & Riparian																																				
						Channel Morph 15	E 656770, N 4355896	Channel Morph & Riparian																																				
Total		5 Sites				–	–	–	3 out of 4			5	1	2	0	3	2	0	0	0	2	0	2	1	0	3	0	2	0	0	2	2	1	0	0	4	0	1	0	0	2	35

[1] If FERC issues a new license with a term longer than 30 years, monitoring will continue at a pattern shown for Years 10 through 30 (i.e., for the Middle Yuba River and Oregon Creek, first 2 times a trigger occurs in 10 year period, and in the tenth year if the trigger is not met 2 times in the 10 period; and for the North Yuba River and Yuba River, every fifth year) beginning in License Year 31.

[2] Besides monitoring in the first calendar year after license issuance, the specific License Years shown in this table are placeholders to represent triggers for monitoring up to 2 times in the Middle Yuba River over a 10-year period (i.e., License Years 1 through 10, 11 through 20, and 21 through 30). The triggers are and one of the following: 1) a sediment pass through event at Our House Diversion Dam (i.e., YCWA opens the Our House Diversion Dam low level outlet in compliance with the *Log Cabin and Our House Diversion Dams Sediment Management Plan* in the license); 2) YCWA closes the Lohman Ridge Diversion Tunnel from April through September in compliance with the *Lohman Ridge Tunnel Closure Condition* in the license; and 3) a flow of 5,720 cfs is recorded at the gage downstream of Our House Diversion Dam.

[3] Besides monitoring in the first calendar year after license issuance, the specific License Years shown in this table are placeholders to represent triggers for monitoring up to 2 times in Oregon Creek. The triggers are and one of the following: 1) a sediment pass through event at Log Cabin Diversion Dam (i.e., YCWA opens the Log Cabin Diversion Dam low level outlet in compliance with the *Log Cabin and Our House Diversion Dams Sediment Management Plan* in the license; 2) YCWA closes the Lohman Ridge Diversion Tunnel from April through September in compliance with the Lohman Ridge Tunnel Closure Condition in the license; and 3) a flow of 1,780 cfs is recorded at the gage downstream of Log Cabin Diversion Dam.

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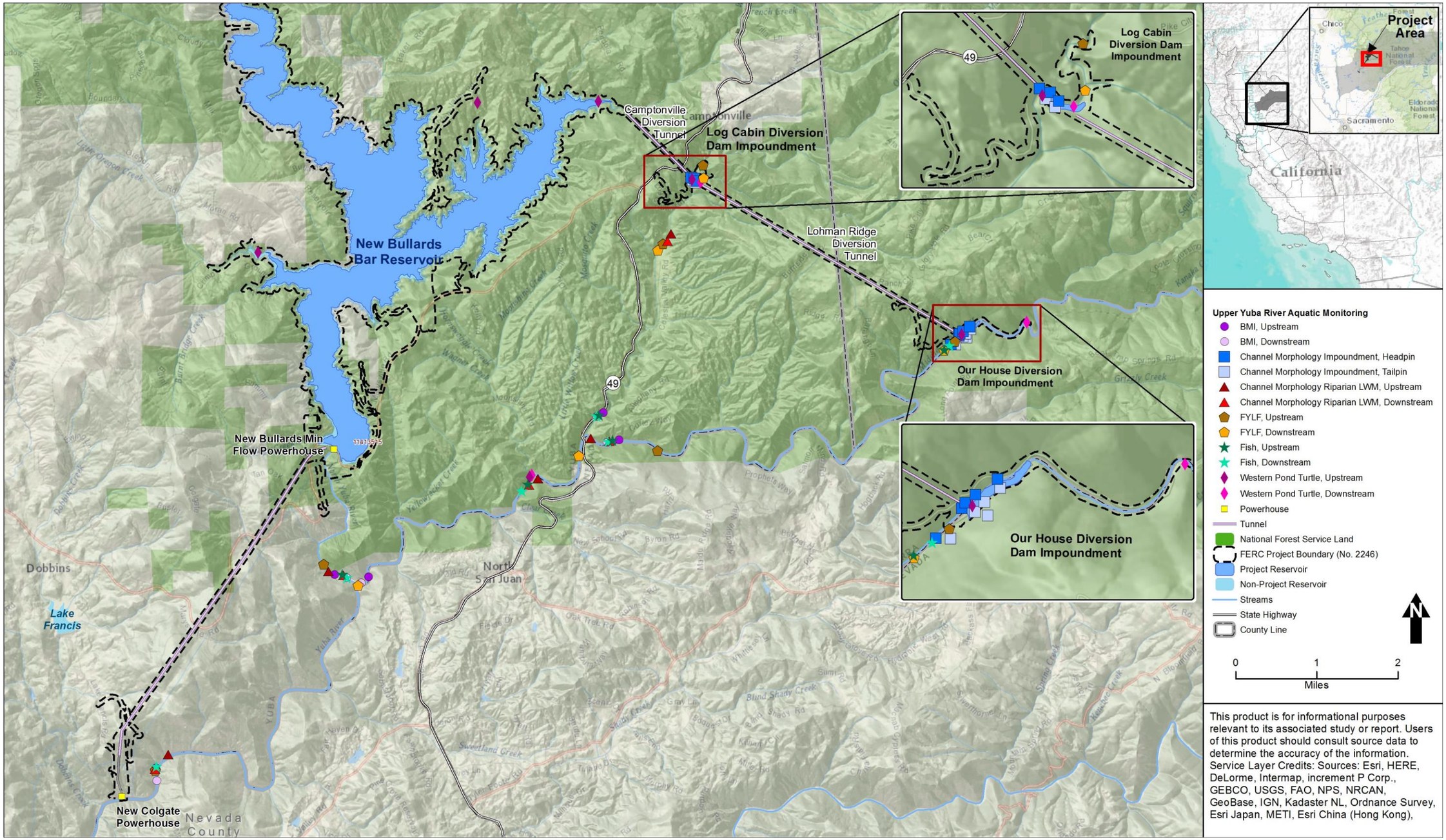

Figure 3.2-1 Monitoring Sites in Relation to Project Facilities and Features.

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SECTION 4.0

REPORTING, CONSULTATION AND PLAN REVISIONS

4.1 Reporting

By March 15 of each year, YCWA will file with FERC, and provide to the Forest Service, USFWS, Cal Fish and Wildlife and SWRCB an Upper Yuba River Aquatic Monitoring Report (Report). The report will include the information described in this Plan for each resource that was monitored in the previous calendar year, and will document non-compliance with this Plan during the performance of the monitoring surveys, if any.

By January 15 of each year, YCWA will provide a draft of the Report to the Forest Service, USFWS, Cal Fish and Wildlife and SWRCB for a 30 day-review period. If YCWA does not adopt a particular written recommendation by the Forest Service, USFWS, Cal Fish and Wildlife or SWRCB, the Report YCWA files with FERC on March 15 will include the reasons for not doing so.

4.2 Consultation

Each year during the term of the license, YCWA will meet with the Forest Service, USFWS, Cal Fish and Wildlife and SWRCB to answer any questions regarding Upper Yuba River Aquatic Monitoring Plan results from the previous calendar year and planned monitoring in that calendar year. The meeting will occur as described in YCWA's Proposed Condition GEN1, Meet with Agencies and Tribes Annually.

4.3 Plan Revisions

YCWA, in consultation with the Forest Service, USFWS, Cal Fish and Wildlife and SWRCB will review, update, and/or revise the Plan, as needed, when significant changes in the existing conditions occur (e.g., site conditions change such that electrofishing should occur instead of snorkeling or the TRC method would be used instead of the RWB method for BMI monitoring). Sixty days will be allowed for Forest Service, USFWS, Cal Fish and Wildlife and SWRCB to provide written comments and recommendations before YCWA files the updated Plan with FERC for FERC's approval. YCWA will include all relevant documentation of coordination/consultation with the updated Plan filed with FERC. If YCWA does not adopt a particular recommendation by Forest Service, USFWS, Cal Fish and Wildlife, or SWRCB, the filing will include the reasons for not doing so. YCWA will implement the Plan as approved by FERC.[7]

[7] The Plan will not be considered revised until FERC issues its approval.

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SECTION 5.0

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Upper Yuba River Aquatic Monitoring Plan

Attachment A

Electrofishing and Fish Snorkeling Field Data Sheets

Yuba River Development Project

FERC Project No. 2246

June 2017

Yuba County Water Agency **STREAM FISH POPULATIONS** Page:_____ of _____

Electrofishing Data

Date_____ Time Start:_____ Time End:_____ Weather:_____

Site:_____ Prepared by:_____

_____ Crew: _____

UTM: **Environmental:**

Upstream: Easting:_____ Northing:_____ Air Temp:_____

Downstream: Easting:_____ Northing:_____ H_2O Temp:_____

Conductivity:_____

Site Length:_____ Ave. Width:_____ Ave. Depth:_____ D.O.:_____

Electrofisher Information:

	Unit 1	Unit 2	Unit 3
Type			
Voltage			
Frequency			
Pulse Width			

Effort:

	Pass 1	Pass 2	Pass 3	Pass 4
Unit 1				
Unit 2				
Unit 3				

Species Information

Pass	Species	Length	Weight	Condition	Notes	Pass	Species	Length	Weight	Condition	Notes

Species Notes

Photos and comments on back.

Yuba County Water Agency

STREAM FISH POPULATIONS
Electrofishing Data

Page______ of _______

Species Information

Pass	Species	Length	Weight	Condition	Notes		Pass	Species	Length	Weight	Condition	Notes

Species Notes

Photos and Comments:

Depletion: $(1-[(N_2*E_1)/(N_1*E_2)]*100=$ ______________ $(1-[(N_3*E_2)/(N_2*E_3)]*100=$ ______________

Species Codes: Black Bullhead=BKB; Black Crappie=BLC; Bluegill=BLG; Brook Trout=BKT; Brown Bullhead=BRB; Brown Trout=BRT; California Roach=CAR; Channel catfish=CCF; Common Carp=CAP; Goldfish=GOS; Green sunfish=GSF; Hardhead=HDH; Lahontan cutthroat trout=LCT; Lahontan redside=LRS; Largemouth bass=LMB; Mosquitofish=MOF; Rainbow trout=RBT; Sacramento pikeminnow=SPW; Sacramento sucker=SSK; Speckled dace=SPD; Smallmouth bass=SMB; Inknown=UNK; Unknown centrarchid=UCD; Unkown minnow=UMW; Unknown salmonid=USD; White crappie=WHC; Riffle sculpin=RFS; Prickly sculpin=PSC; Unknown sculpin=SCL

IF FOUND: Please contact Joel Passovoy @ 916-679-8753.

HDR Engineering
2379 Gateway Oaks Dr.
Sacramento, CA 95833

Yuba County Water Agency **STREAM FISH POPULATIONS** Page:_____ of _____

Snorkel Data

Date_____ Time Start:_____ Time End:_____ Weather:_____

Site:_____ Prepared by:_____

_____ Crew:_____

UTM: **Environmental:**

Upstream: Easting:_____ Northing:_____ Air Temp:_____

Downstrea Easting:_____ Northing:_____ H2O Temp:_____

Conductivity:_____

Site Length:_____ Ave. Width:_____ Ave. Depth:_____ D.O.:_____

Observer 1:_____ **Observer 2:**_____ **Observer 3:**_____ **Observer 4:**_____ **Observer 5:**_____

Visibility: _____

Species Information

Pass	Observ.	Species	Length Class (inches) 0-2	2-4	4-6	6-8	8-10	10-12	12-14	14+

Species Codes: Black Bullhead=BKB; Black Crappie=BLC; Bluegill=BLG; Brook Trout=BKT; Brown Bullhead=BRB; Brown Trout=BRT; California Roach=CAR; Channel catfish=CCF; Common Carp=CAP; Goldfish=GOS; Green sunfish=GSF; Hardhead=HDH; Lahontan cutthroat trout=LCT; Lahontan redside=LRS; Largemouth bass=LMB; Mosquitofish=MOF; Rainbow trout=RBT; Sacramento pikeminnow=SPW; Sacramento sucker=SSK; Speckled dace=SPD; Smallmouth bass=SMB; Inknown=UNK; Unknown centrarchid=UCD; Unkown minnow=UMW; Unknown salmonid=USD; White crappie=WHC; Riffle sculpin=RFS; Prickly sculpin=PSC; Unknown sculpin=SCL

Photos and comments on back.

Yuba County Water Agency **STREAM FISH POPULATIONS** Page:_____ of _____

Snorkel Data

Species Information

Pass	Observ.	Species	Length Class (inches) 0-2	2-4	4-6	6-8	8-10	10-12	12-14	14+

Supplemental Backpack Electrofishing

Model:_____ Voltage:_____ Frequency:_____ Pulse Width:_____

Species Information

Species	Length	Weight	Condition	Notes		Species	Length	Weight	Condition	Notes

Species Notes:

IF FOUND: Please contact Joel Passovoy @ 916-679-8753.

HDR Engineering
2379 Gateway Oaks Dr.
Sacramento, CA 95833

Upper Yuba River Aquatic Monitoring Plan

Attachment B

Benthic Macroinvertebrates (SWAMP) Field Data Sheet

Yuba River Development Project

FERC Project No. 2246

June 2017

REACH DOCUMENTATION

Standard Reach Length (wetted width ≤ 10 m) = 150 m Distance between transects = 15 m
Alternate Reach Length (wetted width >10 m) = 250 m Distance between transects = 25 m

Project Name:	Date: / / 2016	Sample Collection Time:
Stream Name:	Site Name/ Description:	
Site Code:	Crew Members:	
Latitude (actual – decimal degrees): ºN	datum: NAD83	
Longitude (actual – decimal degrees): ºW	*other:*	GPS Device:

AMBIENT WATER QUALITY MEASUREMENTS

** Turbidity, silica, oxygen saturation, and air temp are optional; calibration date required on page 24*

Water Temp (Deg C)	pH	Alkalinity (mg/L)	Turbidity (ntu)*	Oxygen Sat. (%)*
Dissolved O^2 (mg/L)	**Specific. Conduct (uS/cm)**	**Salinity (ppt)**	**Silica (mg/L)***	**Air Temp (Deg C)***

Actual Reach Length (m) *(see reach length guidelines at top of form)*

Explanation:

DISCHARGE MEASUREMENTS

1st measurement = left bank (looking downstream)

check if discharge measurements not possible (explain in field notes section) ☐

VELOCITY AREA METHOD (preferred)

cal. date

Transect Width (m):

	Distance from Left Bank (cm)	Depth (cm)	Velocity (ft/sec)		Distance from Left Bank (cm)	Depth (cm)	Velocity (ft/sec)
1				11			
2				12			
3				13			
4				14			
5				15			
6				16			
7				17			
8				18			
9				19			
10				20			

BUOYANT OBJECT METHOD (use ONLY if velocity area method not possible)

	Float 1	Float 2	Float 3
Distance (m)			
Float Time (sec)			

Float Reach Cross Section

width (m) depth(cm)	Upper Section	Middle Section	Lower Section
Width			
Depth 1			
Depth 2			
Depth 3			
Depth 4			
Depth 5			

Notable Field Conditions (check one box per topic)

Evidence of recent rainfall (enough to increase surface runoff)	NO	☐	minimal	☐	>10% flow increase	☐
Evidence of fires in reach or immediately upstream (<500 m)	NO	☐	< 1 year	☐	< 5 years	☐
Dominant landuse/landcover in area surrounding reach	Agriculture	☐	Forest	☐	Rangeland	☐
	Urban/ Industrial	☐	Suburb/Town	☐	Other	☐
Site is affected by recent scouring event	NO	☐	YES	☐		☐
Channel Engineered	NO	☐	YES	☐		☐

ADDITIONAL COBBLE EMBEDDEDNESS MEASURES

(carry over from transect forms if needed to attain target count of 25; measure in %)

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	

Site Code:	Date: __ __ / __ __ / 2016	

SLOPE and BEARING FORM (transect based - for Full PHAB only)

AUTOLEVEL	
CLINOMETER	
HANDLEVEL	
OTHER	

Starting Transect	MAIN SEGMENT (record percent of inter-transect distance in each segment if supplemental segments are used)						SUPPLEMENTAL SEGMENT (record percent of inter-transect distance in each segment if supplemental segments are used)					
	Stadia rod measurements		Slope (%) or Elevation Difference cm ☐ % ☐	Segment Length (m)	Bearing (0°-359°)	Percent of Total Length (%)	Stadia rod measurements		Slope or Elevation Difference cm ☐ % ☐	Segment Length (m)	Bearing (0°-359°)	Percent of Total Length (%)
K												
J												
I												
H												
G												
F												
E												
D												
C												
B												
A												
additional calculation area												

ADDITIONAL HABITAT CHARACTERIZATION

High Gradient ☐ Low Gradient ☐

Parameter	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/ Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover (50% for low-gradient streams); mix of submerged logs, undercut banks, cobble or other stable habitat	40-70% mix of stable habitat (30-50% for low-gradient streams); well-suited for full colonization potential	20-40% mix of stable habitat (10-30% in low-gradient streams); substrate frequently disturbed or removed	Less than 20% stable habitat (10% in low-gradient streams); lack of habitat is obvious; substrate unstable or lacking
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition (<20% in low-gradient streams)	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected (20-50% in low-gradient streams)	Moderate deposition of new gravel, sand, or fine sediment on bars; 30-50% of the bottom affected (50 - 80% in low-gradient streams)	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently (>80% in low-gradient streams)
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present, (e.g., bridge abutments); evidence of past channelization (> 20yrs) may be present but recent channelization not present	Channelization may be extensive: embankments or shoring structures present on both banks; 40 to 80% of stream reach disrupted	Banks shored with gabian or cement; Over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m):	Bankfull Height (m):

Transect A

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

TAKE PHOTOGRAPHS
(check box if taken & record photo code)

Downstream (**optional**) ☐

Upstream (**required**) ☐

Inter-Transect: AB

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:		Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m):	Bankfull Height (m):	**Transect B**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

Riparian Vegetation
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

Instream Habitat Complexity
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

Densiometer Readings (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

Human Influence
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

Bank Stability
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: BC

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:		Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m):	Bankfull Height (m):	**Transect C**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

Riparian Vegetation
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

Instream Habitat Complexity
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

Densiometer Readings (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

Human Influence
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

Bank Stability
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: CD

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect D**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: DE

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m):	Bankfull Height (m):

Transect E

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: EF

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect F**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

TAKE PHOTOGRAPHS
(check box if taken & record photo code)

Downstream (**required**) ☐

Upstream (**required**) ☐

Inter-Transect: FG

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect G**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

Riparian Vegetation
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

Instream Habitat Complexity
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

Densiometer Readings (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

Human Influence
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

Bank Stability
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: GH

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect H**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: HI

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect I**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: IJ

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m): / Bankfull Height (m):	**Transect J**

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

Inter-Transect: JK

Wetted Width (m):

Inter-Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes

0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
UD = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

FLOW HABITATS
(% between transects, total=100%)

Channel Type	%
Cascade/ Falls	
Rapid	
Riffle	
Run	
Glide	
Pool	
Dry	

Site Code:	Site Name:	Date: __ __ / __ __ / 2016
Wetted Width (m):	Bankfull Width (m):	Bankfull Height (m):

Transect K

Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/ size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes
Left Bank					P A D		P A D	P A D	P A D
Left Center					P A D		P A D	P A D	P A D
Center					P A D		P A D	P A D	P A D
Right Center					P A D		P A D	P A D	P A D
Right Bank					P A D		P A D	P A D	P A D
	Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred)								

Microalgae Thickness Codes
0 = No microalgae present, Feels rough, not slimy;
1 = Present but not visible, Feels slimy;
2 = Present and visible but <1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail.
3 = 1-5mm;
4 = 5-20mm;
5 = >20mm;
U = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code).
D = Dry, not assessed

RIPARIAN VEGETATION
(facing downstream, 5 m u/s, 5 m d/s, 10 m from wetted width)

0 = Absent (0%) 3 = Heavy (40-75%)
1 = Sparse (<10%) 4 = Very Heavy (>75%)
2 = Moderate (10-40%)

Vegetation Class	Left Bank	Right Bank
Upper Canopy (>5 m high)		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
Lower Canopy (0.5 m-5 m high)		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
Ground Cover (<0.5 m high)		
Woody shrubs & saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

INSTREAM HABITAT COMPLEXITY
(5 m u/s, 5 m d/s)

0 = Absent (0%)
1 = Sparse (<10%)
2 = Moderate (10-40%)
3 = Heavy (40-75%)
4 = Very Heavy (>75%)

Filamentous Algae	0 1 2 3 4
Aquatic Macrophytes/ Emergent Vegetation	0 1 2 3 4
Boulders	0 1 2 3 4
Woody Debris >0.3 m	0 1 2 3 4
Woody Debris <0.3 m	0 1 2 3 4
Undercut Banks	0 1 2 3 4
Overhang. Vegetation	0 1 2 3 4
Live Tree Roots	0 1 2 3 4
Artificial Structures	0 1 2 3 4

DENSIOMETER READINGS (0-17)
count covered dots

Center Left	
Center Upstream	
Center Right	
Center Downstream	
Optional	
Left Bank	
Right Bank	

HUMAN INFLUENCE
(circle only the closest to wetted channel; assess 5 m u/s, 5 m d/s)

0 = Not Present;
B = On Bank;
C = Between Bank & 10m from Channel;
P = >10m+<50m from Channel;
Channel (record Yes or No; if Y for an analyte, do not assess banks)

	Left Bank	Channel	Right Bank
Walls/ Rip-rap/ Dams	P C B 0	Y N	0 B C P
Buildings	P C B 0	Y N	0 B C P
Pavement/ Cleared Lot	P C B 0		0 B C P
Road/ Railroad	P C B 0	Y N	0 B C P
Pipes (Inlet/ Outlet)	P C B 0	Y N	0 B C P
Landfill/ Trash	P C B 0	Y N	0 B C P
Park/ Lawn	P C B 0		0 B C P
Row Crop	P C B 0		0 B C P
Pasture/ Range	P C B 0		0 B C P
Logging Operations	P C B 0		0 B C P
Mining Activity	P C B 0	Y N	0 B C P
Vegetation Management	P C B 0		0 B C P
Bridges/ Abutments	P C B 0	Y N	0 B C P
Orchards/ Vineyards	P C B 0		0 B C P

BANK STABILITY
(assess point of transect between wetted width and bankfull)

Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

TAKE PHOTOGRAPHS
(check box if taken & record photo code)

Downstream (**required**) ☐

Upstream (**optional**) ☐

Site Code:	Date: __ __ / __ __ / 2016

BENTHIC INVERTEBRATE SAMPLES

Collection Method (indicate standard or margin-center-margin)			Replicate	# Jars
RWB (standard)	**RWB** (MCM)	**TRC**	**1**	
RWB (standard)	**RWB** (MCM)	**TRC**	**2**	
RWB (standard)	**RWB** (MCM)	**TRC**		
RWB (standard)	**RWB** (MCM)	**TRC**		

Field Notes/ Comments:

Was macroalgae (e.g., filamentous algae) collected in the composite algae sample? Yes / No
If YES, how many of the 11 transect samples contained macroalgae? _____
If YES, what was the original size of the macroalgae cylinder roll before sectioning into ¼ and ¾ pieces? _____ mm length x _____ mm diameter

Analyte	Equipment & Calibration Date
pH	Cal date: / /
Wat temp	Cal date: / /
dissolved oxygen	Cal date: / /
oxygen sat	Cal date: / /
specific cond	Cal date: / /
Salinity	Cal date: / /
Alkalinity	Cal date: / /
Turbidity	Cal date: / /
Silica	Cal date: / /
Air temp	Cal date: / /
Velocity	Cal date: / /

ALGAE SAMPLES

Collection Method (circle one or write new method if applicable)	SWAMP EMAP	SWAMP EMAP	SWAMP EMAP	SWAMP EMAP
Collection Device (sum # of transects per device)	**Rep. 1**	**Rep. 2**	**Rep.**	**Rep.**
Rubber Delimiter (area=12.6cm^2)				
PVC Delimiter (area=12.6cm^2)				
Syringe Scrubber (area=5.3cm^2)				
Other area=				
Number of transects sampled (0-11)				
Composite Volume (mL)				
Assemblage ID volume **(diatoms)** (50 mL tube)				
Assemblage ID volume **(soft algae)** (50 mL tube)				
Check if Qualitative Algae sample was collected with soft algae/diatom sample (required even if macroalgae not visible)	☐	☐	☐	☐
Check if a water chem. **integrated** sample was collected (chl, AFDM)	☐	☐	☐	☐
Chlorophyll a volume use GF/F filter (25 mL **(preferred volume)**				
Ash Free Dry Mass (AFDM) volume use GF/F filter (25 mL **(preferred vol)**				

Water and Sediment Chemistry Samples

Check if a WATER chemistry **grab** sample was collected (nutrients, SSC, etc.)	☐
Check if a DUPLICATE WATER chemistry **grab** sample was collected	☐
Check if a SEDIMENT chemistry sample was collected	☐
Check if a DUPLICATE SED chemistry sample was collected	☐

Sed Coll Device: SCOOP CORE GRAB

Material: Stainless Steel Polyethylene Polycarbonate Other

Sediment Collection Depth (cm): 2 or 5

Create Lab Collection records for each checked box for integrated and grab water chemistry samples

ADDITIONAL PHOTOGRAPHS

Description	Photo Code	Description	Photo Code

Flow Habitat Type	DESCRIPTION
Cascades	Short, high gradient drop in stream bed elevation often accompanied by boulders and considerable turbulence
Falls	High gradient drop in elevation of the stream bed associated with an abrupt change in the bedrock
Rapids	Sections of stream with swiftly flowing water and considerable surface turbulence. Rapids tend to have larger substrate sizes than riffles
Riffles	Shallow sections where the water flows over stream bed particles that create mild to moderate surface turbulence; (< 0.5 m deep, > 0.3 m/s).
Runs	Long, relatively straight, low-gradient sections without flow obstructions. The stream bed is typically even and the water flows faster than it does in a pool; (> 0.5 m deep, > 0.3 m/s). A **step-run** is a series of runs separated by short riffles or flow obstructions that cause discontinuous breaks in slope
Glides	A section of stream with little or no turbulence; (< 0.5 m deep, < 0.3 m/s)
Pools	A reach of stream that is characterized by deep, low-velocity water and a smooth surface; (> 0.5 m deep, < 0.3 m/s)

Size Class Code	Size Class Range	Size Class Description	Common Size Reference
RS	> 4 m	bedrock, smooth	larger than a car
RR	> 4 m	bedrock, rough	larger than a car
XB	1 - 4 m	boulder, large	meter stick to car
SB	25 cm - 1.0 m	boulder, small	basketball to meter stick
CB	64 - 250 mm	cobble	tennis ball to basketball
GC	16 - 64 mm	gravel, coarse	marble to tennis ball
GF	2 – 16 mm	gravel, fine	ladybug to marble
SA	0.06 – 2 mm	sand	gritty to ladybug
FN	< 0.06 mm	fines	not gritty
HP	< 0.06 mm	hardpan (consolidated fines)	
WD	NA	wood	
RC	NA	concrete/ asphalt	
OT	NA	other	

BANK STABILITY

Although this measure of the degree of erosive potential is subjective, it can provide clues to the erosive potential of the banks within the reach. Assign the category whose description best fits the conditions in the area between the wetted channel and bankfull channel (see figure below)

Eroded	Banks show obvious signs of erosion from the current or previous water year; banks are usually bare or nearly bare
Vulnerable	Banks have some vegetative protection (usually annual growth), but not enough to prevent erosion during flooding
Stable	Bank vegetation has well-developed roots that protect banks from erosion; alternately, bedrock or artificial structures (e.g., concrete/ rip-rap) prevent bank erosion

CPOM/ COBBLE EMBEDDEDNESS

CPOM: Record presence (P) or absence (A) of coarse particulate organic matter (>1.0 mm particles) within 1 cm of each substrate particle; if point is dry, record Dry (D)

Cobble Embeddedness: Visually estimate % embedded by fine particles (record to nearest 5%)

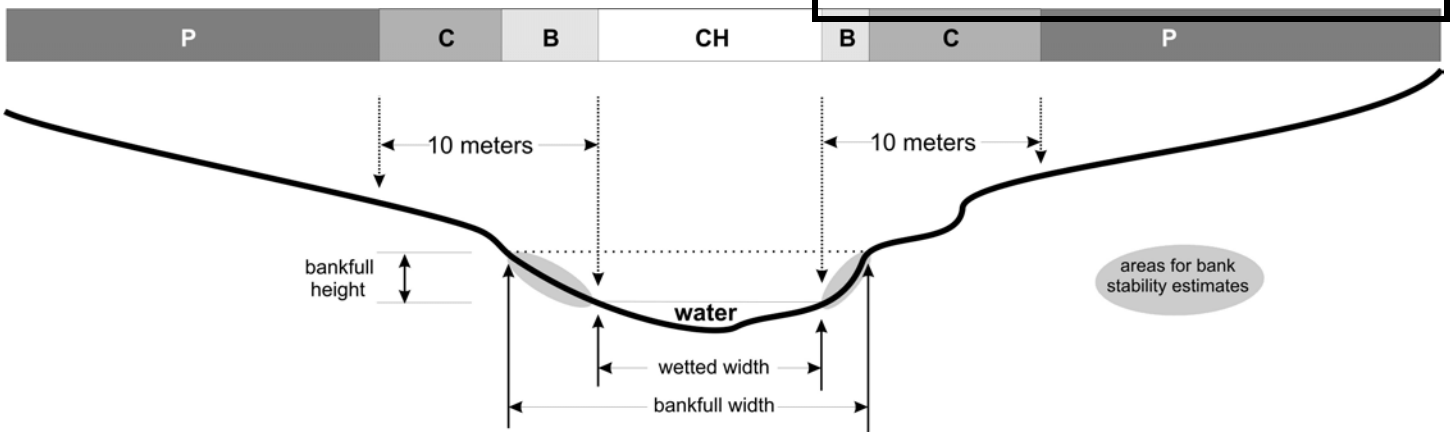


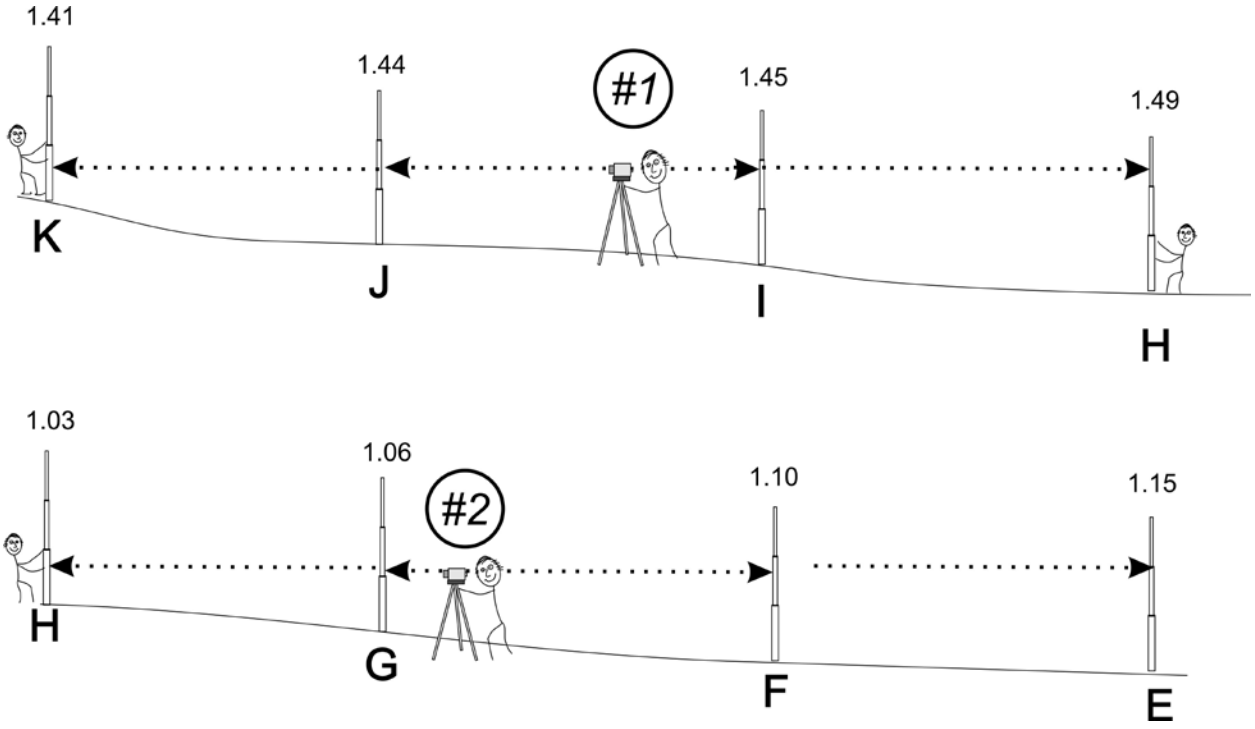
Figure 1. Cross-sectional diagram of stream transect indicating regions for assessing human influence measures:

- The measurement zone extends 5 meters upstream and 5 meters downstream of each transect
- Record one category for each bank and for the wetted channel (3 values possible)
- In reaches with wide banks, region "C" may be entirely overlapped by region "B"; in these cases, circle "B"
- Region "P" extends from 10 meters to the distance that can be seen from the channel, but not greater than 50 m

SLOPE and BEARING FORM *EXAMPLE*

AUTOLEVEL	X
CLINOMETER	
HANDLEVEL	

Starting Transect	MAIN SEGMENT (record percent of inter-transect distance in each segment if supplemental segments are used)						SUPPLEMENTAL SEGMENT (record percent of inter-transect distance in each segment if supplemental segments are used)					
	Stadia rod measurements		Slope (%) or Elevation Difference cm ■ % □	Segment Length (m)	Bearing (0°-359°)	Percent of Total Length (%)	Stadia rod measurements		Slope or Elevation Difference cm □ % □	Segment Length (m)	Bearing (0°-359°)	Percent of Total Length (%)
K	1.41											
J	1.44		3	15	140	100						
I	1.45		1	15	145	100						
H	1.49	1.03	4	15	150	100						
G		1.06	3	15	143	100						
F		1.10	4	15	187	100						
E		1.15	5	15	195	100						



1. Level the auto-level at Position #1
2. Place base of stadia rod at water level every time
3. Sight to stadia rod at Transect K, then Transect J
4. Rotate scope and sight to Transects I and H
5. Move level to Position #2 and re-level
6. Re-sight to stadia rod at Transect H, then Transect G
7. Rotate scope and sight to Transects F and E

Note: Sites will vary in the number of separate level positions needed to survey the reach.

Upper Yuba River Aquatic Monitoring Plan

Attachment C

Foothill Yellow Legged Frog Data Sheets

Yuba River Development Project

FERC Project No. 2246

June 2017

Egg Masses

Date: mm____ dd____ yy____ **Start UTMs:** _____ **End UTMs:** _____ **Reach/Trib:** _____ **Observers:** _____

Survey Method: Tandem Separate # Snorkel_____LB RB # Wade_____LB RB **Start Time:** _____ **End Time:** _____ **Actual VES Time:** _____

Start Air Temp: _____ **End** Air Temp: _____ **Start:** Water Temp: (edgewater) _____ (main channel) _____ (pool) _____ **Discharge:** _____ cfs

Mid-Survey: Water Temp: (edgewater) _____ (main channel) ___Time: ____ **End-survey:** Water temp: (edgewater) _____ (main channel) _____

Search Area Length: _____ **Search Area Width:** _____ **Total Area Searched: (m^2):** _____ **Site Visit:** 1 2 3 4

Past 24 hrs: *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong **Today:** *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong

EM Group Letter	# EMs	H2O Temp (°C)	UTM E	UTM N	Distance from Shore (m)	Max Water Depth (cm)	Mid Column Water Velocity (cm/sec)	[1] EM Attach Substrate	[4] Gosner Stage	[6] Macro Habitat	Notes

Fish Present: Yes No **Type**: Salmonid Centrarchid Cyprinid Catastomids **Other**:_____

Incidental Herps (sp. and lifestage):_____

Comments:_____

_____

_____

_____

QA/QC (initials): _____ Date: _____

Egg Masses

Date: mm____ dd____ yy____ **Start UTM:** _____ **Reach/Trib:** _____ **Observers:** _____

EM Group Letter	# EMs	H2O Temp (°C)	UTM E	UTM N	Distance from Shore (M)	Max Water Depth (cm)	Mid Column Water Velocity (cm/sec)	[1] EM Attach Substrate	[4] Gosner Stage	[6] Macro Habitat	Notes

Comments:_____
_____
_____
_____
_____

QA/QC (INITIALS): _____DATE:_____

Tadpoles

Date: mm____ dd____ yy____ **Start UTMs:** _____ **End UTMs:** _____ **Reach/Trib:** _____ **Observers:** _____

Survey Method: Tandem Separate # Snorkel_____LB RB # Wade_____LB RB **Start Time:** _____ **End Time:** _____ **Actual VES Time:** _____

Start Air Temp: _____ **End** Air Temp: _____ **Start:** Water Temp: (edgewater) _____ (main channel) _____ (pool) _____ **Discharge:** _____ cfs

Mid-Survey: Water Temp: (edgewater) _____ (main channel) ___Time: ____ **End-survey:** Water temp: (edgewater) _____ (main channel) _____

Search Area Length: _____ **Search Area Width:** _____ **Total Area Searched: (m^2):** _____ **Site Visit:** 1 2 3 4

Past 24 hrs: *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong **Today:** *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong

Group Letter	Appox # Tads	H2O Temp (°C)	UTM E	UTM N	Distance from Shore (m)	Max Water Depth (cm)	Mid Column Water Velocity (cm/sec)	[1] Tadpole Stage (1-4)	[2] Gosner Stage	[3] Individual or Average Total Length (mm)	[8] Macro Habitat	Notes

Fish Present: Yes No **Type**: Salmonid Centrarchid Cyprinid Catastomids **Other**:_____

Incidental Herps (spp and lifestage):_____

Comments:_____

_____ QA/QC (initials): _____ Date: _____

Tadpoles

Date: mm____ dd____ yy____ **Start UTM:** _____ **Reach/Trib:** _____ **Observers:** _____

Group Letter	Appox # Tads	H2O Temp (°C)	UTM E	UTM N	Distance from Shore (m)	Max Water Depth (cm)	Mid Column Water Velocity (cm/sec)	[1] Tadpole Stage (1-4)	[2] Gosner Stage	[3] Individual or Average Total Length (mm)	[8] Macro Habitat	Notes

Comments:_____
_____
_____
_____
_____

QA/QC (INITIALS): _____ DATE: _____

Post-Metamorphic Lifestages

Date: mm____ dd____ yy____ **Start UTMs:** _____ **End UTMs:** _____ **Reach/Trib:** _____ **Observers:** _____

Survey Method: Tandem Separate # Snorkel_____LB RB # Wade_____LB RB **Start Time:** _____ **End Time:** _____ **Actual VES Time:** _____

Start Air Temp: _____ **End** Air Temp: _____ **Start:** Water Temp: (edgewater) _____ (main channel) _____ (pool) _____ **Discharge:** _____ cfs

Mid-Survey: Water Temp: (edgewater) _____ (main channel) ___Time: ____ **End-survey:** Water temp: (edgewater) _____ (main channel) _____

Search Area Length: _____ **Search Area Width:** _____ **Total Area Searched: (m^2):** _____ **Site Visit:** 1 2 3 4

Past 24 hrs: *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong **Today:** *Sky*: Overcast Drizzle Showers Clear *Wind:* Calm Light Moderate Strong

# Frogs	UTM E	UTM N	1 Sex (M,F,U)	2 Stage (Y,J,A,U)	3 SVL (mm)	4 Macro Habitat	Notes

Fish Present: Yes No **Type**: Salmonid Centrarchid Cyprinid Catastomids **Other**:_____

Incidental Herps (spp and lifestage):_____

Comments:_____

_____

_____ QA/QC (initials): _____Date: _____

Post-Metamorphic Lifestages

Date: mm____ dd____ yy____ **Start UTM:** _____ **Reach/Trib:** _____ **Observers:** _____

# Frogs	UTM E	UTM N	[1] Sex (M,F,U)	[2] Stage (Y,J,A,U)	[3] SVL (mm)	[4] Macro Habitat	Notes

Comments:_____

_____

_____

_____

_____

Upper Yuba River Aquatic Monitoring Plan

Attachment D

Cross Section Data, Channel Morphology Monitoring

Yuba River Development Project

FERC Project No. 2246

June 2017

Example of form used for Cross Section Data, Channel Morphology Monitoring.

Stream/Reach: _____ Cross Section: _____

Site: _____

Date: _____

Crew Members: _____

Critical points: behind HP, HP, Fprone left , BF left, WS left, TW, WS right, BF right, Fprone right, TP, beyond TP.

HP and zero on left bank as looking d/s

Station	BS	HI	FS	Elev	Notes

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Upper Yuba River Aquatic Monitoring Plan

Attachment E

Geomorphology Photo point Data Sheet

Yuba River Development Project

FERC Project No. 2246

June 2017

PHOTO POINT PROCEDURES

Images taken at the photo points will be landscape photographs that will be taken each monitoring period from the same locations. The views in the photographs will be the same so that differences between monitoring periods can be compared.

Photo point locations will be established to document channel and riparian vegetation conditions within each monitoring location. The location(s) will be established at a location from which multiple view photographs could be taken, if possible. If necessary to document the riparian vegetation, more than one photo point location will be established. Within each view, an identifiable object, such as a large rock, will be included, if possible, to assist with scale and orientation during the monitoring periods. The photo point markers will be located in places that will likely not be eroded easily by high floods or disturbed by other activities, such as vandalism. Markers will be as inconspicuous as possible to minimize the potential for vandalism.

Photo point locations will be established from which channel conditions, including bank erosion, stream bank and bar vegetation, and vegetation within floodplains are clearly visible. If a location is established within the stream channel, a GPS point and distance(s) from the stream banks or other permanent marker will be used to document its position.

This attachment describes the procedure for documenting the photo point locations and for retaking the photographs each monitoring period. A field datasheet is provided. One datasheet will be filled out for each photo point location. For those locations where more than one view is taken from the same photo point location, all the views can be recorded on the same datasheet.

DOCUMENTING PHOTO POINT LOCATIONS

Photo point locations will be selected in consultation with the USDA-FS, State Water Board, and CDFG. A site marker, such as a stake, will be placed at the location. During the first monitoring period, the photo point locations will be established, using the following procedure:

- The photographer will stand immediately over the site marker, if possible. If this is not possible, the location of the photographer relative to the marker will be recorded on the datasheet (distance and angle from the marker).

- The time of the photograph, camera type, focus distance, height of the camera above the ground, compass bearing and vertical angle of the view will be recorded on the datasheet.

- At least one reference point will be established for each photo point location. The reference point will be within 200 feet of the photo point location. A reference point could be a large tree outside of the flood zone or a large rock. The distance, compass bearing, and vertical angle will be measured and recorded from the reference point to the photo point location. A marker will be placed on the reference point. The reference point will be described on the datasheet and a site sketch will be drawn showing major landmarks and the locations of the photo points and reference points. The information from the initial sketch with the reference point locations identified will be transferred to GIS for display over a high resolution aerial image and stored electronically.

- Additional photographs will be taken of the reference point and the photo point locations. The locations of each will be marked and labeled on the photographs for future use in the field. All information on the location of the photo points and reference points will be stored electronically.

- The locations of the photo and reference points will be recorded with GPS. These locations will be overlain on aerial photographs of each monitoring location to document the approximate locations of the points. The maps will be completed at a scale with sufficient detail to identify obvious landmarks and trees. These maps will be electronically stored for future use.

- Each photo point will be given an identification number, which will be used through the duration of the monitoring.

REPEAT PHOTOGRAPHY

The procedures for the photo points that will be followed during the subsequent monitoring periods are described below.

- For each photo point monitoring period, the field crew will take copies of the original photo point documentation on the locations of the photo and reference point markers, copies of the photographs, and maps. The type(s) of cameras used to take the photo points will be noted on the datasheet.

- The photographer will stand at the same place and height as that which the first photographs were taken. The camera will be aligned with the view at the same compass bearing as recorded during the initial photographs. The view will be compared with the previous photographs to ensure that it is as close as possible to the original.

- The time of the photograph, camera type, focus distance, height of the camera above the ground, compass bearing and vertical angle of the view will be recorded for this monitoring period.

- If the photo point marker cannot be located, an attempt will be made to locate a new photo point as close as possible to the original location using the reference point documentation, maps, and previous photographs. The USDA-FS, State Water Board, and CDFG will be notified and consulted if a new location is established.

- The new photographs will be catalogued with the previous photographs and stored electronically. The photographs will be compared with the previous photographs in the Geomorphology and Riparian Monitoring Report.

LITERATURE CITED

Powell, D.C. 2006. Recording the changes: field guide to establishing and maintaining permanent camera point systems. United States Department of Agriculture – Forest Service. Pacific Northwest Region. FS-14-SO-09-06. August. 21 pp.

PHOTO POINT DATASHEET

Site Name: _____ Photo Point Identification Number:_____

Date:_____ Time:_____ Weather Conditions:_____

GPS Coordinates:_____ Photographer:_____

Camera Type:_____

Subject of Photograph and Purpose of Photographs:

Photo 1	**Photo 2**	**Photo 3**
Camera Height (ft):	Camera Height (ft):	Camera Height (ft):
Camera Angle:	Camera Angle:	Camera Angle:
Azimuth:	Azimuth:	Azimuth:
Focus Distance:	Focus Distance:	Focus Distance:
Photo No.:	Photo No.:	Photo No.:
Camera No.:	Camera No.:	Camera No.:
Photo 4	**Photo 5**	**Photo 6**
Camera Height (ft):	Camera Height (ft):	Camera Height (ft):
Camera Angle:	Camera Angle:	Camera Angle:
Azimuth: °	Azimuth:	Azimuth:
Focus Distance:	Focus Distance:	Focus Distance:
Photo No.:	Photo No.:	Photo No.:
Camera No.:	Camera No.:	Camera No.:

Reference Point 1	**Sketch of Photo and Reference Point Locations:**
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	
Reference Point 2	
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	
Reference Point 3	
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	

EQUIPMENT CHECKLIST

1. Datasheets
2. Photo point location markers
3. Sledge hammer
4. Markers for reference points
5. Tape measure (at least 100 feet)
6. Compass
7. Clinometer
8. Field Map
9. GPS unit

Upper Yuba River Aquatic Monitoring Plan

Attachment F

Riparian Vegetation
Field Data Sheet

Yuba River Development Project
FERC Project No. 2246

June 2017

Riparian Monitoring

Site Name		Cross Section #	
Date	Surveyors (circle recorder)		

Woody Plots

Plot #		Photographs:		
% Cover Open/Ground/Other:_____		Disturbances[1]:		
% Cover Overstory: _____				
Dominant Species	**% Cover**	**Stem #**	**NWI Status**	**% Relative Decadence**

Plot #		Photographs:		
% Cover Open/Ground/Other:_____		Disturbances[1]:		
% Cover Overstory: _____				
Dominant Species	**% Cover**	**Stem #**	**NWI Status**	**% Relative Decadence**

[1] Disturbances include human activities, disease, insect infestation and leaf drop

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Riparian Monitoring

Site Name		Cross Section #	
Date	Surveyors (circle recorder)		

Herbaceous Plots

Plot #		Disturbances[1]:		
Count Riparian Woody Seedlings:_____				
Vascular Species	**% Cover**	**Native/Non-native**	**NWI Status**	**Special-status/Listed Weed Status**

Plot #		Disturbances[1]:		
Count Riparian Woody Seedlings:_____				
Vascular Species	**% Cover**	**Native/Non-native**	**NWI Status**	**Special-status/Listed**

[1] Disturbances include human activities, disease, insect infestation and leaf drop

Upper Yuba River Aquatic Monitoring Plan

Attachment G

Large Woody Material Field Data Sheet

Yuba River Development Project
FERC Project No. 2246

June 2017

Large Woody Material Field Data Form and Definitions

INSTREAM WOOD INVENTORY

Page____of____

Age Class (**Age**)
0 -rotten
1 - decayed
2 - bare
3 – limbs attached
4 - bark
5 - needles

Channel Type (**Chan.**)
1 - pool
2 - riffle
3 - glide
4 - rapid
5 - step/pool
6 - cascade
7 - other

Source of large wood (**Source**)
0 - unknown
1 - riparian
2 - hillslope
3 - floated
4 - avalanche
5 - other
Add 'C; if cut end

Stability (**Stabil.**)
0 - no ends
1 - one end
2 - two ends

Orientation (**Orient.**)
angle of wood relative to l or rt bank
estimated to nearest 10 degrees

Structural Association (**Struct.**)
1 – Large Wood Jam
2 - Tree/Rootwad
3- Boulder
4 - Meander
5 - Bar
6 - Bedrock
7 - Beaver Dam
8 - Bank
9 - Log step
10 - Buried in bed
0- None/Other

Function (**Func**.)
0 - drift
1 - bridge
2 - collapsed bridge
3 - ramp
4 - incorporated

Root Wad (**R-Wad**)
0 - no
1 - yes

Veg/Gravel Assoc
0 - no
1 - Rip Veg
2 - Spawning Gravels
3 - Both Veg + gravels

Stream_____Date:_____

Reach No._____

Reach Desc. _____

_____

Crew _____

Tag #	Length (____) total	in chan	Diameter (_____) D1	D2	(deg)	Angle L/R	Age	Stabil.	R-Wad	Func.	Chan.	Struct.	Source	Veg/Gravel Assoc	Comments

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Woody Material Inventory Classification

Age Class (**Age**)	- how old or decayed
0 -rotten	very soft wood that can be pulled apart easily by hand
1 - decayed	moderate softness, cannot be pulled apart easily
2 - bare	no bark or most bark is gone
3 - limbs	limbs are still attached, may have most or all bark intact
4 - bark	all bark intact, a relatively new piece of wood
5 - needles	green or brown needles or leaves still attached, very fresh piece of wood, tree may appear living

Stability (**Stabil.**)	- how stable is the piece of wood, how well is it anchored
0 - no ends	neither end of the wood is anchored in a bank or with other wood
1 - one end	one end is anchored in the bank or with other wood
2 - two ends	both ends are anchored

Root Wad (**R-Wad**)	
0 - no	self explanatory
1 - yes	

Function (**Func**.)	- the woods relative function related to the stream channel
0 - drift	sitting on a bar with both ends within active channel
1 - bridge	both ends above active channel, center suspended above
2 - collapsed bridge	two ends on bank, broken in the middle
3 - ramp	one end in channel, other end out of active channel
4 - incorporated	portion of wood is buried in channel (may or may not be a step)

Channel Type (**Chan.**)	- what channel type is associated with the wood
1 - pool	flat surface, deep with a downstream control
2 - riffle	shallow, finer grained 1-2% slope
3 - glide	between pool and riffle, no downstream control
4 - rapid	(plane bed) 2.5 - 4 % slope, poorly defined steps, moderately steep
5 - step/pool	well defined step pool structure
6 - cascade	very steep, fall, irregular step-pool morphology
7 - other	explain in comments area

Structural Association (**Struct.**)	- stream structure associated with piece, can be more than just one
1 – Large Wood Jam	part of a jam of 3 or more pieces
2 - Tree/Rootwad	associated with a living tree or rootwad
3 - Boulder	associated with a boulder in the stream
4 - Meander	caught on the outside of a meander
5 - Bar	sitting on a point or mid-stream bar
6 - Bedrock	caught on bedrock
7 - Beaver Dam	part of a beaver dam
8 - Bank	imbedded in the bank, buried by soil or bank materials
9 - Log step	forms a step in the stream
10 - Buried in bed	portion of log is buried in channel bed, but is NOT functioning as a step
0 - None/Other	something else (specify)

Source	- can the source of the large wood be determined
0 - unknown	source of wood cannot be determined
1 - riparian	source of wood appears from relatively flat surface adjacent to stream channel
2 - hillslope	wood originates from steeper landform -- either a depositional feature (moraine) or valley wall
3 - floated	origin of wood is from upstream and has been transported into place
4 - avalanche	wood appears to have been transported by moving snow
5 - other	other clearly defined source -- explain in comments section

Veg/Gravel Assoc	Is the large wood associated with deposition that is providing either for rip. veg. estab. Or spawning gravels.
0 - unknown	No association with either spawning gravels or riparian vegetation recruitment/establishment.
1 - riparian	Wood appears to be cause of depositional area that is providing riparian vegetation recruitment opportunity.
2 - spawning gravels	Wood appears to be cause of depositional area that is providing spawning habitat.
3 - both	Wood appears to be cause of depositional area that is providing both riparian vegetation recruitment area and spawning habitat.