2011 SWAMP Bioassessment Monitoring
El Dorado Hydroelectric Project (FERC 184)



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INTRODUCTION

Pursuant to the El Dorado Hydroelectric Project (Project 184) Benthic Macroinvertebrate Monitoring Plan (Plan; GANDA 2010), El Dorado Irrigation District (District) is required conduct BMI monitoring in various Project-affected and reference stream reaches throughout Project 184 watersheds. Per the Plan, bioassessment surveys are required during the first two years of each five-year period of the current Project 184 License (including 2011 and 2012). BMI monitoring efforts conducted during the Project 184 relicensing process between 1999 and 2001 (ECORP 2002) helped establish the Project's ecological resource objective for BMIs which states that macroinvertebrate indices (metrics) in Project-affected reaches should be similar to those in reference reaches located within and outside of the South Fork American River (SFAR) and Upper Truckee River (UTR) drainages.

Previous bioassessment surveys conducted in the Project 184 area followed the California Stream Bioassessment Procedure (CSBP) (CDFG 2003). The Project 184 license requires macroinvertebrate monitoring using the CSBP method or such method as revised in the future. The current accepted methodology is the State's Surface Water Ambient Monitoring Program (SWAMP) Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California (SWAMP 2007) which officially replaced the CSBP as the statewide standard for ambient bioassessment in 2007. Therefore, the SWAMP bioassessment protocol is the methodology specified in the Plan.

The District tasked Garcia and Associates (GANDA) to conduct 2011BMI bioassessment surveys in Project 184 watersheds. This report presents the results of SWAMP bioassessment surveys conducted as specified in the Plan during fall 2011.

METHODS

Site Selection

The Plan specifies monitoring at a total of 18 sites in Project-affected reaches and associated reference reaches within Project 184 watersheds. These watersheds include the following (some of which contain paired sites located above and below existing diversion points):

- Echo Creek (Site EC-B1)
- Pyramid Creek (Site PY-B1)
- Caples Creek (Site CA-B1)
- Silver Fork American River (Site SV-B2)
- South Fork American River (Site SO-B1)
- No Name Creek (Sites NN-B1 and NN-B2)
- Alder Creek (Sites AR-B1 and AR-B2)
- Bull Creek (Sites BU-B1 and BU-B2)
- Ogilby Creek (Sites OG-B1 and OB-B2)

- Esmeralda Creek (Sites ES-B1 and ES-B2)
- Strawberry Creek (Site SB-B1)
- Sherman Canyon Creek (Site SH-B1)
- Woods Creek (Site WC-B1)

The 18 bioassessment sites are located in the same Project-affected and reference reaches specified in the Plan (see Figure 1). GPS locations for each site are listed in Table 1. Generally, 2011 SWAMP bioassessment sites were located as close as possible to those sites selected previously during 1999-2001 relicensing efforts (ECORP 2002), although specific site boundaries for SWAMP survey reaches were established by GANDA field crews in 2011 that may be slightly upstream or downstream from the original areas sampled under the CSBP (for example, because the SWAMP protocol requires a longer survey reach than the CSBP).

Benthic Macroinvertebrate Sampling

Teams of two to four GANDA biologists conducted all benthic macroinvertebrate sampling following the SWAMP protocol. Field sampling was performed between September 29 and November 15, 2011. Sites consisted of 150-meter survey reaches wherever possible. Consistent with SWAMP protocol, shorter survey reaches were established at smaller tributaries including Esmeralda Creek (ES-B1 and ES-B2), No Name Creek (NN-B1 and NN-B2) and Ogilby Creek (OG-B1 and OG-B2) in order to avoid barriers or other confounding areas (*e.g.*, steep waterfalls, cliff areas, culverts, *etc.*). At each of these smaller tributary sites, there were numerous pool-riffle sequences to sample within the established survey reach. For larger streams (wetted width greater than 20 m), SWAMP protocol recommends increasing site length. There was one site where wetted width was consistently greater than 20 meters (Site SO-B1 on the South Fork American River [SFAR] below Kyburz Diversion Dam). However, the total survey reach length was not increased at this site because sufficient representative habitat was present within the 150-m reach and extending the site would have only added large, deep pool habitat that could not be sampled.

At sites located at elevations below 6,500 feet (PY-B1, SO-B1, NN-B1 and 2, AR-B1 and 2, BU-B1 and 2, OG-B1 and 2, ES-B1 and 2, SB-B1, SH-B1), BMI samples were collected as reach-wide benthos (RWB) samples. RWB samples were compilations of eleven 1-ft^2 kick samples collected at the 11 main transects comprising the SWAMP survey reach. At sites near or above 6,500 feet (EC-B1, CA-B1, SV-B2, WC-B1), BMI samples were collected as both RWB samples and targeted riffle composite (TRC) samples. RWB samples were collected as described above; TRC samples were compilations of eight 1-ft^2 kick samples collected at eight randomly selected riffle locations within each SWAMP survey reach. Decisions regarding which sample types to collect at which locations were made by the District in consultation with the SWAMP bioassessment coordinator.

All benthic samples were collected using a Wildco® 18-by-9- inch stream-bottom sampler fitted with a 0.5 mm (500 micron) mesh bag. Samples were collected from downstream to upstream before physical habitat measurements to prevent excessive bottom trampling. At sites where both types of samples were collected, TRC and RWB samples were collected simultaneously in two separate nets while moving from downstream to upstream between transects. All samples were elutriated and cleaned in the field, placed in jars, labeled, and preserved in 10 percent formalin.

Physical Habitat Characterization

Physical habitat parameters (bankfull and wetted width, bankfull height, water depth, substrate composition, cobble embeddedness, algal cover, riparian vegetation, instream habitat complexity, canopy cover, human influence, bank stability, *etc*.) were evaluated at a combination of 11 primary and 10 secondary cross-sectional transects located along the survey reach. The "full" level of effort for physical habitat characterization as described in the SWAMP protocol was performed at all sites. Stream gradient at each site was measured using a clinometer and stadia rod (with eye-level marked) positioned at water's surface from transect to transect; compass bearings between transect mid-points were also measured. The upper, middle and lower portions of each SWAMP survey reach were documented with photographs taken in both the upstream and downstream directions, and both ends of each survey reach were marked using GPS.

Discharge was measured using the standard USGS 20-point velocity-area method at all sites where stream gage data was not available; for streams where depths and velocities were too shallow and slow to measure flows in this manner, discharge was estimated using the buoyant object method to estimate surface velocities.

Basic *in situ* water quality measurements were also taken at each site. Measured parameters included water temperature, pH, specific conductance, and dissolved oxygen concentration. All water quality measurements were collected prior to benthic macroinvertebrate sampling efforts at each site.

Laboratory Protocol

All benthic samples were processed and identified by Jon Lee Consulting. The laboratory subsampling procedure allowed separation of large/rare specimens from finer subsampled material so that more accurate estimations of the whole-sample taxa lists could be made. All samples were subsampled to a minimum of 600 individuals, although the last grid section (*i.e.*, the aliquot containing the 600^{th} individual) was always picked through and identified in its entirety to allow accurate estimation of the total sample abundance (and thus benthic density); therefore, in practice typically 625-675 organisms were identified in the laboratory. This higher level of effort (identifying a minimum of 600 instead of 500 individuals from each sample) is recommended to insure that closer to 500 clearly identifiable specimens are achieved after excluding any ambiguous and/or immature specimens. All specimens were identified to Level II standard taxonomic effort (STE) as defined by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT), which generally corresponds to the genus-species level for most insects, and slightly less rigorous effort (*e.g.*, tribe/subfamily, family, or class) for certain other taxa groups (Level II STE for California taxa is defined in SAFIT [2006]).

Data Analysis

Summary metrics for each replicate sample were calculated using a Microsoft Access database. Metrics are measurable attributes of macroinvertebrate communities that are known to change in response to disturbance or impairment of the stream environment. Metrics included standard richness, composition, tolerance/intolerance, and functional feeding group measures (see Table 2). All sample metrics were calculated from 500-organism fixed-count samples generated from the complete laboratory-identified taxa lists for each sample (500-count taxa lists are the standard for calculating metrics). Sample data were randomly re-sampled and standardized in this manner to achieve uniformity in count between all samples for comparative analyses (*e.g.*, so that the total number of taxa would be accurately represented for each site at a standardized level of effort, regardless of how many organisms were originally identified in the laboratory from each different sample).

In order to reduce the complexity of the information contained in the numerous metrics that describe each sample, data were compiled into a single multi-metric index, the Hydropower Index of Biotic Integrity, or Hydropower-IBI (Rehn 2010). This IBI was developed by the California Department of Fish and Game (CDFG) Aquatic Bioassessment Laboratory to be sensitive to the cumulative effects of hydropower operations on stream benthic communities. The seven component metrics of the Hydropower-IBI (ET taxa richness, %intolerant individuals, %scrapers, %non-insect taxa, Shannon diversity, %predators, and %tolerant individuals) were chosen from over 80 candidate metrics calculated using a combined dataset from nine separate studies of regulated rivers in California managed for hydropower. Values for these constituent metrics were scored (0-10) according to specific thresholds (defined in Table 3) and final Hydropower-IBI scores were achieved by summing the constituent metric scores and adjusting the index to a 100-point scale. Note that although this IBI was originally developed using only TRC-type samples, IBI scores were calculated for both TRC and RWB samples for 2011 Project 184 SWAMP data because recent published and unpublished analyses suggest that RWB and TRC methods can produce generally comparable results across a broad range of settings within California (Van Buuren and Ode 2008). Therefore, it was assumed that RWB samples collected during this study contained sufficient riffle material for Hydropower-IBI analysis. Further details regarding development of the Hydropower-IBI are provided in Rehn (2010).

Ten percent of the benthic macroinvertebrate samples collected during 2011 (2 randomly selected samples out of the 22 total samples collected) were submitted to CDFG's Aquatic Bioassessment Laboratory for a quality assurance/quality control (QA/QC) check for accuracy of enumeration and taxonomic identification.

RESULTS

2011 Benthic Macroinvertebrate Summary

In 2011, it is estimated that nearly 85,000 benthic macroinvertebrates were collected from the 18 sites in the Project 184 area (in TRC and RWB samples combined). Of these individuals, 14,530 specimens were identified, representing 217 different taxa from more than 67 families and 15 taxonomic orders (per SAFIT Level II STE). The most common taxa included caddisflies of the genera *Micrasema* and *Lepidostoma*, the nemourid stonefly *Zapada cinctipes,* clinger mayflies of the genera *Cinygmula, Ironodes,* and *Epeorus,* stoneflies of the genus *Sweltsa*, aquatic earthworms of the class Oligochaeta, mayflies of the genus *Ephemerella*, net-spinning caddisflies of the genus *Hydropsyche*, and the ubiquitous mayfly *Baetis tricaudatus.* Complete taxa lists for 500-organism fixed-counts and estimated whole-sample taxa lists for all samples are presented in Appendices A and B, respectively.

The average number of taxa per sample for all sites (including both TRC and RWB samples) was 44, including an average of 26 EPT taxa. Shannon Diversity averaged 3.01 and Shannon Evenness average 0.78 (78%). Percent EPT averaged 73 percent (53% of which were sensitive EPT) and the dominant taxon comprised 21 percent of the average sample. Tolerant and intolerant individuals comprised 2 and 49 percent of the average sample, respectively. The mean weighted tolerance value was 2.9. On average, collectors were the dominant functional feeding group (30%), followed by scrapers (22%), shredders (19%), predators (18%), filterers (5%), macrophyte herbivores (4%), omnivores (2%), and piercer herbivores (<1%). Macroinvertebrate density averaged 363 individuals/ft^2 for all samples. A summary of biological metrics for 500-organism fixed-counts from all TRC and RWB samples is presented in Table 4. Results of the CDFG laboratory's taxonomic QA/QC check will be reported (as they become available) if any significant discrepancies are found.

2011 Physical Habitat/Water Quality Summary

SWAMP bioassessment sites surveyed in the Project 184 area in 2011 ranked between "optimal" and "marginal" in terms of available epifaunal substrate and cover, sediment deposition, and channel alteration (*i.e.,* rapid bioassessment [RPB] scores). Stream gradient ranged from low (1.6% slope at Caples Creek) to very high (28.0% slope at upper Bull Creek). Human influences encountered within survey reaches included walls/rip-rap, buildings, pavement, roads, pipes, campgrounds, historical logging, and bridge abutments.

Water quality parameters were within acceptable ranges during the fall 2011 SWAMP surveys, with water temperatures ranging from 6.0 to 12.6 °C, pH ranging from 6.7 to 7.7, and dissolved oxygen concentration ranging from 9.5 to 13.8 milligrams/liter. Discharge ranged from less than 1.0 cubic foot per second (cfs) in several smaller creeks to 77.5 cfs in the mainstem SFAR during our surveys. A summary of physical habitat data and water quality measurements collected at each site in 2011 is presented in Tables 5 and 6 (Table 5 summarizes reach-wide habitat measurements collected once at each SWAMP site and

Tables 6a through 6c summarize transect-based measurements collected at multiple cross-sections within each SWAMP survey reach). Site photographs are compiled in Appendix C. Copies of original SWAMP field datasheets are provided in Appendix D.

DISCUSSION

Comparisons between Reference Reaches and Project-Affected Reaches

Overall, samples collected from Project-affected reaches scored slightly lower on average in terms of certain richness, composition, tolerance, and functional feeding group measures than those collected from reference reaches during 2011 SWAMP surveys (Table 4). Although some variation was apparent among individual metrics and samples, scores for the multi-metric Hydropower-IBI averaged 16 percent higher overall in references reaches (57) than Project-affected reaches (49) (Figure 2).

Total taxa richness averaged 25 percent higher in reference reaches versus Project-affected reaches (55 vs. 44, respectively). Richness of individual samples ranged from 68 taxa collected in the RWB sample from upper Ogilby Creek (Site OG-B2), to 31 taxa collected in the RWB sample from Caples Creek below Caples Lake (Site CA-B1). Shannon Diversity averaged nine percent higher at reference sites versus Project-affected sites (3.01 vs. 2.90, respectively; see Figure 3). Diversity of individual samples ranged from 3.67 in the RWB sample from upper Ogilby Creek (Site OG-B2), to 2.00 in the RWB sample from lower Alder Creek below the diversion (Site AR-B1). Macroinvertebrate density was generally lower in reference reaches than Project-affected reaches (256 vs. 437 individuals/ft^2, respectively). Among individual samples, density was lowest in the RWB sample from Woods Creek above Caples Lake (Site WC-B1) (39 individuals/ft^2) and highest in the RWB sample from lower Alder Creek below the diversion (Site AR-B1) (1,245 individuals/ft^2).

Composition measures were more variable overall among reference and Project-affected sites. Averages values for most composition measures were very similar for reference and Project-affected reaches (Table 4). The overall percentage of insects was high for all samples (74% to 90%), although reference reaches had a slightly higher percentage of non-insect taxa on average than Project-affected reaches (12% vs. 7%, respectively).

The average percent composition of tolerant organisms was very low for all samples (<1% to 5%) and the average percent composition of intolerant organisms was typically high (31% to 76%). Thus, average weighted tolerance values were relatively low (*i.e.,* good) for both reference and Project-affected reaches.

Functional feeding group measures were similar overall among reference and Project-affected reaches, however samples from reference reaches had more scrapers (31% vs. 16%) and fewer macrophyte herbivores (<1% vs. 6%) on average (Table 4).

The average composition of the major taxonomic groups differed slightly among reference reaches and Project-affected reaches in 2011. In terms of the major insect orders, mayflies (Order Ephemeroptera), beetles (Order Coleoptera), and true flies (Order Diptera) were more abundant on average in samples from reference reaches, whereas caddisflies (Order Trichoptera) and stoneflies (Order Plecoptera) were more abundant in samples from Project-affected reaches (Figure 4). Non-insect taxa were much less abundant overall than insects, although aquatic earthworms (Class Oligochaeta) and clams (Order Bivalvia) were more abundant on average in samples from reference reaches, while freshwater mites (Class Acari) and snails (Class Gastropoda) were more abundant in samples from Project-affected reaches (Figure 5).

CONCLUSION

In general, Project-affected reaches scored lower than reference reaches in terms of many individual metrics as well as multi-metric Hydropower-IBI scores during 2011. However, the extent to which such differences may be attributable to Project operations remains unclear. The next SWAMP monitoring effort is scheduled for fall 2012; the combined results of both the 2011 and 2012 survey efforts will be used to evaluate benthic data from Project-affected and reference reaches in the context of the ecological resource objective described in the Plan.

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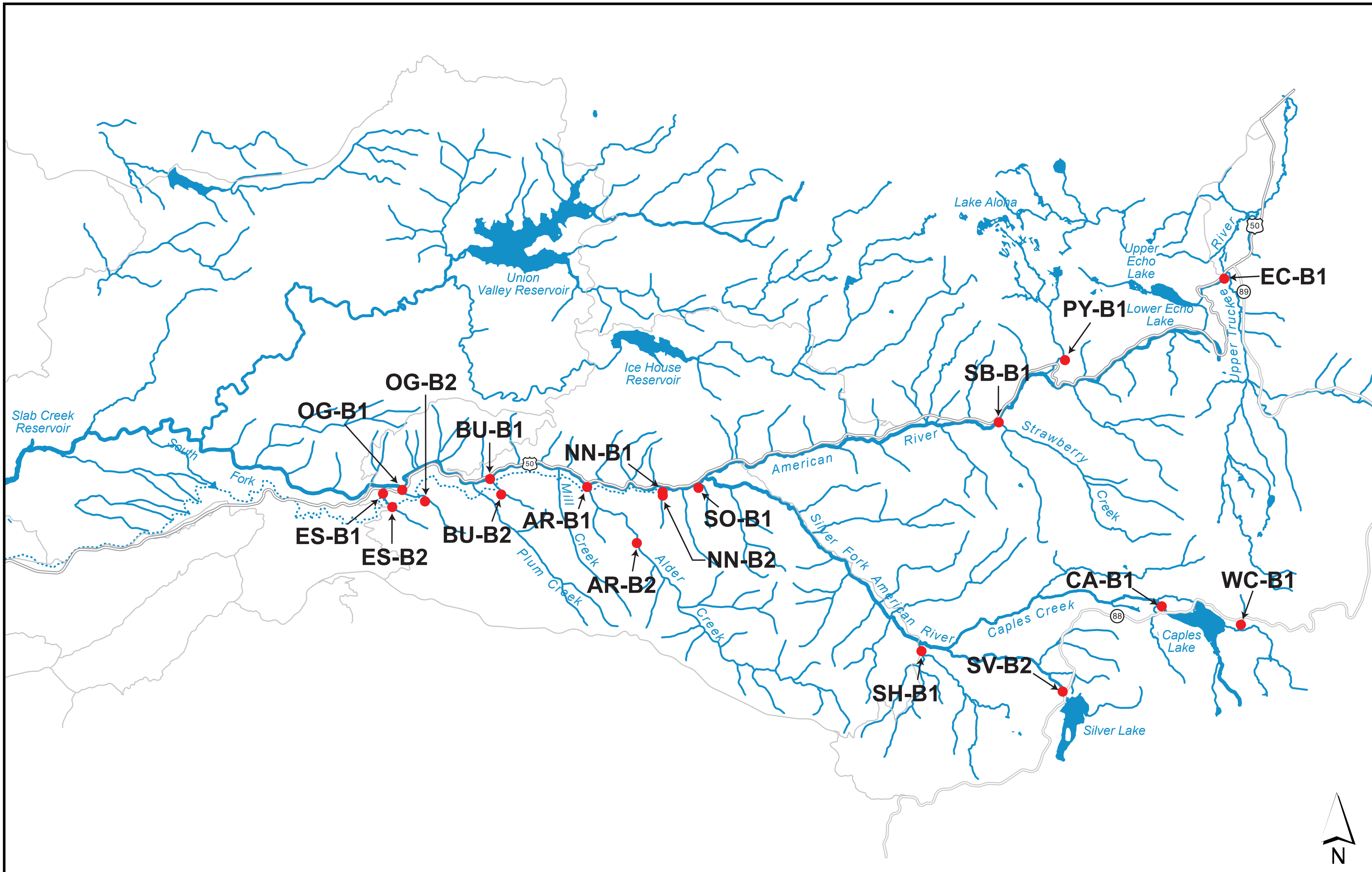

GANDA

Project Location

Benthic Macroinvertebrate Survey Site
Major Waterway
U.S. Highway/Paved Road
Other Road
El Dorado Canal

0 2 4 6 8 10 miles

0 2 4 6 8 10 Kilometers

Figure 1. Benthic Macroinvertebrate Survey Site Locations.

El Dorado County, CA

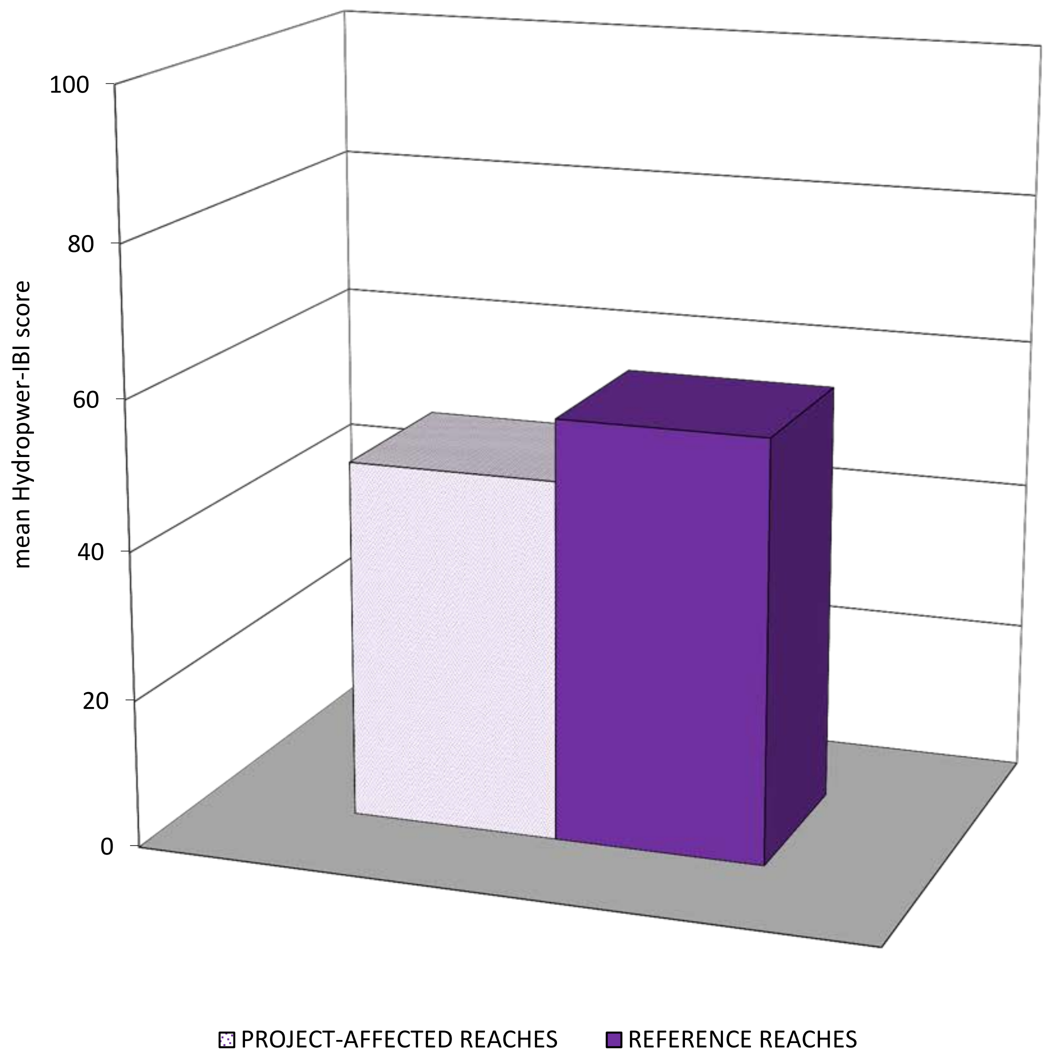

FIGURE 2. Multi-metric Hydropower-IBI scores in Project-affected vs. reference reaches

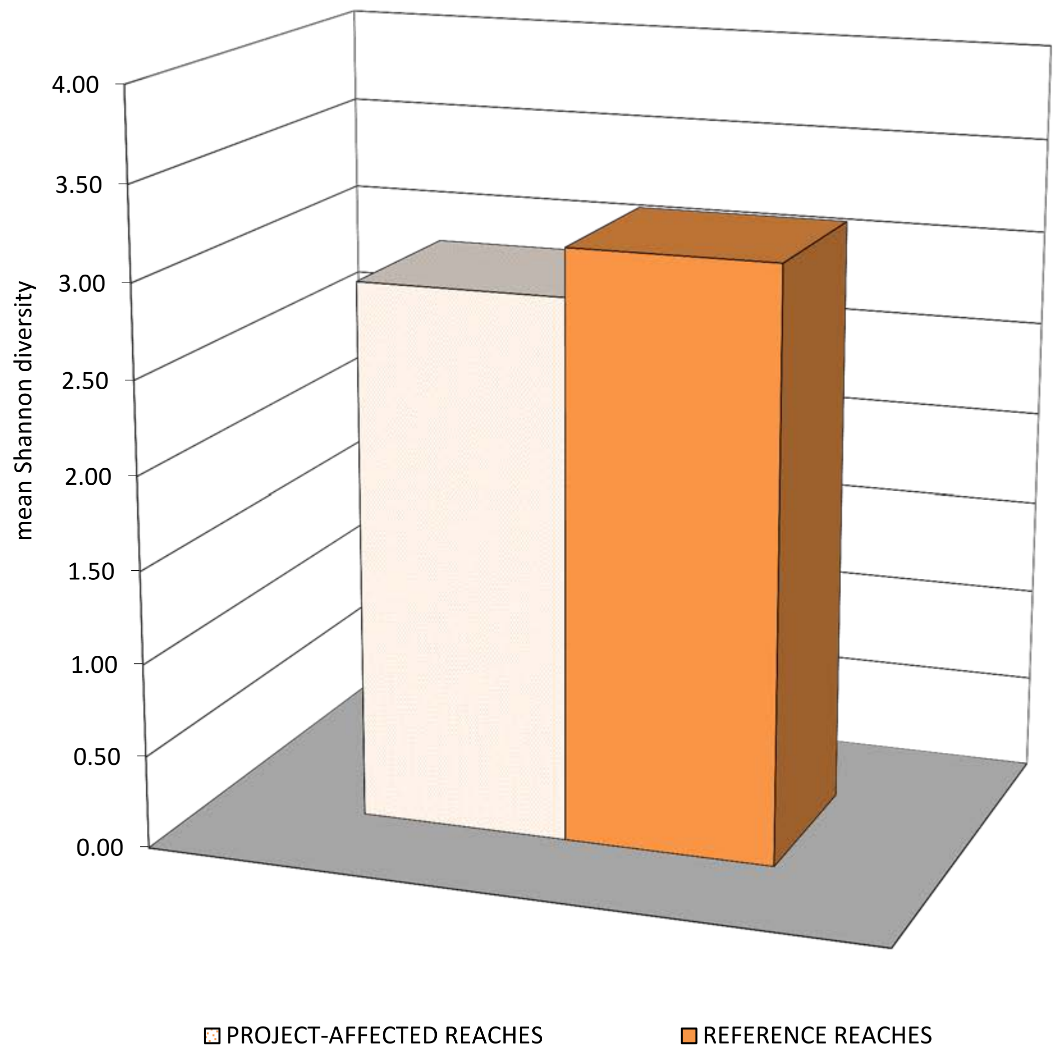

FIGURE 3. Benthic community diversity in Project-affected vs. reference reaches

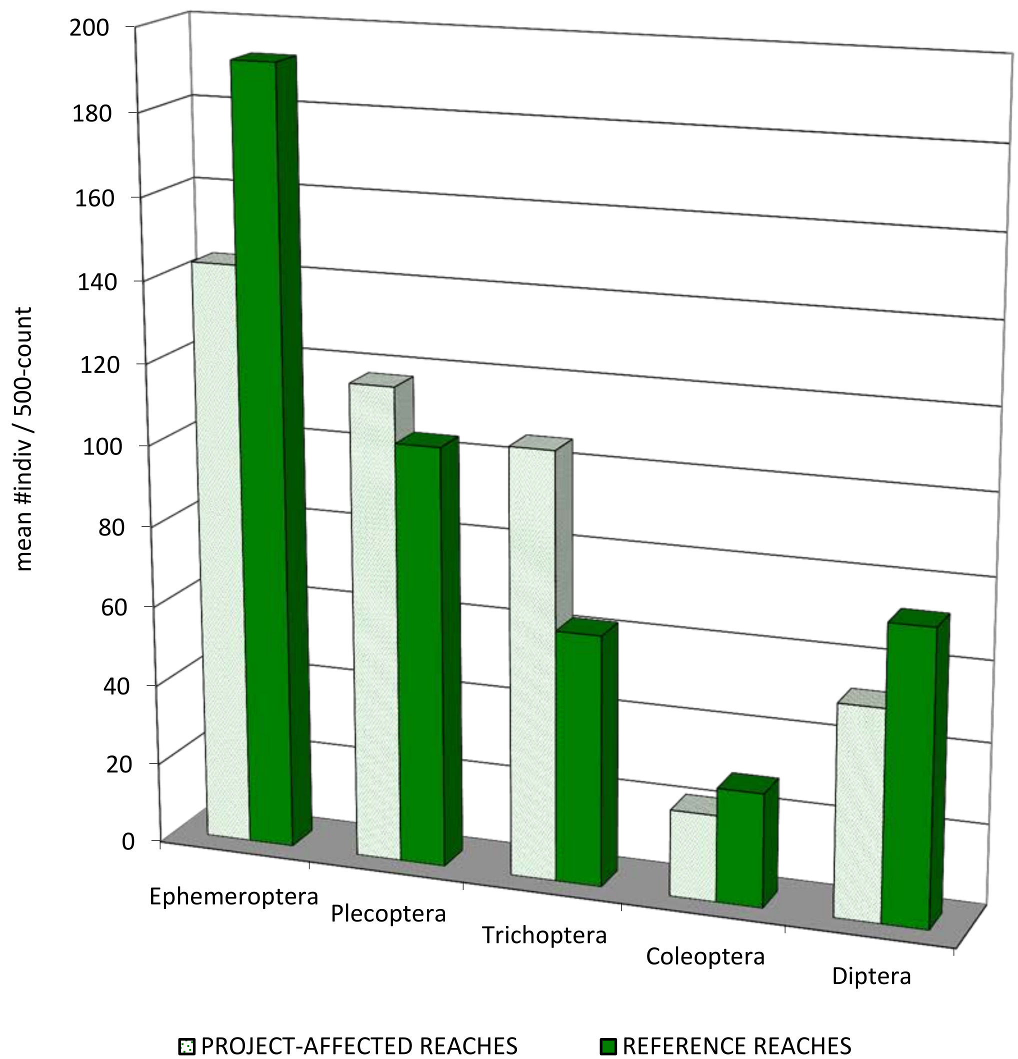

FIGURE 4. Abundance of major insect orders in Project-affected vs. reference reaches

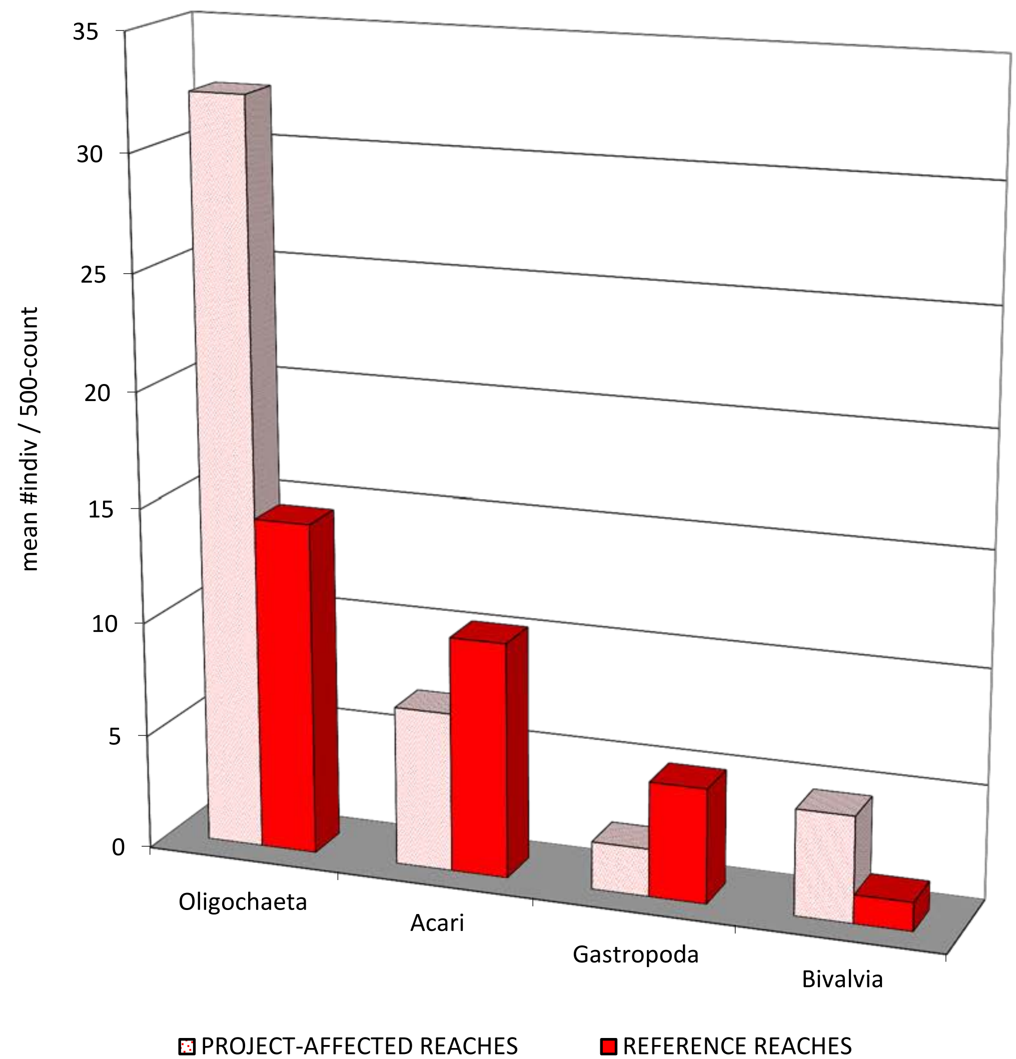

FIGURE 5. Abundance of major non-insect classes in Project-affected vs. reference reaches

TABLE 1. GPS locations of 2011 SWAMP bioassessment survey reaches in Project 184 area.

SITE ID	DESCRIPTION	UTM LOCATION[1]	
		Upstream[2]	Downstream[2]
AR-B1	Alder Creek below diversion	10 S 0727817 4293722	10 S 0727783 4293846
AR-B2	Alder Creek above diversion	10 S 0730155 4291030	10 S 0730155 4291140
BU-B1	Bull Creek below diversion	10 S 0723080 4294280	10 S 0722997 4294368
BU-B2	Bull Creek above diversion	10 S 0723612 4293646	10 S 0723542 4293736
CA-B1	Caples Creek below Caples Lake	10 S 0756345 4288557	10 S 0756231 4288551
EC-B1	Echo Creek below Lower Echo Lake	10 S 0757821 4303759	10 S 0757934 4303807
ES-B1	Esmerelda Creek below diversion	10 S 0718115 4293217	10 S 0718078 4293288
ES-B2	Esmerelda Creek above diversion	10 S 0718332 4292992	10 S 0718311 4293066
NN-B1	No Name Creek below diversion	10 S 0731140 4293874	10 S 0731124 4293956
NN-B2	No Name Creek above diversion	10 S 0731173 4293746	10 S 0731153 4293794
OG-B1	Ogilby Creek below diversion	10 S 0718893 4293859	10 S 0718909 4293906
OG-B2	Ogilby Creek above diversion	10 S 0720413 4293075	10 S 0720346 4293141
PY-B1	Pyramid Creek below Lake Aloha	10 S 0750292 4300308	10 S 0750294 4300162
SB-B1	Strawberry Creek near SFAR confluence	10 S 0747420 4296859	10 S 0747312 4296920
SH-B1	Sherman Canyon Creek	10 S 0743689 4285807	10 S 0743619 4285914
SO-B1	South Fork American below Kyburz diversion	10 S 0732883 4294117	10 S 0732748 4294072
SV-B2	Silver Fork American below Silver Lake	10 S 0750229 4284442	10 S 0750132 4284527
WC-B1	Woods Creek above Caples Lake	10 S 0758190 4287291	10 S 0758071 4287309

[1] GPS datum: NAD 83; [2] Upsream and downstream locations are endpoints of each SWAMP survey reach (corresponding to main survey transects "K" and "A," respectively).

TABLE 2. Biological metrics used to describe benthic samples. Listed responses are for generalized ecological impairment.

METRIC	DESCRIPTION OF METRIC	RESPONSE TO IMPAIRMENT
RICHNESS-TYPE MEASURES		
# Total Taxa	Total number of taxa	Decrease
# Ephemeroptera Taxa	Number of mayfly taxa	Decrease
# Plecoptera Taxa	Number of stonefly taxa	Decrease
# Trichoptera Taxa	Number of caddisfly taxa	Decrease
# Diptera Taxa	Number of taxa in the order Diptera (true flies)	Variable
# Chironomid Taxa	Number of taxa in the dipteran family Chironomidae	Increase
# ET Taxa*	Number of taxa in the orders Ephemeroptera (mayflies) and Trichoptera (caddisflies)	Decrease
# EPT Taxa	Number of taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)	Decrease
Shannon Diversity*	General measure of sample diversity that incorporates richness and evenness (ln-based)	Decrease
Shannon Evenness	Measure of how evenly taxa abundances are distributed	Decrease
Density ($\#/ft^2$)	Estimated total number of individuals per square foot area	Variable
COMPOSITION-TYPE MEASURES		
% EPT	Percent composition of EPT taxa	Decrease
% Sensitive EPT	Percent composition of EPT taxa with tolerance values 0-3	Decrease
% Baetidae	Percent of individuals in mayfly family Baetidae	Increase
% Chironomidae	Percent of individuals in midge family Chironomidae	Increase
% Hydropsychidae	Percent of individuals in caddisfly family Hydropsychidae	Increase
% Dominant Taxon	Percent of sample comprised of individuals from the most common taxon	Increase
% Insect Individuals	Percent of individuals that are insects	Decrease
% Non-Insect Taxa*	Percent of taxa that are non-insect taxa	Increase
TOLERANCE / INTOLERANCE MEASURES		
% Tolerant Individuals*	Percent of individuals that are highly tolerant of impairment as indicated by tolerance values of 8, 9, or 10	Increase
% Intolerant Individuals*	Percent of individuals that are highly intolerant of impairment as indicated by tolerance values of 0, 1, or 2	Decrease
Weighted Tolerance Value	Value between 0 and 10, weighted by abundances of organisms designated as tolerant or intolerant	Increase
FUNCTIONAL FEEDING GROUP MEASURES		
% Filterers	Percent of individuals that filter fine particulate matter	Increase
% Scrapers*	Percent of individuals that graze upon periphyton	Variable
% Collectors	Percent of individuals that collect/gather fine particulate matter	Increase
% Shredders	Percent of individuals that shred coarse particulate matter	Decrease
% Predators*	Percent of individuals that feed on other organisms	Variable
% Macrophyte Herbivores	Percent of individuals that feed on plants	Variable
% Piercer Herbivores	Percent of individuals that pierce plants	Variable
% Omnivores	Percent of individuals that feed on various food items	Variable
% Parasites	Percent of individuals that parasitize other organisms	Variable
MULTI-METRIC INDEX		
Hydropwer-IBI	Composite index of 7 key metrics* selected to be sensitive to cumulative effects of hydropower operations (scores out of 100)	Decrease

TABLE 3. Scoring ranges for constituent metrics of the Hydropower-IBI. Thresholds shown are for 500-organism fixed-count samples identified to SAFIT Level II standard taxonomic effort (after Rehn 2010).

SCORE	#ET Taxa Richness	%Intolerant Individuals	%Scrapers	%Non-Insect Taxa	Shannon Diversity	%Predators	%Tolerant Individuals
0	0-4	0-5	0-2	≥20	≤2.35	0-7	≥18
1	5-6	6-9	3-7	19	2.36-2.47	8	16-17
2	7	10-13	8-11	17-18	2.48-2.60	9	15
3	8-9	14-17	12-15	16	2.61-2.72	10	13-14
4	10-11	18-21	16-19	15	2.73-2.84	11	12
5	12-13	22-25	20-23	14	2.85-2.96	12	10-11
6	14-15	26-29	24-27	13	2.97-3.08	13	9
7	16-17	30-33	28-31	11-12	3.09-3.20	14	7-8
8	18	34-37	32-35	10	3.21-3.33	15	6
9	19-20	38-41	36-39	9	3.34-3.49	16	4-5
10	≥21	≥42	≥40	≤8	≥3.50	≥17	≤3

TABLE 4. Summary of biological metrics for 2011 Project 184 SWAMP bioassessment samples

2011 SWAMP BIOASSESSMENT	PROJECT-AFFECTED SITES													REFERENCE SITES									AVERAGES	
	AR-B1 RWB	BU-B1 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	NN-B1 RWB	OG-B1 RWB	PY-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	AR-B2 RWB	BU-B2 RWB	ES-B2 RWB	OG-B2 RWB	NN-B2 RWB	SB-B1 RWB	SH-B1 RWB	WC-B1 RWB	WC-B1 TRC	PROJECT	REFERENCE
RICHNESS-TYPE MEASURES																								
# Total Taxa	40	51	31	36	37	38	50	62	57	36	50	48	38	49	65	48	68	51	58	61	43	49	44	55
# Ephemeroptera Taxa	7	8	3	5	11	10	6	5	8	9	13	7	8	11	7	8	7	6	13	13	9	8	8	9
# Plecoptera Taxa	6	11	3	4	7	6	10	13	12	8	7	7	7	9	11	9	11	11	11	9	10	14	8	11
# Trichoptera Taxa	9	9	3	6	10	9	7	9	11	7	7	11	6	10	8	6	8	8	12	13	6	8	8	9
# Diptera Taxa	9	14	18	16	6	9	19	17	14	5	12	15	11	11	25	16	25	12	12	16	13	16	13	16
# Chironomid Taxa	6	10	15	13	5	7	14	8	11	4	6	10	7	7	13	10	16	6	5	9	6	10	9	9
# ET Taxa*	16	17	6	11	21	19	13	14	19	16	20	18	14	21	15	14	15	14	25	26	15	16	16	18
# EPT Taxa	22	28	9	15	28	25	23	27	31	24	27	25	21	30	26	23	26	25	36	35	25	30	23	28
Shannon Diversity*	2.00	2.94	2.54	2.62	2.69	2.80	3.18	3.41	3.37	2.86	3.10	3.21	2.98	2.71	3.59	2.97	3.67	3.15	3.16	3.39	2.87	2.90	2.90	3.16
Shannon Evenness	0.54	0.75	0.74	0.73	0.75	0.77	0.81	0.83	0.83	0.80	0.79	0.83	0.82	0.70	0.86	0.77	0.87	0.80	0.78	0.83	0.76	0.75	0.77	0.79
Density (#/ft^2)	1245	296	377	517	577	749	343	219	274	156	387	291	255	603	147	374	180	405	294	187	39	74	437	256
COMPOSITION-TYPE MEASURES																								
% EPT	85	79	56	61	88	89	48	61	74	84	78	69	83	67	62	70	48	70	85	73	85	87	73	72
% Sensitive EPT	77	55	52	56	62	53	43	53	64	56	44	49	56	31	46	58	37	58	69	50	54	49	55	50
% Baetidae	<1	13	2	3	7	6	3	4	10	15	18	<1	3	2	5	2	4	10	14	5	4	8	6	6
% Chironomidae	7	7	16	12	5	4	13	4	14	3	5	8	5	2	13	9	15	7	2	15	6	7	8	8
% Hydropsychidae	5	1	0	0	7	22	1	7	0	5	4	5	10	1	3	0	<1	6	3	<1	0	<1	5	2
% Dominant Taxon	56	29	26	26	28	22	18	12	14	16	18	12	16	31	10	26	9	20	14	12	26	29	22	20
% Insect Individuals	97	92	74	76	93	94	82	84	92	89	91	88	94	97	95	90	79	92	95	94	97	98	88	93
% Non-Insect Taxa*	3	8	26	24	7	6	18	16	8	11	9	12	6	3	5	10	21	8	5	6	3	2	12	7
TOLERANCE / INTOLERANCE MEASURES																								
% Tolerant Individuals*	2	<1	3	4	<1	1	5	4	2	1	1	5	3	2	<1	<1	1	2	3	<1	1	1	3	1
% Intolerant Individuals*	76	26	55	56	60	51	35	51	56	56	41	49	52	31	37	35	33	52	72	49	56	49	51	46
Weighted Tolerance Value	2.0	3.3	3.1	3.0	2.5	2.9	3.5	3.0	2.8	2.6	3.1	2.9	2.7	3.5	3.2	3.1	3.6	2.6	1.8	3.0	2.7	2.9	2.9	2.9
FUNCTIONAL FEEDING GROUP MEASURES																								
% Filterers	11	<1	2	3	7	22	<1	3	2	<1	5	12	14	20	2	<1	4	2	1	2	<1	5	6	4
% Scrapers*	12	39	0	1	14	12	15	12	15	27	29	11	17	49	13	38	14	29	37	32	28	38	16	31
% Collectors	9	32	32	31	21	22	44	33	35	40	51	39	32	9	35	30	33	31	29	28	28	20	32	27
% Shredders	6	16	21	21	44	31	20	23	22	20	4	15	15	6	19	18	22	16	13	26	20	15	20	17
% Predators*	7	11	41	41	10	10	18	25	12	13	10	20	21	14	29	13	24	17	19	12	20	14	18	18
% Macrophyte Herbivores	56	1	0	0	<1	0	2	3	14	0	<1	<1	0	<1	<1	<1	<1	4	<1	0	0	0	6	<1
% Piercer Herbivores	0	0	2	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0
% Omnivores	<1	<1	2	3	3	4	1	<1	1	1	<1	2	1	1	2	<1	1	<1	1	0	3	9	2	2
MULTI-METRIC INDEX																								
Hyropower-IBI	42	49	39	41	49	46	50	49	51	50	52	57	56	57	57	53	51	52	63	62	57	59	49	57

TABLE 5. Summary of reach-wide physical habitat measurements from 2011 Project 184 SWAMP bioassessment sites

	2011 SWAMP BIOASSESSMENT	AR-B1	AR-B2	BU-B1	BU-B2	CA-B1	EC-B1	ES-B1	ES-B2	NN-B1	NN-B2	OG-B1	OG-B2	PY-B1	SB-B1	SH-B1	SO-B1	SV-B2	WC-B1
REACH-WIDE MEASUREMENTS *(measured once per site)*																			
GENERAL	Site Elevation (m)	1082	1511	1002	1261	2367	1948	1159	1182	1164	1197	945	1240	1921	1733	1722	1199	2193	2388
GENERAL	Evidence of Recent Rainfall	no	min	no	no	no	no	no	no	min	min	no	min	no	no	min	no	no	no
GENERAL	Evidence of Fires (<500m)	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
GENERAL	Dominat Land Use*	F	F	F	F	F	F/S	F	F	F	F	F	F	F	F	F	F	F	F
GENERAL	Reach Length (m)	150	150	150	150	150	150	100	100	100	60	50	100	150	150	150	150	150	150
GENERAL	Reach Slope (%)	4.8	3.8	11.8	8.0	1.6	6.0	6.3	4.3	17.1	28.0	6.8	4.1	2.2	4.8	3.2	2.4	2.5	4.8
GENERAL	Reach Sinuosity	1.2	1.3	1.2	1.2	1.3	1.2	1.3	1.4	1.3	1.3	1.0	1.0	1.0	1.1	1.1	1.0	1.1	1.2
GENERAL	Discharge (cfs)	1.5	2.2	0.2	7.5	11.4	1.8	0.5	0.5	0.4	0.4	18.9	0.1	15.8	9.1	1.7	77.5	21.5	9.2
RPB	Epifaunal Substrate/Cover (0-20)	18	19	16	18	19	17	19	17	18	14	15	15	19	18	19	18	19	19
RPB	Sediment Deposition (0-20)	19	16	11	13	18	17	18	18	16	15	10	13	20	16	18	16	19	17
RPB	Channel Alteration (0-20)	20	20	19	20	20	17	20	20	19	16	18	15	20	20	20	19	19	20
WATER QUALITY	Sample Date	10/19	10/21	11/15	9/29	10/18	10/17	10/19	10/19	10/19	10/19	10/19	10/21	10/18	10/20	10/20	10/20	10/18	10/18
WATER QUALITY	Sample Time	1500	1030	0930	1400	1200	1400	0930	1020	1500	1400	1220	1040	1700	0930	1300	1030	1330	1000
WATER QUALITY	Water Temperature (°C)	11.6	7.3	6.0	12.4	11.8	9.0	9.3	9.3	10.7	10.7	10.8	9.1	11.7	5.5	8.1	9.6	12.6	6.6
WATER QUALITY	pH	7.3	7.1	7.4	7.7	6.9	7.2	7.4	7.4	7.5	7.5	7.2	7.3	6.7	7.0	7.3	7.2	6.7	7.3
WATER QUALITY	DO Concentration (mg/L)	13.8	11.2	11.2	10.7	9.5	10.2	10.2	10.2	11.5	11.5	11.5	10.5	10.0	11.2	10.6	11.6	9.9	10.0
WATER QUALITY	Specific Conductance (µS/cm)	42	33	86	76	17	51	47	47	115	115	66	89	2	36	40	32	12	47

**Dominant land use= forest (F), subutrb/town (S), rangeland (R)*

TABLE 6a. Summary of transect-based physical habitat measurements from 2011 Project 184 SWAMP bioassessment sites

	2011 SWAMP BIOASSESSMENT	AR-B1	AR-B2	BU-B1	BU-B2	CA-B1	EC-B1	ES-B1	ES-B2	NN-B1	NN-B2	OG-B1	OG-B2	PY-B1	SB-B1	SH-B1	SO-B1	SV-B2	WC-B1
TRANSECT-BASED MEASUREMENTS *(measured at multiple cross-sectional transects within site)*																			
CHANNEL	Mean Wetted Width (m)	11.9	7.1	1.6	1.3	7.9	6.2	1.4	1.5	2.0	1.6	2.6	1.2	7.5	6.3	8.1	31.2	10.5	4.8
	Mean Bankfull Width (m)	22.5	17.5	5.9	3.7	10.7	10.4	3.6	3.7	4.7	4.2	8.5	5.0	11.3	11.1	13.9	43.6	13.0	6.8
	Mean Bankfull Height (m)	0.75	0.66	0.44	1.09	0.48	0.60	0.51	0.56	0.44	0.52	1.04	0.50	6.92	0.66	0.55	0.77	0.45	0.62
	Mean Depth (m)	0.23	0.22	0.09	0.10	0.29	0.13	0.08	0.09	0.06	0.06	0.07	0.08	0.28	0.19	0.19	0.38	0.35	0.30
BED	Median Particle Size (D_{50}) (mm)	450	120	70	22	68	104	57	24	49	300	50	49	215	160	121	383	187	75
	Mean Cobble Embeddedness (%)	12	17	24	35	12	6	23	14	25	2	42	22	7	10	14	11	13	12
	% Bedrock (>4m)	25	13	2	10	16	0	5	0	0	41	8	0	10	16	20	11	12	5
	% Boulder, large (>1m-4m)	10	4	3	0	1	2	0	0	0	0	0	0	4	5	4	7	3	4
	% Boulder, small (>25cm-1m)	23	28	16	2	7	26	8	0	14	10	10	4	34	23	16	47	25	23
	% Cobble (>64mm-25cm)	22	17	30	20	29	41	35	26	30	10	30	38	31	27	27	15	38	24
	% Gravel, coarse (>16-64mm)	8	17	15	21	36	17	26	31	17	5	17	30	8	10	13	4	11	25
	% Gravel, fine (>2-16mm)	10	18	25	18	5	14	13	19	14	12	14	10	9	14	8	14	6	9
	% Sand + %Fines (0-2mm)	3	3	9	29	7	0	13	24	24	21	22	18	5	6	12	2	5	11
	CPOM Presence (%)	77	68	88	94	56	41	72	78	91	81	84	91	44	47	85	49	38	76
	Mean Microalgae Thickness (mm)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Attached Macroalgae Presence (%)	0	40	0	3	57	9	0	0	0	0	4	1	32	11	7	37	53	19
	Unattached Macroalgae Presence (%)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Macrophyte Presence (%)	5	30	25	10	3	0	8	2	27	48	10	12	0	3	62	26	4	0
BANK	Stable Banks (%)	95	100	41	100	100	100	0	32	100	100	0	0	100	91	100	100	100	100
	Vulnerable Banks (%)	5	0	0	0	0	0	68	23	0	0	45	36	0	0	0	0	0	0
	Eroded Banks (%)	0	0	59	0	0	0	32	45	0	0	55	64	0	9	0	0	0	0

TABLE 6b. Summary of Transect-Based Physical Habitat Measurements from 2011 Project 184 SWAMP Bioassessment Sites (cont'd)

	2011 SWAMP BIOASSESSMENT	AR-B1	AR-B2	BU-B1	BU-B2	CA-B1	EC-B1	ES-B1	ES-B2	NN-B1	NN-B2	OG-B1	OG-B2	PY-B1	SB-B1	SH-B1	SO-B1	SV-B2	WC-B1
TRANSECT-BASED MEASUREMENTS cont'd *(measured at multiple cross-sectional transects within site)*																			
HABITAT TYPE	Cascade/Fall (%)	4	2	7	5	0	3	1	1	7	20	0	1	0	3	1	2	1	6
	Rapid (%)	5	0	0	0	1	3	0	0	3	15	33	0	0	3	5	3	0	4
	Riffle (%)	24	24	31	47	45	64	48	47	46	30	55	42	35	45	29	37	42	18
	Run (%)	15	12	13	11	35	10	16	22	13	1	4	30	27	33	10	50	38	18
	Glide (%)	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pool (%)	53	63	44	32	20	22	32	31	32	35	10	22	38	17	56	9	20	46
	Dry Channel (%)	0	0	6	2	0	0	0	0	0	0	0	6	0	0	0	0	0	0
HABITAT COMPLEXITY	Filamentous Algae	A/S	A/S	A	A	S/M	A	A	A	A	A	A	A	A/S	A/S	A/S	A/S	A/S	A/S
	Aquatic Macrophytes	S	S/M	S	A/S	M/H	A/S	A/S	A/S	A/S	A/S	S	A/S	A/S	A/S	M/H	S/M	A/S	A
	Boulders	H/VH	M/H	M/H	S/M	S/M	M/H	S/M	A/S	M	M	M/H	S/M	M/H	M/H	M/H	M/H	M/H	M/H
	Woody Debris >3m	A/S	A	A/S	S/M	S/M	A/S	S/M	A/S	A/S	S/M	A/S	S	A/S	A/S	A/S	A/S	A/S	A/S
	Woody Debris <3m	S	A/S	S/M	S/M	S	S	S	S	S	S	S	S	S	S	S	S	S	S/M
	Undercut Banks	A/S	A	A/S	H/VH	S	A/S	S/M	A/S	A/S	A/S	A/S	A/S	S	A/S	A	A/S	A/S	A/S
	Overhanging Vegetation	S/M	S/M	M/H	M/H	S/M	M/H	S/M	M	M/H	M	S	M/H	S/M	S	M/H	S	S	M/H
	Live Tree Roots	A/S	A/S	A/S	A/S	A/S	A/S	A/S	A/S	A/S	A/S	S	A/S	A/S	A/S	A/S	A/S	A/S	A/S
	Artificial Structures	A/S	A	A/S	A	A	A/S	A	A	A/S	A/S	A	A	A	A/S	A	A/S	A	A

**Habitat Complexity Codes= Absent (A), Sparse (S), Moderate (M), Heavy (H), Very Heavy (VH)*

TABLE 6c. Summary of Transect-Based Physical Habitat Measurements from 2011 Project 184 SWAMP Bioassessment Sites (cont'd)

	2011 SWAMP BIOASSESSMENT	AR-B1	AR-B2	BU-B1	BU-B2	CA-B1	EC-B1	ES-B1	ES-B2	NN-B1	NN-B2	OG-B1	OG-B2	PY-B1	SB-B1	SH-B1	SO-B1	SV-B2	WC-B1
TRANSECT-BASED MEASUREMENTS cont'd *(measured at multiple cross-sectional transects within site)*																			
RIPARIAN*	Mean Total Canopy Cover (%)	58	26	95	95	42	66	98	98	98	98	87	97	62	58	63	27	46	53
	Trees/Saplings (>5m high)	M/H	M	H/VH	M/H	M/H	M/H	H/VH	H/VH	H/VH	H/VH	M/H	H/VH	M/H	M/H	M/H	H/VH	M/H	S/M
	Shrubs/Saplings (0.5-5m high)	M/H	M	M/H	M/H	M/H	S/M	M/H	H/VH	S/M	S/M	M/H	M/H	S/M	S/M	S/M	M	S/M	M/H
	Woody Shrubs/Saplings (<0.5m high)	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	S/M	M
	Herbs/Grasses (<0.5m high)	S/M	S/M	S/M	S/M	M/H	S/M	S/M	S/M	H/VH	S	A/S	S/M	S/M	S/M	S	S/M	S/M	M/H
	Barren Soil/Duff (<0.5m high)	M/H	M/H	M/H	S/M	S/M	M/H	H/VH	M/H	S/M	VH	S	H	M/H	M/H	M/H	M/H	M/H	S/M
HUMAN INFLUENCE	Walls/Rip-Rap/Dams (%)	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0
	Buildings (%)	5	0	27	0	0	5	0	0	5	0	0	0	0	59	0	0	0	0
	Pavement/Cleared Lot (%)	9	0	27	0	0	5	0	0	0	0	0	0	0	18	0	0	0	0
	Road/Railroad (%)	68	0	14	0	0	32	50	77	0	0	0	0	0	18	0	50	0	0
	Pipes/(Inlet/Outlet) (%)	0	0	5	0	0	0	0	0	90	100	0	0	0	14	0	0	0	0
	Landfill/Trash (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Park/Lawn (%)	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	5	0
	Row Crops (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pasture/Range (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Logging Operations (%)	0	0	0	9	0	0	0	0	0	0	0	50	0	0	0	0	0	0
	Mining Activity (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vegetation Management (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bridges/Abutments (%)	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orchards/Vineyards (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Riparian Vegetation Codes= Absent (A), Sparse (S), Moderate (M), Heavy (H), Very Heavy (VH)*

Appendix A

500-Organism Fixed-Count Taxa Lists
2011 Project 184 SWAMP Bioassessment

APPENDIX A. 2011 Project 184 SWAMP Bioassessment 500-Organism Fixed-Count Taxa Lists

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Hydra					55	39								2								
Turbellaria			12	1	7	11		4	5	8	2	4	5	13			1				2	
Sphaeriidae															1							
Pisidium						7	1				12	4		5		1			26	13		
Juga			7	2					10	11	8			25								
Gyraulus													2	2								
Oligochaeta	5	5	20	12	65	63	33	24	51	24	30	16	23	43	48	6	27	30	22	7	4	6
Acari																						
Utaxatax											1		1									
Athienemanniidae											1	3										
Hydrovolzia			1								7	2										
Cyclothyas											8	8										
Protzia	2										4	3				8	1	1				
Wandesia																2						
Atractides	1	1						1								1		1				
Hygrobates							1										1					
Estelloxus												1	1									
Lebertia	4										3	1			1	4		4			5	1
Limnochares														1								
Mideopsis				1										1								
Sperchon		8											2									
Sperchonopsis								2							3							
Stygothrombium														1	2			2				
Testudacarus						2																
Torrenticola	2			7					1	8			3	12		2		5	12	11		1
Ostracoda			1		2				21	1	3		3								2	
Ameletus	1	1	1	2			1			1			6	7	2	1	11	1	7	2	36	13
Baetis tricaudatus	2	9	8	4	9	17	33	30			13	39	45		74	68	9	89	2	11	8	36
Diphetor hageni			56	20					15	12	6	13	4	20			18			3	13	5
Attenella delantala																13		10				
Caudatella hystrix		1					8	12				3			7	8		2				
Drunella doddsi							2	12								26	4	8				
Drunella grandis						1	1	5					1		9	2	6	5			3	
Drunella pelosa		4											11					17				
Ephemerella	27	6	9	15	21	30	13	15	7	28			19	9	8	4	19	63	62	80	34	11
Ephemerella velmae		1														2	3					
Cinygma			3	5					2	6	1	3		2								
Cinygmula	14	153	32			1	52	36	7	29				9	30	6	50	61	12	38	131	145
Ecdyonurus																	12					
Epeorus	14	44					8	3		2					78	68	24	20	20	19	2	4
Ironodes	3	5	144	47			6	8	38	128	30	36	25	27		2	1	8	3	21		
Rhithrogena	1	1					2	14							20	40	18	9			4	37
Paraleptophlebia		12	20	48	3	7	7	2	4	20	18	8	1	22	35	6	26	4	49	32	4	4
Capniidae		3	19	2		1	1		4	3	9	13	3	2		4	4				35	12
Eucapnopsis brevicauda		3												2		1	5	1			3	3
Kathroperla									1	1				6								
Sweltsa	1	10	11	14	130	131	20	10	37	17	12		3	22	6	12	17	15	51	57	36	29
Leuctridae			1		14	19			1		3		2	1			2		2			12
Moselia infuscata			14	27					16	7	2	1	8	25		1						
Malenka				3							6	3	7									
Soyedina			6	8					5	1	25	12	3	21								
Visoka cataractae														3		1						
Zapada cinctipes	1	6	21	34	76	78	51	83	33	39	56	26	36	4	30	11	27	1	13	33	53	35
Zapada columbiana											2		1									2
Zapada frigida														9	1		5					
Zapada oregonensis group		11	9	4			16	25	17	20	3	5	14		30	3	7		13	28	2	9
Sierraperla cora												1										
Soliperla											2	1										
Yoraperla			1	6											32					2		
Calineuria californica	1	7	4	7			10	9	9	13			9	1	5	6	7	3	1	4		1
Doroneuria baumanni							4	4							6							

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Hesperoperla hoguei				5					6		23	18				1						
Frisonia picticeps																					6	7
Isoperla	6	9											4					4	4	5	2	
Kogotus nonus																	2				5	2
Oroperla barbara	1															1		3				1
Perlinodes aurea		4																4				2
Skwala																			3	3	19	13
Susulus venustus			3								1	1										
Pteronarcys princeps			1	6						1		1	1									
Taeniopterygidae	1	3					6	10			2				2	1					13	35
Apatania					1	2											1				2	2
Pedomoecus sierra																2						
Amiocentrus aspilus		3					5	2		1			16		1		3					1
Micrasema	281	4	3	4			2		8	3	16	21	69	1		1		2	1			
Heteroplectron californicum							2							1			5		4			
Agapetus	1																					
Anagapetus			7						14	14	5	2	15									
Glossosoma	5	8											30			1	1	6	1			
Arctopsyche grandis															23	14						
Hydropsyche	25	6					36	108								1	2	16	27	51		2
Parapsyche			7	14					6		37	29		1				2				
Agraylea								1														
Hydroptila					9	2																
Lepidostoma	27	5	2		17	9	140	40	3	1			16	13	7	43	13	20	43	10	4	
Mystacides alafimbriata																			2			
Limnephilidae							3	1					1			4						2
Cryptochia											1											
Ecclisomyia																					1	1
Psychoglypha																					3	
Dolophilodes			2								2	1		2				4				
Wormaldia				4																		
Yphria californica				1																		
Polycentropus			4	10					1					3	1		6		8			
Rhyacophila				4				2											6	5		
Rhyacophila arnaudi																	3					
Rhyacophila betteni group	1	4	2	1		1	3	8	1		8	3	2		9	1	2			1	2	3
Rhyacophila brunnea group	3	1				3	3	3			1		4		3				6	10		4
Rhyacophila grandis group			4										1									
Rhyacophila hyalinata group												3	1			7						
Rhyacophila oreta group										1												
Rhyacophila sibirica group	4	3	1	16		3	2		5	3	7	3	11	15		4	1					
Gumaga								1						12			1		2	1		
Farula											13	102										
Neophylax	5																					
Neophylax occidentalis		4					1									5	7	10				
Oligophlebodes		2													1	53	41		3		3	3
Cordulegaster dorsalis				1																		
Octogomphus specularis				12																		
Dysmicohermes				1										1								
Orohermes crepusculus		14											1			6	4	1	1			
Sialis				3										3							2	
Sanfilippodytes											1											
Ampumixis dispar	3																					
Cleptelmis addenda		2													2		1		9	3		
Heterlimnius			19	35					90	37	58	35	1	26								
Lara				4						1	5	13		9								
Narpus									2	1	1	1	1	1				2				
Optioservus	8	23															2	16	2			
Ordobrevia nubifera	2															2						
Zaitzevia parvula		4													4	4	1	10	7	1		
Zaitzevia posthonia			1	7						1				2								
Hydraena				3								1	1	5								
Ametor scabrosus											1						1					
Eubrianax edwardsi	3	1	2														4	3	7	8		
Anchycteis			1	1					2		2	7										
Elodes											1											
Atherix pachypus																15		3				

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Ceratopogonidae				2																		
Atrichopogon											1											
Bezzia/Palpomyia				3				1		1	3			8		4	5		2		6	3
Forcipomyia			2																			
Boreochlus			1								1	3		1								
Brillia			7				10	5	20	17	1		21	8		2					1	1
Brundiniella eumorpha				7																		
Cardiocladius		1																				
Chironomini														1								
Conchapelopia																					2	
Corynoneura			1						3					2			2					
Cricotopus (Nostococladius)				4													60					
Cricotopus ssp.					11	3		2									1		4	3		
Diamesa					1	6															11	7
Eukiefferiella brehmi group	3																					
Eukiefferiella claripennis group			3									2	3									
Eukiefferiella devonica group		2			1	5		1														2
Eukiefferiella gracei group																		1				3
Eukiefferiella ssp.					10	8																
Heleniella														1		1						
Larsia				2																		
Limnophyes									3								1					
Macropelopia													1	3								
Metriocnemus			1																			
Micropsectra	2	1	3	7	6	5			5	4	2	13	16	6	7	2	3	4	3	2	8	2
Micropsectra/Tanytarsus							3	2														
Microtendipes pedellus group				2					1										5			
Nanocladius						1							1						2	1		
Natarsia				2					1													
Odontomesa											1											
Orthocladiinae			10	1					10	4	1		1	1								
Orthocladius					4	11											1	8				
Orthocladius complex		1			15	2							5						4	1	4	3
Orthocladius lignicola					2																	
Pagastia					1					2							1					
Paramerina		1																				
Parametriocnemus			5	19					9	3	5	9	10	15								
Paratanytarsus					1	5													2			
Parochlus																						2
Parorthocladius																1	1					
Phaenopsectra									4													
Polypedilum							5	5						6	3				10	6		
Potthastia longimana group					6														1			
Psilometriocnemus																						
Reomyia			2	12					3	4			3	9								
Rheocricotopus		1		3			3	1	3				1	1								
Rheopelopia					9	8	4												2	4		
Rheotanytarsus	27															2	4	2				
Robackia																		1				
Stempellina				3						6	7	2		6								
Sublettea	1																					
Synorthocladius					8	3									3							
Tanypodinae																						1
Tanytarsus		2		3	4	2				1				15							2	10
Thienemanniella	1								1													
Thienemannimyia group									2	2				1								
Tvetenia bavarica group	2		2	1	2	2		3	1	2	2	5	10	1	2			9	5	8		3
Dixa										1	1			1			2					
Meringodixa chalonensis				1							4			2								
Chelifera/Metachela					2	8																
Empididae														1								
Neoplasta	1		2	6					3		2	1	5				1	1				
Oreogeton				2					2			1	2	1								1
Wiedemannia	6	4						5							4			1	3			
Glutops				2					3	1	2	2										
Maruina lanceolata	2										2							2				
Pericoma/Telmatoscopus			1	4							10	10				6					9	3
Prosimulium																1						
Simulium ssp.		93	1	2	6	1			2		3	4	8				4	4	1	5	1	11
Antocha				1	2	3										1	1	1	24	8		
Dicranota		2		3					2	3		1		8		1	5				3	2
Hesperoconopa				2						5				1							4	2
Hexatoma		1					2			1				5		4			1	1	9	
Limnophila				5										4			2			2		
Rhabdomastix																					1	
TOTAL	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*

Appendix B

Estimated Whole-Sample Taxa Lists
2011 Project 184 SWAMP Bioassessment

APPENDIX B. 2011 Project 184 SWAMP Bioassessment Estimated Whole-Sample Taxa Lists

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Hydra					541	315			6					3								
Turbellaria			58	8	62	82		58	42	36	20	34	29	57	3	5	3				1	
Sphaeriidae															8							
Pisidium					14	89	48	10	18		48	27		24		5			271	47		
Juga			29	5					36	126	40			90								
Gyraulus													5	15								
Oligochaeta	77	90	163	35	596	596	375	337	299	228	200	192	139	174	139	48	127	219	144	43	3	8
Acari																						
Utaxatax											4		5									
Athienemanniidae											4	14										
Hydrovolzia			5								20	7										
Cyclothyas											36	41										
Hydryphantidae											4											
Protzia	77	20	5								20	27				34	3	7				
Wandesia																5						
Atractides	19	10		3				19								5		7				
Hygrobates							10										10					
Estelloxus				3								7	10									
Lebertia	77										12	7			5	34	7	27	5	3	5	1
Limnochares														3								
Mideopsis				5										3								
Sperchon	58	90											5									
Sperchonopsis		10						10					5		5	5		7				
Stygothrombium											4			3	3			14				
Testudacarus				3	7	7		10	6		4											
Torrenticola	77			33					6	42			14	60		14		27	59	33		1
Ostracoda			10		7				162	12	8		10	3							1	
Asellidae													5						5			
Ameletus	19	20	5	3			10			6			67	24	5	14	31	14	27	10	35	14
Baetis tricaudatus	135	160	48	18	96	130	337	356		6	44	322	255		229	428	24	705	32	43	6	40
Diphetor hageni			303	85					114	66	52	130	14	63			55		11	7	12	5
Attenella delantala																53		103				
Caudatella hystrix		20				7	67	115				34	14		24	58	3	21				
Drunella doddsi	19						38	125								192	21	21				
Drunella grandis	19					7	19	48					10		32	29	17	27			2	
Drunella pelosa		40											53					151				
Ephemerella	750	90	58	65	226	205	240	87	30	222			120	42	56	43	45	397	404	320	26	12
Ephemerella velmae		20														14	7					
Cinygma			19	13					24	42	8	14		9								
Cinygmula	365	1900	163			7	529	433	78	204				39	91	29	267	575	64	100	117	175
Ecdyonurus																	31					
Epeorus	577	590					77	19		24					288	462	116	192	101	77	2	4
Ironodes	38	70	913	163			48	115	305	964	144	377	135	126	3	5	7	34	21	87		
Rhithrogena	19	50					29	125							48	240	51	116			9	37
Paraleptophlebia	38	150	96	188	41	62	58	77	18	96	56	48	10	78	123	34	123	27	271	133	4	5
Siphlonuridae																	3					
Capniidae		20	144	5	7	27	10		54	48	56	116	19	9		14	24	7			29	14
Eucapnopsis brevicauda		60	5										5	3		5	10	7			2	3
Kathroperla			5						6	6				28								
Sweltsa	38	90	115	30	1116	1158	269	154	317	180	52	27	24	87	24	72	75	116	287	217	30	34
Leuctridae			5		75	123			6		12	7	10	3	3		14		5			13
Moselia infuscata			91	105					120	72	8	7	58	81		5						
Malenka			5	10						6	24	21	14									
Soyedina			58	25					60	30	108	62	10	54								
Visoka cataractae														12		5						
Zapada cinctipes	77	130	135	90	521	548	740	1010	210	377	300	205	236	33	104	82	55	27	48	110	43	45
Zapada columbiana											12	14	5									3
Zapada frigida							10	10		6				21	3		24					
Zapada oregonensis group		110	77	13			212	365	126	162	20	48	72		93	19	21		80	140	3	11
Sierraperla cora									6			21										
Soliperla											8	7										

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Yoraperla		30	5	10							4	27		3	123				5	3		
Calineuria californica	19	104	25	17			78	100	108	105			36	9	13	29	31	22	22	13		1
Doroneuria baumanni							39	53							28							
Hesperoperla hoguei			20	16					27		87	121	1	3		1						
Hesperoperla pacifica										1								1				
Cultus	58																	7				
Frisonia picticeps																					5	8
Isoperla	231	100								6			53					48	48	33	1	1
Kogotus nonus																	7				5	2
Oroperla barbara	19	10														12		22				1
Perlinodes aurea	3	12																14				2
Skwala																6			16	18	13	16
Susulus venustus			5								4	7										
Pteronarcys princeps			14	11					1	6		4	1					1				
Taeniopterygidae	19	50					58	96			20				3	10					8	41
Apatania		10			7	27											3				2	2
Pedomoecus sierra																19						
Amiocentrus aspilus		70					87	67		6			77		3		17	7				1
Micrasema	7423	90	34	10			10		84	30	52	178	433	3		10		34	5			
Heteroplectron californicum			5	5			38						5	12			7		16			
Agapetus	19																3					
Anagapetus			19	3					168	126	16	27	67		3							
Glossosoma	77	100											168			10	3	27	5			
Arctopsyche grandis															67	149						
Hydropsyche	750	120					442	1183					5			10	7	137	186	220		2
Parapsyche			48	45					36	6	148	281		3				7				
Agraylea								10														
Hydroptila					48	21														3		
Lepidostoma	750	70	14		144	68	1894	500	24	12	4		144	54	29	245	65	199	266	67	2	
Mystacides alafimbriata																			11			
Limnephilidae							38	10					10			19	3					3
Cryptochia											4	7										
Ecclisomyia																					2	2
Psychoglypha																					3	
Dolophilodes			14	3							4	7		6				48				
Wormaldia				10						18												
Yphria californica				3					6								3					
Polycentropus			34	23					6					6	3		21		48	3		
Rhyacophila				5				19											21	7		
Rhyacophila angelita group																	3					
Rhyacophila arnaudi																5	4					
Rhyacophila betteni group	19	30	10	3		7	19	48	12		37	21	10		29	10	11		5	3	2	4
Rhyacophila brunnea group	59	20	5		7	14	19	38	12		4	7	29		16	5			21	27		4
Rhyacophila grandis group			19										10									
Rhyacophila hyalinata group	19	20				7						21	5			72		28				
Rhyacophila oreta group										6												
Rhyacophila sibirica group	58	20	14	40		7	29		36	18	44	62	43	39		24	7					1
Gumaga								10						39			3		5	3		
Farula											48	938										
Neophylax	77																					
Neophylax occidentalis		50					10									19	27	137				
Oligophlebodes		10													5	337	147	7	5	3	3	3
Cordulegaster dorsalis				7							5			1								
Octogomphus specularis				26																		
Dysmicohermes				1										3								
Orohermes crepusculus	2	130						11					7			15	11	7	14	3		
Sialis				5										12							2	
Agabus				3																		
Sanfilippodytes											4											
Ampumixis dispar	58																					
Cleptelmis addenda	19	20													11		7		53	20		
Heterlimnius			144	120					593	317	328	267	5	126								

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Lara	19		5	13					6	6	40	55		36								
Narpus									12	6	4	21	5	6				7				
Optioservus	173	350														5	14	171	11			
Ordobrevia nubifera	19															5		7				
Zaitzevia parvula		70													8	38	7	75	74	10		
Zaitzevia posthonia			5	33					6	6				6								
Stenocolus scutellaris																		2				
Hydraena			5	5					12			7	5	15								
Ametor scabrosus											4						3					
Eubrianax edwardsi	77	20	10														24	21	53	53		
Anchycteis			6	3					7	6	15	48										
Elodes											8											
Diptera											4											
Atherix pachypus																82		48				
Ceratopogonidae				3																		
Atrichopogon											4											
Bezzia/Palpomyia		20		10			29	38		12	8			45		10	21		16	3	4	3
Forcipomyia			5																			
Probezzia			5																			
Stilobezzia		10																				
Chironomini														3								
Microtendipes pedellus group	38			5					6										48			
Phaenopsectra									18					3					5			
Polypedilum							87	67						15	11				69	30		
Robackia																		14				
Micropsectra	38	10	14	30	48	41			42	54	4	96	87	30	19	10	14	62	27	7	5	2
Micropsectra/Tanytarsus							96	19														
Paratanytarsus					21	41													11			
Rheotanytarsus	731														3	14	14	14				
Stempellina				10					6	48	28	27		27								
Sublettea	19														3							
Tanytarsus		10		10	34	21				6			5	48							2	13
Diamesa					21	55												7			8	12
Pagastia					7	14				24		7					3		5			1
Potthastia longimana group					34	14													5			
Orthocladiinae			63	3					78	24	12		34	3								
Brillia			24				135	115	156	114	12		106	45	3	5	7				1	1
Cardiocladius		10																				
Corynoneura			5						24					3			3					
Cricotopus ssp.	38				68	14		10									3		21	10		
Cricotopus (Nostococladius)	19			8												14	298					
Eukiefferiella ssp.					75	55		10													1	
Eukiefferiella brehmi group	77			3												14						
Eukiefferiella claripennis group			19						12			21	24		3			7				
Eukiefferiella devonica group		30			14	34		29												3		2
Eukiefferiella gracei group																		21				3
Heleniella														3		5						
Krenosmittia										6												
Limnophyes									12								3					
Metriocnemus			5																			
Nanocladius			5		7	7					4		5						16	7		
Orthocladius	19				27	62	10										3	62				
Orthocladius complex		10	5		82	27			6				24			5		7	21	7	4	5
Orthocladius lignicola					7																	
Parametriocnemus			48	65					54	24	16	103	67	45		5						
Parorthocladius																5	7					1
Psilometriocnemus																						
Rheocricotopus		10		8			38	10	12	6	4	7	5	9	5							
Synorthocladius					27	14									11							
Thienemanniella	19		5						6				5									
Tvetenia bavarica group	19		5	5	21	34		29	12	12	8	48	43	3	5			41	37	17		3
Tvetenia discoloripes group									6									7				

Final SAFIT ID	AR-B1 RWB	AR-B2 RWB	BU-B1 RWB	BU-B2 RWB	CA-B1 RWB	CA-B1 TRC	EC-B1 RWB	EC-B1 TRC	ES-B1 RWB	ES-B2 RWB	NN-B1 RWB	NN-B2 RWB	OG-B1 RWB	OG-B2 RWB	PY-B1 RWB	SB-B1 RWB	SH-B1 RWB	SO-B1 RWB	SV-B2 RWB	SV-B2 TRC	WC-B1 RWB	WC-B1 TRC
Boreochlus			5							6	4	14		3								
Parochlus																						2
Odontomesa											4											
Tanypodinae																						1
Brundiniella eumorpha				20																		
Conchapelopia																					3	
Larsia				5																		
Macropelopia													10	9								
Natarsia				3					6					3								
Paramerina		10																				
Rheopelopia					48	89	48												32	7		
Reomyia			19	23					12	12			10	36			3					
Thienemannimyia group									18	18				3								
Dixa										6	4	7		3			10					
Meringodixa chalonensis				3							8		5	3								
Chelifera/Metachela					41	55																
Neoplasta	38		10	23					18		12	41	38		3		3	7	5			
Oreogeton			10	3					12	6		14	5	6								1
Wiedemannia	154	30		3				29					14		16			14	11	3		
Empididae														15								
Glutops				5					24	12	12	21		3								
Maruina lanceolata	38										4							7				
Pericoma/Telmatoscopus			14	8							40	75				14	14				7	3
Prosimulium																5						
Simulium ssp.		1180	10	5	41	7			6		8	48	43				14	41	5	37	1	17
Antocha				3	7	41				6						14	7	14	133	40		
Dicranota	1	42		5				10	20	24		7	5	42		5	17				2	2
Hesperoconopa				5						30				3							4	2
Hexatoma		10		3			19			20				22	3	12			5	8	6	
Limnophila				10										18			3		1	3		
Rhabdomastix																					2	
Tipula		1							6													
TOTAL	**13694**	**6629**	**3251**	**1615**	**4145**	**4139**	**6349**	**5994**	**3777**	**4112**	**2412**	**4458**	**3012**	**1980**	**1715**	**3232**	**2059**	**4257**	**3198**	**2041**	**428**	**593**

Appendix C

Site Photographs
2011 Project 184 SWAMP Bioassessment

FIGURE AR-B1-1. Looking upstream from the bottom transect (A) at Site AR-B1

FIGURE AR-B1-2. Looking downstream from the bottom transect (A) at Site AR-B1

FIGURE AR-B1-3. Looking upstream from the middle transect (F) at Site AR-B1

FIGURE AR-B1-4. Looking downstream from the middle transect (F) at Site AR-B1

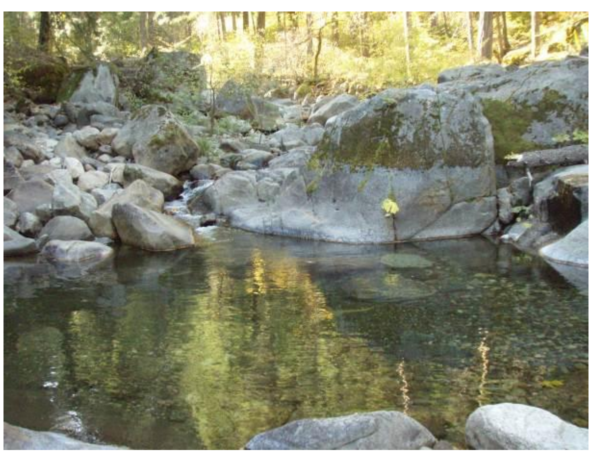

FIGURE AR-B1-5. Looking upstream from the upper transect (K) at Site AR-B1

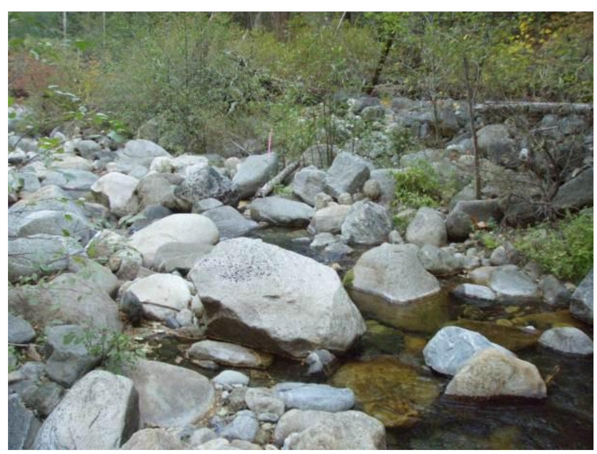

FIGURE AR-B1-6. Looking downstream from the upper transect (K) at Site AR-B1

FIGURE AR-B2-1. Looking upstream from the bottom transect (A) at Site AR-B2

FIGURE AR-B2-2. Looking downstream from the bottom transect (A) at Site AR-B2

FIGURE AR-B2-3. Looking upstream from the middle transect (F) at Site AR-B2

FIGURE AR-B2-4. Looking downstream from the middle transect (F) at Site AR-B2

FIGURE AR-B2-5. Looking upstream from the upper transect (K) at Site AR-B2

FIGURE AR-B2-6. Looking downstream from the upper transect (K) at Site AR-B2

FIGURE CA-B1-1. Looking upstream from the bottom transect (A) at Site CA-B1

FIGURE CA-B1-2. Looking downstream from the bottom transect (A) at Site CA-B1

FIGURE CA-B1-3. Looking upstream from the middle transect (F) at Site CA-B1

FIGURE CA-B1-4. Looking downstream from the middle transect (F) at Site CA-B1

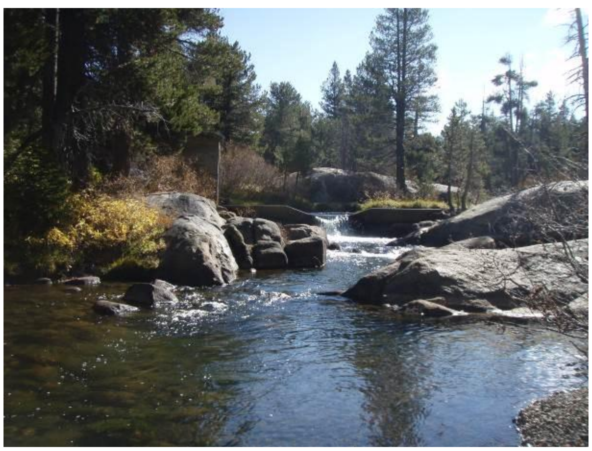

FIGURE CA-B1-5. Looking upstream from the upper transect (K) at Site CA-B1

FIGURE CA-B1-6. Looking downstream from the upper transect (K) at Site CA-B1

FIGURE EC-B1-1. Looking upstream from the bottom transect (A) at Site EC-B1

FIGURE EC-B1-2. Looking downstream from the bottom transect (A) at Site EC-B1

FIGURE EC-B1-3. Looking upstream from the middle transect (F) at Site EC-B1

FIGURE EC-B1-4. Looking downstream from the middle transect (F) at Site EC-B1

FIGURE EC-B1-5. Looking upstream from the upper transect (K) at Site EC-B1

FIGURE EC-B1-6. Looking downstream from the upper transect (K) at Site EC-B1

FIGURE ES-B1-1. Looking upstream from the bottom transect (A) at Site ES-B1

FIGURE ES-B1-2. Looking downstream from the bottom transect (A) at Site ES-B1

FIGURE ES-B1-3. Looking upstream from the middle transect (F) at Site ES-B1

FIGURE ES-B1-4. Looking downstream from the middle transect (F) at Site ES-B1

FIGURE ES-B1-5. Looking upstream from the upper transect (K) at Site ES-B1

FIGURE ES-B1-6. Looking downstream from the upper transect (K) at Site ES-B1

FIGURE ES-B2-1. Looking upstream from the bottom transect (A) at Site ES-B2

FIGURE ES-B2-2. Looking downstream from the bottom transect (A) at Site ES-B2

FIGURE ES-B2-3. Looking upstream from the middle transect (F) at Site ES-B2

FIGURE ES-B2-4. Looking downstream from the middle transect (F) at Site ES-B2

FIGURE ES-B2-5. Looking upstream from the upper transect (K) at Site ES-B2

FIGURE ES-B2-6. Looking downstream from the upper transect (K) at Site ES-B2

FIGURE NN-B1-1. Looking upstream from the bottom transect (A) at Site NN-B1

FIGURE NN-B1-2. Looking downstream from the bottom transect (A) at Site NN-B1

FIGURE NN-B1-3. Looking upstream from the middle transect (F) at Site NN-B1

FIGURE NN-B1-4. Looking downstream from the middle transect (F) at Site NN-B1

FIGURE NN-B1-5. Looking upstream from the upper transect (K) at Site NN-B1

FIGURE NN-B1-6. Looking downstream from the upper transect (K) at Site NN-B1

FIGURE NN-B2-1. Looking upstream from the bottom transect (A) at Site NN-B2

FIGURE NN-B2-2. Looking downstream from the bottom transect (A) at Site NN-B2

FIGURE NN-B2-3. Looking upstream from the middle transect (F) at Site NN-B2

FIGURE NN-B2-4. Looking downstream from the middle transect (F) at Site NN-B2

FIGURE NN-B2-5. Looking upstream from the upper transect (K) at Site NN-B2

FIGURE NN-B2-6. Looking downstream from the upper transect (K) at Site NN-B2

FIGURE OG-B1-1. Looking upstream from the bottom transect (A) at Site OG-B1

FIGURE OG-B1-2. Looking downstream from the bottom transect (A) at Site OG-B1

FIGURE OG-B1-3. Looking upstream from the middle transect (F) at Site OG-B1

FIGURE OG-B1-4. Looking downstream from the middle transect (F) at Site OG-B1

FIGURE OG-B1-5. Looking upstream from the upper transect (K) at Site OG-B1

FIGURE OG-B1-6. Looking downstream from the upper transect (K) at Site OG-B1

FIGURE OG-B2-1. Looking upstream from the bottom transect (A) at Site OG-B2

FIGURE OG-B2-2. Looking downstream from the bottom transect (A) at Site OG-B2

FIGURE OG-B2-3. Looking upstream from the middle transect (F) at Site OG-B2

FIGURE OG-B2-4. Looking downstream from the middle transect (F) at Site OG-B2

FIGURE OG-B2-5. Looking upstream from the upper transect (K) at Site OG-B2

FIGURE OG-B2-6. Looking downstream from the upper transect (K) at Site OG-B2

FIGURE PY-B1-1. Looking upstream from the bottom transect (A) at Site PY-B1

FIGURE PY-B1-2. Looking downstream from the bottom transect (A) at Site PY-B1

FIGURE PY-B1-3. Looking upstream from the middle transect (F) at Site PY-B1

FIGURE PY-B1-4. Looking downstream from the middle transect (F) at Site PY-B1

FIGURE PY-B1-5. Looking upstream from the upper transect (K) at Site PY-B1

FIGURE PY-B1-6. Looking downstream from the upper transect (K) at Site PY-B1

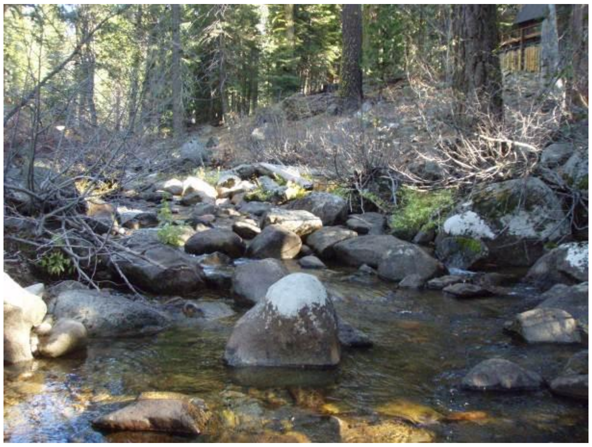

FIGURE SB-B1-1. Looking upstream from the bottom transect (A) at Site SB-B1

FIGURE SB-B1-2. Looking downstream from the bottom transect (A) at Site SB-B1

FIGURE SB-B1-3. Looking upstream from the middle transect (F) at Site SB-B1

FIGURE SB-B1-4. Looking downstream from the middle transect (F) at Site SB-B1

FIGURE SB-B1-5. Looking upstream from the upper transect (K) at Site SB-B1

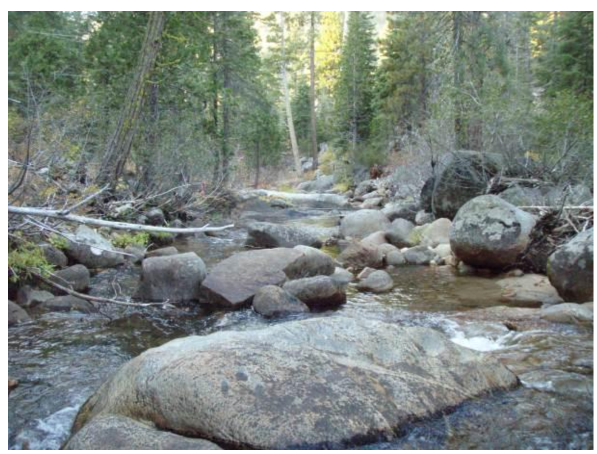

FIGURE SB-B1-6. Looking downstream from the upper transect (K) at Site SB-B1

FIGURE SH-B1-1. Looking upstream from the bottom transect (A) at Site SH-B1

FIGURE SH-B1-2. Looking downstream from the bottom transect (A) at Site SH-B1

FIGURE SH-B1-3. Looking upstream from the middle transect (F) at Site SH-B1

FIGURE SH-B1-4. Looking downstream from the middle transect (F) at Site SH-B1

FIGURE SH-B1-5. Looking upstream from the upper transect (K) at Site SH-B1

FIGURE SH-B1-6. Looking downstream from the upper transect (K) at Site SH-B1

FIGURE SO-B1-1. Looking upstream from the bottom transect (A) at Site SO-B1

FIGURE SO-B1-2. Looking downstream from the bottom transect (A) at Site SO-B1

FIGURE SO-B1-3. Looking upstream from the middle transect (F) at Site SO-B1

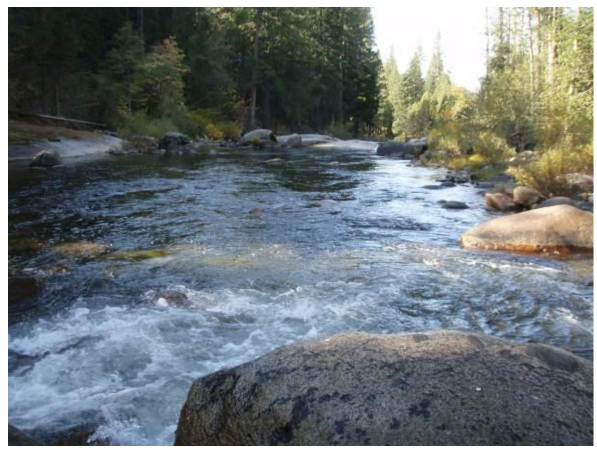

FIGURE SO-B1-4. Looking downstream from the middle transect (F) at Site SO-B1

FIGURE SO-B1-5. Looking upstream from the upper transect (K) at Site SO-B1

FIGURE SO-B1-6. Looking downstream from the upper transect (K) at Site SO-B1

FIGURE SV-B2-1. Looking upstream from the bottom transect (A) at Site SV-B2

FIGURE SV-B2-2. Looking downstream from the bottom transect (A) at Site SV-B2

FIGURE SV-B2-3. Looking upstream from the middle transect (F) at Site SV-B2

FIGURE SV-B2-4. Looking downstream from the middle transect (F) at Site SV-B2

FIGURE SV-B2-5. Looking upstream from the upper transect (K) at Site SV-B2

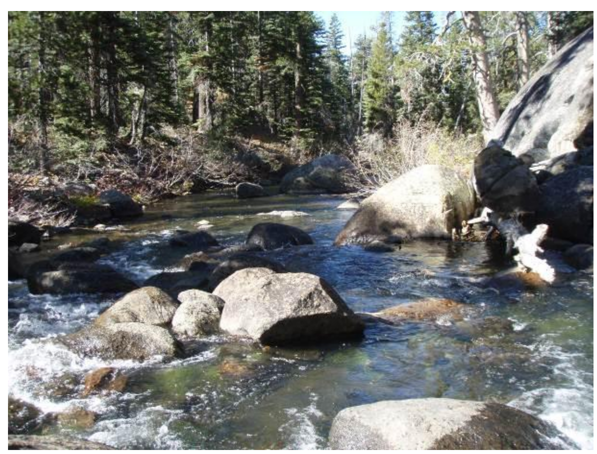

FIGURE SV-B2-6. Looking downstream from the upper transect (K) at Site SV-B2

FIGURE WC-B1-1. Looking upstream from the bottom transect (A) at Site WC-B1

FIGURE WC-B1-2. Looking downstream from the bottom transect (A) at Site WC-B1

FIGURE WC-B1-3. Looking upstream from the middle transect (F) at Site WC-B1

FIGURE WC-B1-4. Looking downstream from the middle transect (F) at Site WC-B1

FIGURE WC-B1-5. Looking upstream from the upper transect (K) at Site WC-B1

FIGURE WC-B1-6. Looking downstream from the upper transect (K) at Site WC-B1

Appendix D

Copies of Field Datasheets
2011 Project 184 SWAMP Bioassessment