National Park Service
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Natural Resource Stewardship and Science

Integrated Aquatic Community and Water Quality Monitoring of Wadeable Streams in the Klamath Network

Selected Appendixes

Natural Resource Report NPS/KLMN/NRR—2013/670

ON THE COVER
Annie Creek, Crater Lake National Park
Photograph by: Kelly Lawrence

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This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

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This report is available from the Klamath Inventory and Monitoring Network web site http://science.nature.nps.gov/im/units/klmn/index.cfm and the Natural Resource Publications Management web site (http://www.nature.nps.gov/publications/NRPM).

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Contents

Executive Summary

This is the companion volume to *Integrated aquatic community and water quality monitoring of wadeable streams in the Klamath Network: Narrative and Standard Operating Procedures*. Included are either the full text of the appendix, or a link/contact for accessing the selected appendix.

Appendix included in their full, original text are:

- Appendix A: Annual report from pilot project (originally formatted for the NRTR series, but allowances made for formatting within an existing NRR report)
- Appendix B:Expectations of Field Crew
- Appendix E: Standard Operating Procedure for Icom IC-F70DT Radio Guide
- Appendix F: Field Data Sheets and Logs
- Appendix G: Example of Site Folder
- Appendix H: Example of Fish, Amphibian, and Invasive Species Guide
- Appendix M: Equipment List
- Appendix N: Job Hazard Analyses
- Appendix R: Operational Checklist

Also included are the frontpages of other appendixes from the protocol, but instead of including the entire appendix, a link is provided to the electronic resource (for example, manufacturer websites for product manuals).

Finally, Appendix S: Park Maps and Preliminary Sampling Sites contain the frontpage, but is considered sensitive information for the possibility that upon implementation we may be reporting on threatened or endangered species encountered at those sites.

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix A: Annual Report from Pilot Project

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains a typical annual report that will be developed after each sampling cycle for wadeable streams. It is written in the format for publication as part of the Natural Resources Technical Report; however, the front and backpages have been omitted as part of its inclusion in the current report, as are page number and other standard formatting issues.

Preface

This report is meant as a stand-alone progress report on the wadeable streams monitoring of the Klamath Inventory and Monitoring Network. The intended audience is park managers, park specialists, interested regional scientists, and the general public. Although many details concerning the protocol are best obtained from reading the entire protocol, it is our aim that this report be understandable without further reading. The format and level of detail chosen to achieve this is similar to a scientific publication, albeit with the goal of reaching a broader audience. The topics covered by these reports, written every 3 years at the completion of a sampling period for the lakes of the Network are: (1) lists of streams sampled, with basic parameters summarized; (2) biodiversity information (invertebrates, fish, amphibians) of each stream; (3) status and condition estimates where applicable; and (4) interesting findings of special significance to the audience.

Due to the timeline for protocol submission, this draft annual report did not receive review from park staff specialists to tailor the format to their needs. In the first years of protocol implementation, the annual reports will be critically reviewed by all intended audiences and refined iteratively to achieve the necessary goals.

Executive Summary

In 2009, the Klamath Inventory and Monitoring Network initiated a pilot project of wadeable stream monitoring protocols in Redwood National and State Parks. The purpose of the project was to field test draft standard operating protocol methods for evaluation of suitability and feasibility. This report serves as a draft example of the expected types of data to be reported from the final implementation of the protocol.

A total of 22 stream sites on 11 streams were visited from 18 August to 30 September 2009. The methods based on the US Environmental Protection Agency Environmental Monitoring and Assessment Program (EPA EMAP) protocols. These methods were largely successful and a prominent finding was the need to use electrofishing to obtain the best data on vertebrate distribution.

The streams of Redwood National and State Parks were characterized by low acid neutralizing capacity, with several streams having values below NPS and EPA threshold of 20 mg/l. However, this is likely the result of both small watershed and local geology. It does highlight the susceptibility of the streams to acidification from acid rain or acid mines. Among other water quality standards, there were no exceedances in: Chloride, Total nitrogen, pH, Sodium, or Sulfate.

A total of 17,677 individual macroinvertebrates from 153 distinct genera were identified by the contract laboratory. A total of five amphibian species were observed: Foothill Yellow-legged Frog (*Rana boylii*), Olympic Salamander (*Rhyacotriton olympicus*), Pacific Giant Salamander (*Dicamptodon ensatus*), Tailed Frog (*Ascaphus truei*), and Western Toad (*Bufo boreas*). Of these, the Pacific Giant Salamander was the most ubiquitous (17 sites) and the Olympic Salamander was the rarest (single site: Godwood Creek). Eight distinct fish species were observed snorkeling, however, and life stages prohibited the identification of all species (Table 6). Species confirmed were: Coho Salmon (*Oncorhynchus kisutch*), Cutthroat trout (*Oncorhynchus clarki*), Steelhead trout (*Oncorhynchus mykiss*), and Three Spine Stickleback (*Gasterosteus aculeatus*). Lamprey ammocetes (larval fish) were observed only when electrofished, but the life stage prevented species identification. Sculpin was also observed, but no confirmed species identification was made.

Results of the Northern California Coastal IBIs suggest that the streams of REDW are all at least in “Good” condition, with some sites in the “Very Good” category. The application of the EPA threshold of “52” to indicate impairment (<52: unimpaired; ≥52 impaired) from Stoddard et al. (2005) shows that no sites within REDW are impaired based on macroinvertebrate assessment.

Acknowledgements

We thank Daniel Sarr at the Klamath Network for his contributions to the developing the Water Quality monitoring protocols of the network. Park staff at Redwood National and State Parks helped implement and improve the quality of the work, especially David Anderson and Vicki Ozaki. Special thanks to the Klamath Network staff: Sean Mohren, Bess Perry, and Lorin Groshong. Sean Mohren designed the stream database and helped improve the wildlife biology portions, especially amphibians. Bess Perry assisted with many details, and so much more. Lorin Groshong ran the GRTS draw for site selection and helped with the last minute determination of sites on the topo maps. The field crew, led by Charles Stanley, also deserves special mention for their ability to work in the challenging conditions of the redwood forests.

Introduction

The Klamath Network vital sign selection process resulted in the identification of two aquatic resource vital signs for monitoring: Aquatic Communities and Water Quality (Sarr et al. 2007). Prioritization of these vital signs was driven by potential natural and anthropogenic stressors on water resources (including physical, chemical, and biological characteristics) of freshwater habitats and resources.

The Klamath Network is located in southern Oregon and northern California and includes the National Park Service units of: Crater Lake National Park (CRLA), Lassen Volcanic National Park (LAVO), Lava Beds National Monument (LABE), Oregon Caves National Monument (ORCA), Redwood National and State Parks (REDW), and Whiskeytown National Recreation Area (WHIS). Of these, LABE does not have any surface water resources, and is hence not covered by this protocol.

During the scoping process and Vital Sign determination process (detailed in Sarr et al. 2007), an emphasis was put on two aspects of the water quality monitoring: (1) a probabilistic sample, allowing determination of park wide status and trends; and (2) an integrated ecosystem approach to monitoring. To accomplish the first aspect, we implemented a spatially-balanced probability sampling throughout the park boundaries, called Generalized Random Tessellation Stratified - (GRTS). This procedure is random, but by spatially balancing the spread of sites, it ensures that all areas of the park are represented in the sample. To accomplish the second aspect, we are sampling as much of the components of the ecosystem as possible: physical habitat, water chemistry, riparian zones, macroinvertebrates, amphibians, and fish. By sampling all of these (balanced against what is logistically and financially possible), an integrated approach to monitoring ecosystem change can be had.

This annual report details the results of the monitoring of 22 sample reaches on 11 streams of Redwood National and State Parks sampled as a part of the pilot project developing the monitoring protocol. The full objectives of the wadeable streams protocol are presented in the protocol narrative (Dinger et al., in development [this document]). This annual report focus on portions of the objectives, mainly the characterization of the habitat, water quality, and biotic communities in a probabilistic sample wadeable streams and provides estimates of status and condition.

Methods

Study Site

This project was carried out in Redwood National and State Parks (REDW), which is in coastal northern California and is composed of Redwood National Park, Prairie Creek, Del Norte Coast and Jedediah Smith State Parks. Redwood National and State Parks covers 131,983 acres of coastal redwood forests, prairies and seashores, including 38,982 acres of old-growth redwood forests.

In this report, we visited a total of 22 sample reaches on 11 streams (Table 1, Figures 1 and 2). Two of these streams were "judgment" streams selected by REDW park staff in the development stage of the protocol (Redwood Creek and Godwood Creek). Redwood Creek was selected for a history of disturbance (logging roads) and being a 303d site for temperature and sediment. Godwood Creek was selected as an example of a pristine, old growth forest stream. The remaining streams were chosen using GRTS and sampling sites on the stream were randomly selected thereafter. Each site was assigned a unique code from the GRTS procedure.

Water Chemistry

In a well mixed riffle, a 1 liter amber high-density-poly-ethylene (HDPE) sample bottle was submerged to collect the water sample. On shore, using a 60 ml syringe and filter holder, each water sample was filtered through a 0.45 µm nylon membrane filter into an amber, HDPE, acid washed 250 ml bottle. After 250 ml were filtered, the bottle was capped and kept cool until able to freeze (generally <4 hours). These samples were then shipped to the Cooperative Chemical Analytical Laboratory at Oregon State University, Corvallis. These samples were analyzed for: anions (Ca^{2+}, Na^{+}, K^{+}, and Mg^{2+}); cations (SO_4^{2-} and Cl^{-}); and nutrients (total dissolved nitrogen, total dissolved phosphorous).

In the same riffle, a Eureka Environmental "*Manta*" water quality probe and "*Amphibian*" pocket PC data logger were used to take seven cross-section measurements of temperature, pH, conductivity, dissolved oxygen, and turbidity.

Stream Habitat Characteristics

Stream habitat parameters were sampled using protocols based on the US Environmental Protection Agency Environmental Monitoring and Assessment Program protocols. In short, a sample reach 40 times longer than the average wetted width of the stream is set up with 11 equally spaced transects within the sample reach. A maximum reach length of 500 meters was imposed, as well as a minimum reach length of 150 meters.

At each transect, we collected measured cross-sectional information on wetted width, depth, embeddedness, and substrate. In the middle of the stream, we collected measures of overhead shading with a convex, spherical densiometer. Areal categorization of habitat cover in the following classes were estimated: Artificial substrate, Boulders, Filamentous Algae, Large wood, Macrophytes, Overhanging banks, Roots, Small wood, and Undercut banks. At each transect, visual searches for invasive plant species were conducted. Other data were collected on the riparian plant community structure, dominant trees, and bank characteristics but are not presented here

Table 1. **Streams sampled during pilot project, date sampled, location, and basic stream parameters. * indicates slope at this site was below the resolution of the method. – indicates no discharge available due to equipment malfunction. Watershed size estimated using the USGS National Map Viewer.**

Stream Name	Unique Site Code	Date Sampled	Latitude	Longitude	Slope(%)	Discharge m^3/s	Discharge ft^3/s	Watershed size (km^2)
Bummer Lake Creek	09B	8/25/2009	41.74364	124.05185	4.5	0.02	0.54	9.7
Bummer Lake Creek	09K	9/2/2009	41.74345	124.05522	6.0	0.02	0.77	10.7
Damnation Creek	04B	8/21/2009	41.65646	124.12613	2.8	0.01	0.22	3.7
Damnation Creek	04K	9/4/2009	41.66034	124.12541	2.4	0.01	0.18	3.2
East Fork Mill Creek	101	9/9/2009	41.72563	124.07963	0.8	0.05	1.90	33.0
East Fork Mill Creek	14J	9/10/2009	41.72940	124.09235	0.5	0.07	2.55	42.0
Forty-four Creek	06A	8/18/2009	41.22041	124.01464	4.8	0.03	1.21	7.9
Forty-four Creek	06B	9/15/2009	41.21619	124.04582	6.7	0.01	0.21	1.3
Godwood Creek	17A	9/22/2009	41.37399	124.02930	1.8	-	-	2.6
Godwood Creek	17B	9/30/2009	41.36555	124.02360	1.2	0.02	0.79	3.5
Emerald Creek	10U	9/3/2009	41.19960	123.99219	4.5	0.00	0.13	7.6
Emerald Creek	10B	8/5/2009	41.20396	123.98994	3.3	0.01	0.29	6.9
Little Lost Man Creek	02T	9/23/2009	41.32122	124.02052	6.4	-	-	10.0
Little Lost Man Creek	02K	10/2/2009	41.31715	124.01644	2.9	0.01	0.18	9.5
Lost Man Creek	07K	9/24/2009	41.32122	123.99451	2.9	0.02	0.74	15.2
Lost Man Creek	07J	9/20/2009	41.32902	124.02232	0.7	0.04	1.43	27.7
May Creek	01B	8/13/2009	41.35497	124.00925	2.2	0.00	0.12	1.9
May Creek	01A	8/20/2009	41.35361	123.99866	3.3	0.00	0.04	0.9
Redwood Creek	16A	9/16/2009	41.19730	123.99313	0.2	0.41	14.37	620.0
Redwood Creek	16B	9/17/2009	41.27925	124.03004	< 0.1 *	0.43	15.33	702.0
West Branch Mill Creek	102	8/27/2009	41.68706	124.06488	7.6	0.01	0.38	3.9
West Branch Mill Creek	103	9/8/2009	41.71928	124.10844	1.0	0.05	1.65	21.9

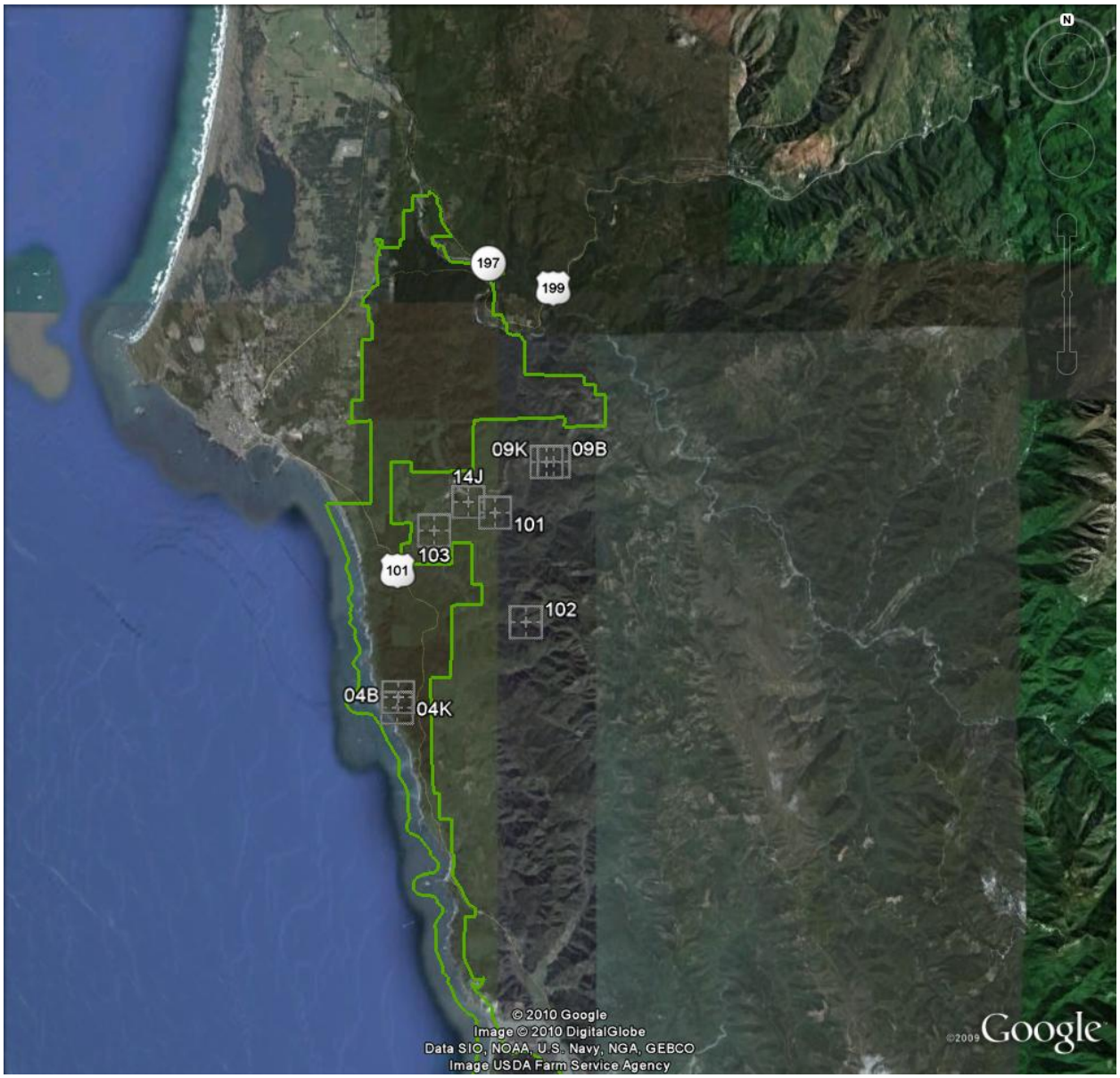

Figure 1. Sites sampled in the northern portion of REDW in the pilot project. The green line indicates the park boundary of the National Park; sites that are outside were sampled in state parks (boundaries not represented). Site codes are presented in Table 1.

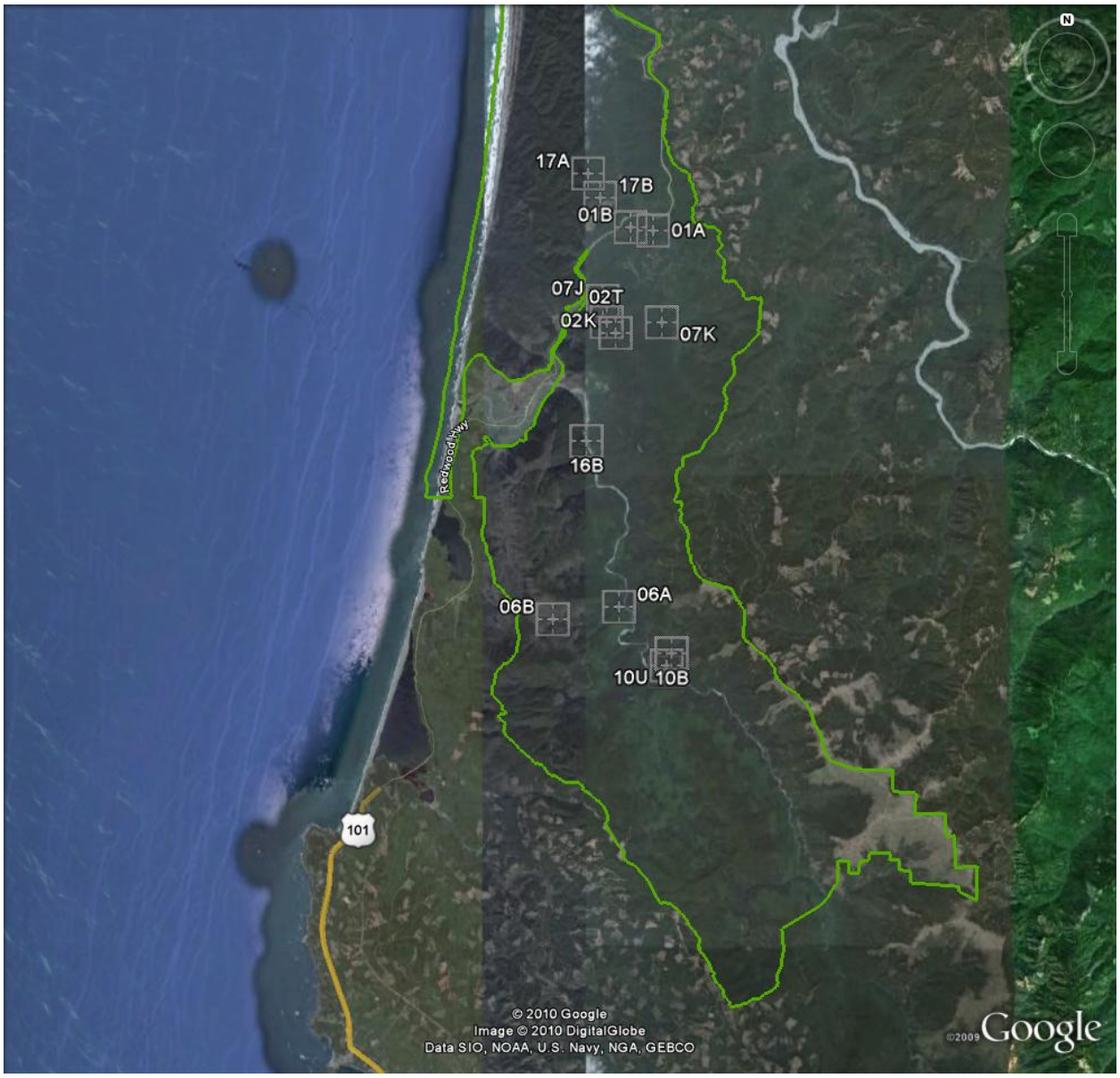

Figure 2. Sites sampled in the southern portion of REDW in the pilot project. The green line indicates the park boundary of the National Park; sites that are outside were sampled in state parks (boundaries not represented). Site codes are presented in Table 1.

Discharge measurements were made at the most ideal location (laminar flow, no obstructions) along a cross-section profile of between 10 to 20 equidistant points using a Flowtracker ADV flowmeter.

Slope was measured using an Abney Level and stadia rod for each inter-transect distance and the total elevational change summed for the reach to calculate the gradient.

Aquatic Communities

Aquatic macroinvertebrates were collected using a target riffle composite sampling technique. Eight separate samples (1 ft^2) at random riffles (or high velocity) were collected using a 500 µm mesh net. Samples were composited, preserved in 95% Ethanol, and sent to the National Aquatic

Monitoring Center, Utah State University, Logan, Utah. Macroinvertebrates were identified to the lowest practical level and expressed in individuals per square meter.

Fish and amphibians were sampled by snorkeling the reach. In habitats not deep enough to allow snorkeling, these habitats were either bypassed or observed by submerging the head in the deepest portions. Additional observations made while walking the reach were also made using Visual Encounter Survey techniques.

At three sites (East Fork Mill Creek [101], Redwood Creek [16A], and West Branch Mill Creek [103]), we were able to electrofish with David Anderson, Fisheries Biologist at REDW, under his permits. At these sites, three crew members did a single pass through the entire reach using a Smith-Root LR-24 backpack electrofisher.

Derived Metrics

Indices of biotic integrity (also called multi-metric models by the EPA) were calculated for macroinvertebrate and vertebrate samples. For macroinvertebrates, we utilized the North Coastal California model by Rehn et al. (2005), a regional model developed by the state of California, and the west-wide mountain model (Stoddard et al. 2005). The west-wide invertebrate EPA model was done on the entire dataset and not on a random draw of 300 individuals. For vertebrates, we utilized the EPA EMAP vertebrate west-wide model (Stoddard et al. 2005). Stream condition was assessed using the ranking scale of Rehn et al. (2005): 0 – 20 Very Poor; 21 – 40 Poor; 41 – 60 Fair; 61 – 80 Good; 81 – 100 Very Good. Caution should be used in application of this scale to the EPA models; however, they do provide a general indication of the stream condition. Full details of how these metrics are calculated are provided in the protocol (Dinger et al., in review [this document]).

Water Quality Exceedances

Measured values of water quality (temperature, acid neutralizing capacity, chloride, total nitrogen, sodium, sulfate, pH, and turbidity) were compared to state and national standards (Table 2.)

Table 2. Water quality standards used for assessing exceedances for the NPS, California and EPA.

Parameter	NPS Standards	California	EPA Standards			
		Drinking Water	Drinking Water	Health Advisory	National Ambient Water Quality Criteria	Region 10 Collaborative Guidance
Acid neutralizing capacity (mg/l) (alkalinity in standards)	> 25				> 20	
Chloride (mg/l)		< 250 mg/l			<230[1,4] , <860[2,4] - when associated only with NA	
Dissolved Oxygen (mg/l)	> 4				> 8.0 1 day minimum (water column)	
Total Nitrogen (as NO2 + NO3) (mg/l)		< 10	< 10			
pH	> 6.5		6.5 to 8.5		5 to 9*, 6.5 to 9&(max)	
Sodium (mg/l)				20		
Sulfate (mg/l)			500		250[3]	
Temperature, (fall, winter, spring) (7 day average of daily maximum)						< 9 °C (Bull trout); < 13 °C (general salmon and trout); < 14 °C (Steelhead)
Temperature, maximum (7 day average of daily maximum)						< 12 °C (Bull trout); < 16 °C (salmon and trout core rearing); < 18 °C (salmon and trout noncore rearing); < 20 °C (salmon and trout migration)
Turbidity (NTU)	< 50	< 1	< 1			

[1]Standard for Freshwater Aquatic Life Protection (4 day average); [2]Maximum 1 hour concentration; [3]Taste and odor standards; [4]Chloride standards only apply when dominant cation is Sodium.

Results

A total of 22 sampling sites were visited from 18 August to 30 September 2009. Sites were successfully sampled in a single day visit with a three person crew when vertebrate sampling was limited to snorkeling and visual encounter surveys. When electrofishing was possible under the permit of David Anderson, a total of four people were necessary to accomplish all tasks.

Stream Habitat Characterization

Stream sites sampled ranged from wide (Redwood Creek site 16B at 25.8 meters) to narrow (May Creek at 0.7 meters) (Table 3). Boulders and overhanging vegetation were the dominant sources of instream habitat cover. There was no cover observed from artificial substrates and macrophytes (in the form of moss) were only present in Godwood Creek. The most overall instream cover was in Little Lost Man Creek (100.7%) and lowest in Redwood Creek (19.5%). Discharge and slope are presented in Table 1.

Water Chemistry

Temperature measured during the field visit ranged from 9.8 °C (Godwood Creek) to 17.5 °C (Redwood Creek) (Table 4). However, these temperatures are instantaneous measurements and do not represent the diel or seasonal variation in water temperatures. Turbidity was low in many sites (0.1 NTU in Little Lost Man Creek) and was high in May Creek (124.8 NTU). At four sites, recorded turbidity resulted in negative values and is not presented here. Attempts to calibrate the dissolved oxygen probe of the multiprobe resulted in errors and were impossible to calibrate at *all sites.* The probe was judged to be broken and dissolved oxygen is not presented here because of this. At four sites, we were unable to collect water chemistry samples; reasons included broken filtration equipment, no prepared filters, and streams too shallow to fill the water sample bottle without contamination.

Aquatic Communities

A total of 17,677 individual macroinvertebrates from 153 distinct genera were identified by the contract laboratory (Appendix).

A total of five amphibian species were observed: Foothill Yellow-legged Frog (*Rana boylii*), Olympic Salamander (*Rhyacotriton olympicus*), Pacific Giant Salamander (*Dicamptodon ensatus*), Tailed Frog (*Ascaphus truei*), and Western Toad (*Bufo boreas*). Of these, the Pacific Giant Salamander was the most ubiquitous (17 sites), and the Olympic Salamander was the rarest (single site: Godwood Creek) (Table 5).

Eight distinct fish species were observed snorkeling, however, but life stages prohibited the identification of all species (Table 6). Species confirmed were: Coho Salmon (*Oncorhynchus kisutch*), Cutthroat trout (*Oncorhynchus clarki*), Steelhead trout (*Oncorhynchus mykiss*), and Three Spine Stickleback (*Gasterosteus aculeatus*). Lamprey ammocetes (larval fish) were observed only when electrofished, but the life stage prevented species identification. Sculpin were similarly only observed with electrofishing. Additional observations while snorkeling included unidentified fish, including a sucker species (family Catostomidae), an unidentified Salmonidae, and one specimen that was not seen long enough for even a preliminary identification.

Table 3. Physical habitat characteristics measured during the pilot project. Unique site codes are as in Table 1, Figures 2 and 3. Emb. = embeddedness. Sum of all categories is a measure of total habitat cover and can exceed 100%.

				In-Stream Habitat Cover (%)											
Stream Name	Unique Site Code	Wetted Width (m)	Average depth (m)	Artificial Substrate	Boulders	Filamentous algae	Large Wood	Macrophytes	Overhanging vegetation	Roots	Small Wood	Undercut Bank	Sum of all categories	Overhead shading (%)	Emb. (%)
Bummer Lake Creek	09B	4.8	22.8	0.0	58.0	11.8	5.0	0.0	8.9	0.9	3.2	0.5	88.2	90.1	18.2
Bummer Lake Creek	09K	7.3	22.6	0.0	51.4	0.0	12.5	0.0	5.0	10.0	7.7	0.5	87.0	90.9	24.7
Damnation Creek	04B	2.4	19.2	0.0	3.2	0.0	8.2	0.0	16.1	12.7	13.2	2.3	55.7	89.3	20.2
Damnation Creek	04K	2.5	18.4	0.0	4.5	0.0	6.4	0.0	53.0	23.2	4.5	2.3	93.9	94.4	27.4
East Fork Mill Creek	101	9.1	19.8	0.0	14.1	12.3	0.9	0.0	7.3	19.1	0.5	7.7	61.8	57.3	14.0
East Fork Mill Creek	14J	7.4	11.1	0.0	9.1	0.0	6.8	0.0	9.5	8.2	2.3	2.7	38.6	81.1	26.7
Forty-four Creek	06A	3.4	14.4	0.0	11.1	0.0	17.7	0.0	29.5	1.8	8.9	5.2	74.3	91.3	57.1
Forty-four Creek	06B	1.3	15.7	0.0	0.0	0.0	8.9	0.0	28.9	15.5	25.7	9.1	87.9	97.9	53.8
Godwood Creek	17A	3.3	11.3	0.0	0.0	0.0	8.4	6.1	28.4	11.6	4.1	17.2	75.9	89.6	26.4
Godwood Creek	17B	3.7	11.3	0.0	0.0	0.0	9.1	2.3	10.5	4.1	8.6	4.1	38.6	96.0	27.7
Emerald Creek	10U	2.3	10.5	0.0	48.4	0.0	24.1	0.0	8.4	7.3	5.0	5.0	98.2	88.4	26.2
Emerald Creek	10B	4.3	9.8	0.0	1.4	0.0	19.5	0.0	11.1	15.2	4.6	13.0	64.8	81.8	27.5
Little Lost Man Creek	02T	3.2	9.1	0.0	68.4	0.0	8.9	0.0	17.0	3.2	3.2	0.0	100.7	88.0	62.1
Little Lost Man Creek	02K	3.3	9.0	0.0	16.8	0.0	15.9	0.0	7.7	6.4	6.6	10.7	64.1	92.5	64.9
Lost Man Creek	07K	5.1	15.3	0.0	29.8	0.0	24.3	0.0	3.6	3.2	6.4	1.4	68.6	72.7	59.3
Lost Man Creek	07J	7.3	15.8	0.0	0.0	0.0	14.8	0.0	11.8	1.4	3.6	0.0	31.6	90.2	56.9
May Creek	01B	2.7	9.2	0.0	0.0	0.5	6.4	0.0	32.0	6.8	23.0	6.1	74.8	85.3	60.4
May Creek	01A	0.7	3.6	0.0	2.3	0.0	5.0	0.0	20.5	1.4	8.2	5.0	42.3	85.2	73.1
Redwood Creek	16A	18.9	11.3	0.0	5.5	2.3	5.5	0.0	4.1	0.5	1.8	0.0	19.5	41.8	27.6
Redwood Creek	16B	25.8	10.0	0.0	0.0	2.3	2.7	0.0	12.0	9.5	8.2	0.9	35.6	23.0	27.0
West Branch Mill Creek	102	3.3	12.1	0.0	44.5	0.0	23.2	0.0	2.3	11.6	5.5	0.0	87.0	90.1	31.8
West Branch Mill Creek	103	4.8	11.7	0.0	0.6	18.1	7.3	0.0	15.2	13.4	7.7	2.5	64.8	70.2	28.6

Table 4. Water chemistry parameters measured in the pilot project. Temperature, conductivity, pH, and turbidity were measured using a Eureka Environmental multiprobe. Water chemistry nutrients, anions, and cations were analyzed by the Cooperative Chemical Analytical Laboratory. NTU = Nephlometric turbidty units; N = total nitrogen, P = total phosphorous, Na = sodium, K = potassium, Ca = calcium, Mg = magnesium, SO4 = sulfate, and Cl = chloride. NA = not available. * indicates turbidity was a negative measurement.

							Water Chemistry (mg/l)							
Stream Name	Unique Site Code	Temperature (°C)	Specific Conductivity (ms/cm)	pH	Turbidity (NTU)	Acid neutralizing capacity (in mg/l of $CaCO_3$)	N	P	Na	K	Ca	Mg	SO4	Cl
Bummer Lake Creek	09B	11.9	0.0740	7.5	8.5	28.3	NA	NA	NA	NA	NA	NA	NA	NA
Bummer Lake Creek	09K	12.2	0.0696	7.5	6.9	25.0	0.23	0.02	3.49	0.31	3.35	4.87	0.80	3.33
Damnation Creek	04B	12.4	0.1287	7.3	1.0	27.3	0.14	0.02	10.89	0.64	8.34	2.92	2.14	15.80
Damnation Creek	04K	11.8	0.1137	7.2	*	25.0	0.14	0.02	10.44	0.64	7.89	2.66	2.07	15.18
East Fork Mill Creek	101	12.8	0.0879	7.4	0.3	27.3	0.08	0.01	4.04	0.42	4.75	2.68	0.89	4.20
East Fork Mill Creek	14J	11.8	0.0640	7.2	*	23.0	0.11	0.02	3.86	0.38	4.66	2.50	0.85	3.86
Forty-four Creek	06A	12.3	0.0451	6.9	94.6	14.2	0.16	0.02	4.20	0.38	3.57	1.16	0.52	5.55
Forty-four Creek	06B	12.3	0.0510	7.0	41.9	10.0	0.29	0.02	4.56	0.46	2.51	1.14	0.53	6.65
Godwood Creek	17A	9.8	0.1050	7.7	7.1	46.8	0.09	0.04	8.50	0.62	6.54	6.71	0.82	10.99
Godwood Creek	17B	11.8	0.1260	7.3	8.1	44.2	0.08	0.03	8.45	0.57	6.25	6.39	0.82	10.96
Emerald Creek	10U	13.1	0.1003	7.1	*	33.8	0.08	0.02	5.59	0.61	11.54	2.21	2.20	5.87
Emerald Creek	10B	14.1	0.1061	7.4	37.1	15.0	NA	NA	NA	NA	NA	NA	NA	NA
Little Lost Man Creek	02T	12.6	0.0732	7.0	2.4	23.8	0.1	0.02	6.37	0.62	5.55	2.05	0.77	6.44
Little Lost Man Creek	02K	10.2	0.0735	7.4	0.1	23.3	NA	NA	NA	NA	NA	NA	NA	NA
Lost Man Creek	07K	12.9	0.0798	7.1	6.1	30.7	0.20	0.02	5.75	0.65	7.44	2.10	1.12	5.34
Lost Man Creek	07J	12.5	0.0730	7.4	2.4	24.6	0.13	0.02	5.75	0.58	5.70	2.23	0.81	5.46
May Creek	01B	12.1	0.0920	7.4	124.8	38.0	0.16	0.02	6.64	0.57	7.47	3.77	0.42	6.76
May Creek	01A	13.1	0.1026	7.1	34.2	33.0	0.13	0.02	6.18	0.53	6.80	3.31	0.36	6.03
Redwood Creek	16A	16.8	0.1581	7.9	9.4	60.7	0.07	0.01	2.90	0.36	20.74	1.79	2.24	3.28
Redwood Creek	16B	17.5	0.1490	7.6	8.1	54.7	0.11	0.01	4.41	0.61	22.02	2.63	2.52	4.48
West Branch Mill Creek	102	13.6	0.0500	7.1	*	22.5	NA	NA	NA	NA	NA	NA	NA	NA
West Branch Mill Creek	103	12.1	0.0734	7.2	1.6	16.2	0.10	0.02	3.33	0.43	3.23	0.89	0.39	3.44

Table 5. Amphibians observed during the pilot project.

Stream Name	Unique Site Code	Sample method	Foothill Yellow Legged Frog	Olympic Salamander	Pacific Giant Salamander	Tailed Frog	Western Toad
Bummer Lake Creek	09B	Snorkel			X		
Bummer Lake Creek	09K	Snorkel			X		
Damnation Creek	04B	Snorkel			X	X	
Damnation Creek	04K	Snorkel			X	X	
East Fork Mill Creek	101	Electrofished			X		
East Fork Mill Creek	14J	Snorkel					
Forty-four Creek	06A	Snorkel			X	X	X
Forty-four Creek	06B	Snorkel					
Godwood Creek	17A	Snorkel		X	X	X	
Godwood Creek	17B	Snorkel			X	X	
Emerald Creek	10U	Snorkel	X		X	X	X
Emerald Creek	10B	Snorkel	X		X	X	X
Little Lost Man Creek	02T	Snorkel			X		
Little Lost Man Creek	02K	Snorkel			X		
Lost Man Creek	07K	Snorkel			X		
Lost Man Creek	07J	Snorkel					
May Creek	01B	Snorkel			X	X	
May Creek	01A	Snorkel			X		
Redwood Creek	16A	Electrofished	X				X
Redwood Creek	16B	Snorkel	X				X
West Branch Mill Creek	102	Snorkel	X		X		
West Branch Mill Creek	103	Electrofished			X		

Indices of Biotic Integrity indicated that all streams sites sampled are in “Good” (20 sites) or “Very Good” (2 sites) condition using the California Northern Coastal Region IBI; 13 sites in “Good” and eight sites in “Very Good” using the EPA West Wide Invertebrate index; and one site categorized as “Fair” – Redwood Creek (16B) (Table 7). Although the EPA Vertebrate index was only calculated at the three sites that were electrofished, two sites were rated “Very Good” and one site “Good.”

Table 6. Fish species observed during pilot project. UNID = unidentified.

Stream Name	Unique Site Code	Sample method	Coho Salmon	Cutthroat Trout	Lamprey	Rainbow Trout	Sculpin	Steelhead	Sucker	Three Spine Stickleback	UNID fish	UNID Trout
Bummer Lake Creek	09B	Snorkel		X				X				
Bummer Lake Creek	09K	Snorkel		X				X				
Damnation Creek	04B	Snorkel				X						
Damnation Creek	04K	Snorkel										X
East Fork Mill Creek	101	Electrofished	X		X		X	X		X		
East Fork Mill Creek	14J	Snorkel	X					X		X		
Forty-four Creek	06A	Snorkel		X				X				X
Forty-four Creek	06B	Snorkel						X				
Godwood Creek	17A	Snorkel						X				
Godwood Creek	17B	Snorkel	X	X				X		X		
Emerald Creek	10U	Snorkel		X				X				
Emerald Creek	10B	Snorkel		X				X				
Little Lost Man Creek	02T	Snorkel						X				
Little Lost Man Creek	02K	Snorkel	X					X				
Lost Man Creek	07K	Snorkel	X					X				
Lost Man Creek	07J	Snorkel	X	X				X		X		
May Creek	01B	Snorkel	X	X								
May Creek	01A	Snorkel	X								X	
Redwood Creek	16A	Electrofished			X		X	X		X		
Redwood Creek	16B	Snorkel						X	X	X		
West Branch Mill Creek	102	Snorkel		X								
West Branch Mill Creek	103	Electrofished	X		X		X	X		X		

Table 7. Indices of biotic integrity for sites sampled in pilot project. General categorical condition assessment is based on the scale: 0 – 20, "Very Poor"; 21 – 40, "Poor"; 41 – 60, "Fair"; 61 – 80, "Good"; and 81 – 100, "Very Good", using the scale of Rehn et al. (2005). * indicates site not electrofished, so vertebrate index not applied.

Stream Name	Unique Site Code	California Northern Coastal Region B-IBI	EPA West Wide Invertebrate	EPA West Wide Vertebrate
Bummer Lake Creek	09B	75.0	72.0	*
Bummer Lake Creek	09K	68.8	84.8	*
Damnation Creek	04B	71.3	70.8	*
Damnation Creek	04K	80.0	79.1	*
East Fork Mill Creek	101	76.3	81.0	79.3
East Fork Mill Creek	14J	82.5	82.1	*
Forty-four Creek	06A	75.0	77.6	*
Forty-four Creek	06B	73.8	77.4	*
Godwood Creek	17A	76.3	78.7	*
Godwood Creek	17B	76.3	74.7	88.7
Emerald Creek	10U	76.3	83.2	*
Emerald Creek	10B	80.0	79.6	*
Little Lost Man Creek	02T	77.5	81.1	*
Little Lost Man Creek	02K	78.8	83.9	*
Lost Man Creek	07K	68.8	90.5	*
Lost Man Creek	07J	81.3	84.1	*
May Creek	01B	77.5	64.9	*
May Creek	01A	75.0	68.1	*
Redwood Creek	16A	75.0	75.5	*
Redwood Creek	16B	72.5	52.8	*
West Branch Mill Creek	102	72.5	75.0	*
West Branch Mill Creek	103	72.5	70.1	82.7

Discussion

The application of water quality standards to REDW shows the need for site-specific interpretation of these standards. Acid neutralizing capacity, a measure of the ability of a water body to resist changes in pH, is below the NPS threshold for eight of the 22 sites sampled. However, all sampled sites had pH within the regulatory thresholds for both freshwater aquatic life standards and drinking water. The low alkalinities observed in REDW are more likely a function of limited watershed and stream length, since the source of carbonates responsible for alkalinity in stream waters is through erosion of the geologic basin (Allan and Castillo 2007). In small coastal basins, there is limited absorption of these carbonates from the bedrock, limiting the acid neutralizing capacity in REDW. Hence, the low alkalinities in REDW do not indicate pollution or degradation; however, they do highlight the poor buffering capacity of these streams, thereby suggesting high susceptibility to pollution-driven acidification (e.g., acid rain or acid mine drainages).

Turbidity standards were exceeded in most streams based on drinking water standards. The more applicable NPS standards were only exceeded in two streams (Forty-four Creek [06A] and May Creek [01B]). The turbidity probe also proved difficult to maintain, with several sites producing negative values of turbidity. Based on these results, the implemented protocol will include more frequent calibrations of the turbidity probe. However, the observed problems in the pilot project of maintaining an accurate calibration suggest that limited interpretation should be made from the pilot project.

Among other water quality standards, there were no exceedances in: Chloride, Total nitrogen, pH, Sodium, or Sulfate. Problems with the dissolved oxygen probe prevented reporting of values and the application of standards.

Stream water temperature standards are based on 7 day averages, but here we take single point measurements, which do not capture the daily or seasonal variability of water temperatures. However, we suggest that our single time measurements, if above the regulatory average, should be taken as an indication that requires follow-up studies. For the pilot project, only Redwood Creek (both sites) with temperatures over 16 °C (the maximum 7 day average for core salmon and trout rearing streams based on EPA Region 10 collaborative guidance) was over the threshold. Indeed, Redwood Creek is listed as a water quality impaired site (303d) based on elevated temperatures. Potential stressors identified in increased temperatures include: logging road construction/maintenance, removal of riparian vegetation, streambank modifications, erosion/siltation, natural and non-point sources (California 303d list 2006).

Macroinvertebrate collections using the targeted riffle techniques proved doable in all habitats and generated a rich collection of taxa. However, recent work by the California Department of Fish and Game has shown certain advantages of using a “reach-wide benthos” technique, which incorporates semi-quantitative sampling of pool and slack water habitats (Rehn et al. 2007). This has changed the focus of the EPA EMAP program to eliminate the targeted riffle technique and implement only the reach-wide benthos sampling. Based on this, we have switched from the original targeted riffle technique used in the pilot project to the reach-wide benthos for the final implementation of the sampling protocol. Rehn et al. (2007) suggest that although the original

indexes were based on targeted riffle techniques, the use of reach-wide benthos sampling data can be used interchangeably, but that the reach-wide benthos technique was generally more precise (although not substantially more). The reach-wide benthos has additional advantages of being applicable in a larger range of stream types (slow moving streams) and does not require the field crews to precisely identify riffles.

Results of the Northern California Coastal IBIs suggest that the streams of REDW are all at least in "Good" condition, with some sites in the "Very Good" category. The application of the EPA threshold of "52" to indicate impairment (<52: unimpaired; ≥52 impaired) from Stoddard et al. (2005) shows that no sites within REDW are impaired based on macroinvertebrate assessment.

The EPA invertebrate model gives similar results to the Northern California Coastal model, but for the purpose of this draft example of an annual report, we were not able to implement a random draw component of the draft database prior to protocol submission (SOP #22: Data Analysis and Reporting). The metric should be calculated only on the random draw subset for each sample as a step to standardize for density differences and subsampling. Hence, the results presented here should only be used a sample of the type of metric to be included in protocol implementation.

Although the Northern California Coastal IBI gave similar results to the EPA invertebrate model (with the above qualifier in place), there was one notable exception at Redwood Creek (16B), where the Northern California Coastal IBI was 72.5 (Good) and the EPA model was 52.8 (Fair). This corresponds to the observed pattern of the North Coast Regional Water Quality Control Board, which found that the Northern California Coastal model was useful for assessing stream conditions for urban or agricultural impacts but did not accurately assess impacts from timber harvest industries. This highlights the need for using multiple assessment methodologies for assigning water quality condition. In this case, Redwood Creek is a known 303(d) site impacted by timber harvest activities.

Calculations of observed/expected models (O/E) of taxonomic completeness (Hawkins et al. 2000) were also not able to be implemented prior to protocol submission. Annual reports during implementation will include this valuable metric that measures observed biodiversity when compared to expected biodiversity in reference conditions.

The sampling procedures from the draft protocol proved doable with a three person crew. However, the quality of the data obtained by electrofishing shows the necessity of using a four person crew with the ability to electrofish. For instance, snorkeling, when compared to electrofishing, missed Sculpin and Lampreys. Electrofishing also provided greater ability to identify the fish of each site. Hence, electrofishing provided greater taxonomic resolution, and a more complete and accurate assessment of the species present in the park ecosystems.

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Appendix. Taxonomic results of macroinvertebrates and identified by contract laboratory. ITIS code = Integrated Taxonomic Information System (www.itis.gov) Taxonomic Serial Number, a unique serial number assigned to each taxon that provides updated taxonomy and status. Species where identification is not possible, but can be placed between two or more taxa (splits or species groups) do not have ITIS codes.

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
68422	Annelida	Clitellata					
83170	Arthropoda	Arachnida	Trombidiformes	Hydryphantidae		*Protzia*	
83172	Arthropoda	Arachnida	Trombidiformes	Hydryphantidae		*Wandesia*	
83297	Arthropoda	Arachnida	Trombidiformes	Hygrobatidae		*Hygrobates*	
83281	Arthropoda	Arachnida	Trombidiformes	Hygrobatidae			
83034	Arthropoda	Arachnida	Trombidiformes	Lebertiidae		*Lebertia*	
83006	Arthropoda	Arachnida	Trombidiformes	Sperchonidae		*Sperchon*	
83029	Arthropoda	Arachnida	Trombidiformes	Sperchonidae		*Sperchonopsis*	
83005	Arthropoda	Arachnida	Trombidiformes	Sperchonidae			
83250	Arthropoda	Arachnida	Trombidiformes	Torrenticolidae		*Testudacarus*	
83254	Arthropoda	Arachnida	Trombidiformes	Torrenticolidae		*Torrenticola*	
82769	Arthropoda	Arachnida	Trombidiformes				
99237	Arthropoda	Entognatha	Collembola				
109234	Arthropoda	Insecta	Coleoptera	Carabidae			
114006	Arthropoda	Insecta	Coleoptera	Dryopidae		*Helichus*	
112314	Arthropoda	Insecta	Coleoptera	Dytiscidae	Hydroporinae	*Oreodytes*	
728253	Arthropoda	Insecta	Coleoptera	Dytiscidae		*Sanfilippodytes*	
114197	Arthropoda	Insecta	Coleoptera	Elmidae		*Ampumixis*	*dispar*
114168	Arthropoda	Insecta	Coleoptera	Elmidae		*Heterlimnius*	*koebelei*
114167	Arthropoda	Insecta	Coleoptera	Elmidae		*Heterlimnius*	
114137	Arthropoda	Insecta	Coleoptera	Elmidae		*Lara*	
114144	Arthropoda	Insecta	Coleoptera	Elmidae		*Narpus*	*concolor*
114142	Arthropoda	Insecta	Coleoptera	Elmidae		*Narpus*	
	Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus*	*divergens/pecosensis*
114180	Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus*	*quadrimaculatus*
114177	Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus*	
114236	Arthropoda	Insecta	Coleoptera	Elmidae		*Ordobrevia*	*nubifera*
114205	Arthropoda	Insecta	Coleoptera	Elmidae		*Zaitzevia*	
114093	Arthropoda	Insecta	Coleoptera	Elmidae			

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
111947	Arthropoda	Insecta	Coleoptera	Haliplidae		*Brychius*	
112757	Arthropoda	Insecta	Coleoptera	Hydraenidae		*Hydraena*	
112811	Arthropoda	Insecta	Coleoptera	Hydrophilidae			
708467	Arthropoda	Insecta	Coleoptera	Psephenidae	Eubrianacinae	*Eubrianax*	*edwardsii*
114082	Arthropoda	Insecta	Coleoptera	Psephenidae		*Acneus*	
114069	Arthropoda	Insecta	Coleoptera	Psephenidae			
130931	Arthropoda	Insecta	Diptera	Athericidae		*Atherix*	*pachypus*
127729	Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogoninae	*Probezzia*	
127113	Arthropoda	Insecta	Diptera	Ceratopogonidae	Forcipomyiinae	*Atrichopogon*	
127152	Arthropoda	Insecta	Diptera	Ceratopogonidae	Forcipomyiinae	*Forcipomyia*	
127076	Arthropoda	Insecta	Diptera	Ceratopogonidae			
129873	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Cladotanytarsus*	
129884	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Constempellina*	
129421	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Demicryptochironomus*	
129890	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Micropsectra*	
129535	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Microtendipes*	
129935	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Paratanytarsus*	
129657	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Polypedilum*	
129952	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Rheotanytarsus*	
129730	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Robackia*	
129872	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Tanytarsus*	
130038	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	*Zavrelia*	
129872	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae		
129229	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae		
128401	Arthropoda	Insecta	Diptera	Chironomidae	Diamesinae	*Pagastia*	
	Arthropoda	Insecta	Diptera	Chironomidae	Diamesinae	*Potthastia*	*gaedii group*
128477	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Brillia*	
128520	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Chaetocladius*	
128563	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Corynoneura*	
568521	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Cricotopus*	*trifascia group*
128575	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Cricotopus*	
128689	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Eukiefferiella*	
128730	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Heleniella*	

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
128734	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Heterotanytarsus*	
128737	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Heterotrissocladius*	
128771	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Krenosmittia*	
128776	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Limnophyes*	
128811	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Lopescladius*	
128844	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Nanocladius*	
568523	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Orthocladius*	
128951	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Parachaetocladius*	
128968	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Parakiefferiella*	
128978	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Parametriocnemus*	
128989	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Paraphaenocladius*	
129018	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Psectrocladius*	
129052	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Pseudorthocladius*	
129071	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Pseudosmittia*	
129083	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Psilometriocnemus*	
129086	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Rheocricotopus*	
129161	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Synorthocladius*	
129182	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Thienemanniella*	
129197	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae	*Tvetenia*	
128457	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae		
	Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae		
127987	Arthropoda	Insecta	Diptera	Chironomidae	Podonominae	*Parochlus*	
128026	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	*Brundiniella*	
128207	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	*Paramerina*	
128215	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	*Pentaneura*	
128236	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	*Thienemannimyia group*	
128259	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	*Zavrelimyia*	
127994	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae		
128078	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae		
125810	Arthropoda	Insecta	Diptera	Dixidae		*Dixa*	
125874	Arthropoda	Insecta	Diptera	Dixidae		*Meringodixa*	*chalonensis*
125809	Arthropoda	Insecta	Diptera	Dixidae			
136824	Arthropoda	Insecta	Diptera	Dolichopodidae			

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
136305	Arthropoda	Insecta	Diptera	Empididae	Hemerodromiinae	*Chelifera*	
136327	Arthropoda	Insecta	Diptera	Empididae	Hemerodromiinae	*Hemerodromia*	
	Arthropoda	Insecta	Diptera	Empididae	Hemerodromiinae		
135849	Arthropoda	Insecta	Diptera	Empididae		*Clinocera*	
136352	Arthropoda	Insecta	Diptera	Empididae		*Neoplasta*	
136377	Arthropoda	Insecta	Diptera	Empididae		*Oreogeton*	
135830	Arthropoda	Insecta	Diptera	Empididae			
146893	Arthropoda	Insecta	Diptera	Ephydridae			
130915	Arthropoda	Insecta	Diptera	Pelecorhynchidae		*Glutops*	
125392	Arthropoda	Insecta	Diptera	Psychodidae		*Maruina*	
125514	Arthropoda	Insecta	Diptera	Psychodidae		*Pericoma*	
125468	Arthropoda	Insecta	Diptera	Psychodidae		*Psychoda*	
125351	Arthropoda	Insecta	Diptera	Psychodidae			
126774	Arthropoda	Insecta	Diptera	Simuliidae	Simuliinae	*Simulium*	
126640	Arthropoda	Insecta	Diptera	Simuliidae			
130436	Arthropoda	Insecta	Diptera	Stratiomyidae		*Euparyphus*	
130150	Arthropoda	Insecta	Diptera	Stratiomyidae			
131527	Arthropoda	Insecta	Diptera	Tabanidae		*Tabanus*	
130934	Arthropoda	Insecta	Diptera	Tabanidae			
119660	Arthropoda	Insecta	Diptera	Tipulidae	Limoniinae	*Antocha*	*monticola*
119704	Arthropoda	Insecta	Diptera	Tipulidae	Limoniinae	*Limonia*	
119037	Arthropoda	Insecta	Diptera	Tipulidae	Tipulinae	*Tipula*	
121027	Arthropoda	Insecta	Diptera	Tipulidae		*Dicranota*	
120094	Arthropoda	Insecta	Diptera	Tipulidae		*Hexatoma*	
118840	Arthropoda	Insecta	Diptera	Tipulidae			
118831	Arthropoda	Insecta	Diptera				
100996	Arthropoda	Insecta	Ephemeroptera	Ameletidae		*Ameletus*	
100801	Arthropoda	Insecta	Ephemeroptera	Baetidae		*Acentrella*	
100800	Arthropoda	Insecta	Ephemeroptera	Baetidae		*Baetis*	
100873	Arthropoda	Insecta	Ephemeroptera	Baetidae		*Centroptilum*	
568598	Arthropoda	Insecta	Ephemeroptera	Baetidae		*Diphetor*	*hageni*
100755	Arthropoda	Insecta	Ephemeroptera	Baetidae			
	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Drunella*	*coloradensis/flavilinea*

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
101368	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Drunella*	*doddsii*
101385	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Drunella*	*spinifera*
101395	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Serratella*	
101318	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Timpanoga*	*hecuba*
101232	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae			
100598	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Cinygma*	
100557	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Cinygmula*	
100626	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Epeorus*	
100666	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Ironodes*	
100572	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Rhithrogena*	
100504	Arthropoda	Insecta	Ephemeroptera	Heptageniidae			
101041	Arthropoda	Insecta	Ephemeroptera	Isonychiidae		*Isonychia*	
101405	Arthropoda	Insecta	Ephemeroptera	Leptohyphidae		*Tricorythodes*	
101187	Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae		*Paraleptophlebia*	
101095	Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae			
103829	Arthropoda	Insecta	Hemiptera	Gerridae	Gerrinae	*Gerris*	
103801	Arthropoda	Insecta	Hemiptera	Gerridae			
103885	Arthropoda	Insecta	Hemiptera	Veliidae			
115045	Arthropoda	Insecta	Megaloptera	Corydalidae		*Orohermes*	*crepusculus*
115023	Arthropoda	Insecta	Megaloptera	Corydalidae			
593042	Arthropoda	Insecta	Odonata	Cordulegastridae		*Cordulegaster*	*dorsalis*
101738	Arthropoda	Insecta	Odonata	Gomphidae		*Ophiogomphus*	
101664	Arthropoda	Insecta	Odonata	Gomphidae			
102643	Arthropoda	Insecta	Plecoptera	Capniidae	Capniinae		
103254	Arthropoda	Insecta	Plecoptera	Chloroperlidae	Chloroperlinae	*Suwallia*	
103236	Arthropoda	Insecta	Plecoptera	Chloroperlidae		*Kathroperla*	
103233	Arthropoda	Insecta	Plecoptera	Chloroperlidae		*Paraperla*	
103273	Arthropoda	Insecta	Plecoptera	Chloroperlidae		*Sweltsa*	
103202	Arthropoda	Insecta	Plecoptera	Chloroperlidae			
102910	Arthropoda	Insecta	Plecoptera	Leuctridae		*Moselia*	*infuscata*
102840	Arthropoda	Insecta	Plecoptera	Leuctridae			
102567	Arthropoda	Insecta	Plecoptera	Nemouridae		*Malenka*	
102556	Arthropoda	Insecta	Plecoptera	Nemouridae		*Soyedina*	

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
102594	Arthropoda	Insecta	Plecoptera	Nemouridae		*Zapada*	*cinctipes*
102597	Arthropoda	Insecta	Plecoptera	Nemouridae		*Zapada*	*oregonensis group*
102591	Arthropoda	Insecta	Plecoptera	Nemouridae		*Zapada*	
102517	Arthropoda	Insecta	Plecoptera	Nemouridae			
102515	Arthropoda	Insecta	Plecoptera	Peltoperlidae		*Sierraperla*	*cora*
103142	Arthropoda	Insecta	Plecoptera	Peltoperlidae		*Soliperla*	
102510	Arthropoda	Insecta	Plecoptera	Peltoperlidae		*Yoraperla*	
102488	Arthropoda	Insecta	Plecoptera	Peltoperlidae			
102986	Arthropoda	Insecta	Plecoptera	Perlidae		*Calineuria*	*californica*
103123	Arthropoda	Insecta	Plecoptera	Perlidae		*Doroneuria*	*baumanni*
102972	Arthropoda	Insecta	Plecoptera	Perlidae		*Hesperoperla*	*pacifica*
102914	Arthropoda	Insecta	Plecoptera	Perlidae			
102995	Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperlinae	*Isoperla*	
103102	Arthropoda	Insecta	Plecoptera	Perlodidae	Perlodinae	*Skwala*	
102994	Arthropoda	Insecta	Plecoptera	Perlodidae			
102473	Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcyinae	*Pteronarcys*	*californica*
102471	Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcyinae	*Pteronarcys*	
102467	Arthropoda	Insecta	Plecoptera				
115935	Arthropoda	Insecta	Trichoptera	Apataniidae		*Apatania*	
116906	Arthropoda	Insecta	Trichoptera	Brachycentridae		*Brachycentrus*	
116958	Arthropoda	Insecta	Trichoptera	Brachycentridae		*Micrasema*	
116905	Arthropoda	Insecta	Trichoptera	Brachycentridae			
116538	Arthropoda	Insecta	Trichoptera	Calamoceratidae	Calamoceratinae	*Heteroplectron*	*californicum*
117121	Arthropoda	Insecta	Trichoptera	Glossosomatidae	Agapetinae	*Agapetus*	
117159	Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosomatinae	*Glossosoma*	
117120	Arthropoda	Insecta	Trichoptera	Glossosomatidae			
115529	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsychinae	*Arctopsyche*	
115563	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsychinae	*Parapsyche*	*almota*
115560	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsychinae	*Parapsyche*	*elsis*
115556	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsychinae	*Parapsyche*	
115453	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychinae	*Hydropsyche*	
115398	Arthropoda	Insecta	Trichoptera	Hydropsychidae			
115641	Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptilinae	*Hydroptila*	

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
115849	Arthropoda	Insecta	Trichoptera	Hydroptilidae		*Palaeagapetus*	
115629	Arthropoda	Insecta	Trichoptera	Hydroptilidae			
116794	Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostomatinae	*Lepidostoma*	
116001	Arthropoda	Insecta	Trichoptera	Limnephilidae	Limnephilinae	*Hesperophylax*	
115998	Arthropoda	Insecta	Trichoptera	Limnephilidae	Limnephilinae	*Hydatophylax*	*hesperus*
115974	Arthropoda	Insecta	Trichoptera	Limnephilidae	Limnephilinae	*Psychoglypha*	
115907	Arthropoda	Insecta	Trichoptera	Limnephilidae		*Cryptochia*	
115933	Arthropoda	Insecta	Trichoptera	Limnephilidae			
115319	Arthropoda	Insecta	Trichoptera	Philopotamidae	Philopotaminae	*Dolophilodes*	
115258	Arthropoda	Insecta	Trichoptera	Philopotamidae	Philopotaminae	*Wormaldia*	
115257	Arthropoda	Insecta	Trichoptera	Philopotamidae			
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*angelita group*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*betteni group*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*brunnea/vemna group*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*grandis group*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*hyalinata group*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*sibirica group B*
	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*vofixa group*
115097	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	
117003	Arthropoda	Insecta	Trichoptera	Sericostomatidae		*Gumaga*	
116046	Arthropoda	Insecta	Trichoptera	Uenoidae	Thremmatinae	*Neophylax*	
116331	Arthropoda	Insecta	Trichoptera	Uenoidae	Uenoinae	*Farula*	
115095	Arthropoda	Insecta	Trichoptera				
99208	Arthropoda	Insecta					
93953	Arthropoda	Malacostraca	Amphipoda	Anisogammaridae		*Ramellogammarus*	
93861	Arthropoda	Malacostraca	Amphipoda	Crangonyctidae		*Stygobromus*	
93294	Arthropoda	Malacostraca	Amphipoda				
92120	Arthropoda	Malacostraca	Isopoda				
173546	Chordata	Amphibia	Anura	Leiopelmatidae		*Ascaphus*	*truei*
81400	Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiinae	*Pisidium*	
76591	Mollusca	Gastropoda	Basommatophora	Planorbidae			
71584	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae		*Juga*	*bulbosa*
71570	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae		*Juga*	

ITIS Code	Phylum	Class	Order	Family	Subfamily	Genus	Species
71541	Mollusca	Gastropoda	Neotaenioglossa	Pleuroceridae			
69459	Mollusca	Gastropoda					
563956	Nemata						
53964	Platyhelminthes	Turbellaria					

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix B: Expectations of Field Crew

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains a list of expectations for crew members, designed to ensure that employees act as exemplary personnel, and that the highest quality effort is exerted during sampling.

Integrated Aquatic Community and Water Quality Monitoring of Wadeable Streams in the Klamath Network

Expectations of Field Crews

The purpose of this document is to lay out a series of standards for field crew conduct to ensure two important aspects:

1. The crew represents the ideals and mission of the National Park Service to the highest degree possible.
2. The data collected by the crew is of the highest quality possible under the guidelines of the protocol.

To accomplish this, the undersigned agrees to:

- Hold the biological and cultural resources of the park in the highest regard.
- Recognize that members of the public, i.e., park visitors, are their "customers" and deserve the time and respect of the crew – the crew has a job as interpretative instructors.
- Obey all park regulations and permit requirements to the letter.
- Prioritize personal safety.
- Follow all protocols.
- Any deviations deemed necessary by the Crew Leader from the protocol will be reported to the Project Lead within 48 hours.
- All data shall be recorded at the appropriate time, and memories will not be relied upon.
- Report any observations of interest to appropriate park personnel – this includes observations of problem wildlife or illicit human activity.

Name (please print):_____ Date:_____

Signature:_____ Position:_____

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix C: USGS Safety Manual, Chapter A9 (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the full text of the Unites States Geological Survey manual on field safety. It contains guidelines and rules covering a variety of topics pertinent to the Klamath Inventory and Monitoring Network Wadeable Streams Protocol. It should be read and followed by the Field Crew.

http://water.usgs.gov/owq/FieldManual/Chap9/content.html

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix D: Leave No Trace Handbook (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the full text the Leave No Trace manual on minimizing environmental impacts. It contains guidelines and rules covering a variety of topics pertinent to the Klamath Inventory and Monitoring Network Wadeable Streams Protocol. It should be read and followed by the Field Crew

http://lnt.org

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix E: Standard Operating Procedure for Icom IC-F70DT Radio Guide

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This guide has been written to give field crews basic knowledge of how to use the Icom radios provided. However, it is recommended that crews also read the instruction manual, although much of the material presented is for advanced use (e.g., radio networks, stun functions, etc.) The sections of the manual most pertinent to the end-user are sections 1-3, 5, 6, and 10.

The use of this radio is for "occupational use only" – these radios are not to be used for general population use. Treat these radios with respect and use accordingly.

During use in the field, the provided leather case should be used at all times to help protect the radio from the elements and general wear and tear.

When issued a radio, you should receive:

- One Icom Radio (IC-F70DT)
- One antennae (should be preattached)
- One Leather belt case, with snap retention and belt clip
- One or two BP-254 battery pack(s) – 2 if remote areas are expected
- One BC-119N Desktop Battery Charger
- One BP-237 AA battery pack

Icom Overview

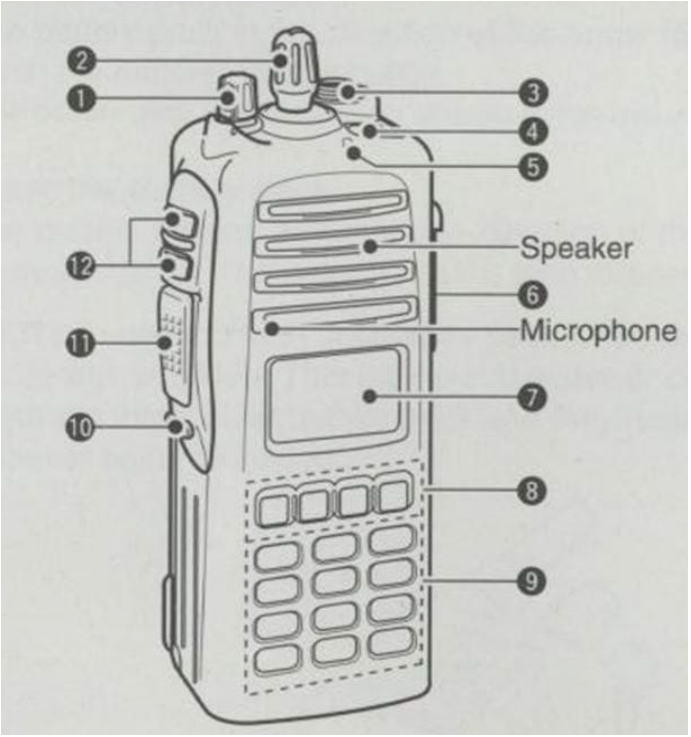
The Klamath Network has eight Icom FC-F70DT VHF two-way radios for use by the field crew. These radios are light-weight, powerful, fairly robust to field use, and provide a safety measure and logistical contact to local park staff.

It is the responsibility of the field crew to familiarize themselves with the use and operation of the radio unit. **It is further the responsibility of the Field Crew Leader to communicate with the local park staff to establish local radio procedures** (e.g., check-ins (if required), call signs, etc.).

Any problems with programming or operations should be reported to Klamath Network office staff as soon as possible.

Radio Specifications

Maximum number of channels: **256**
Power: **5 watt**
Operational Range: **5 to 7 miles (8 to 11 kilometers)**, but highly dependent on local conditions.
Battery Life: **14.5 hours** of continuous operational use (intermittent crew use should extend this).



1. Power and Volume Control
2. Rotary Channel Selector
3. Antenna Connection
4. Emergency Switch
5. Busy/Transmit Switch (Green = receiving/squelch open) (Red = transmitting)
6. Connector cover
7. Display
8. Function Keys
9. Keypad
10. "Monitor Switch" – programmed to "user set"
11. PTT – Push To Talk
12. Up/Down Switches

Basic Operation

1. Turn the radio on by rotating knob (**1**) clockwise (this also controls volume).
2. Rotate knob (**2**) to the appropriate channel (confirm channel on screen [**7**]).
3. Push PTT button (**11**).
4. Talk, holding the transmitter upright and 2 to 4 inches from mouth.
5. Release PTT button (**11**) to receive.
6. Simple!

Changing Channels

Depending on the park, location within a park, or the location the radio was last used, the channel zone and channel may need to be changed for proper usages (Contact local park staff to establish proper channels for usage).

Establish the proper zone (see Table 1):

1. With the radio on, depress button "P_0" from the Function Keys (**8**).
2. Use the Up/Down Switches (**12**) to scroll through the zones.
3. The changing zones will be displayed on the screen (**7**).
4. Upon finding the correct zone, depress "P_0" to set the zone.

Changing the channel within the zone:

1. Turn the Channel Select Knob (**2**) until you reach the proper channel.

In Emergency Situations

If you are in an emergency situation (e.g., life threatening, broken limb(s), mountain lion gnawing on you, etc.), and you are unable to reach park staff, you have two options:

1. Depress the orange button (**4**). This sends an emergency signal on the currently selected channel (no voice necessary). If you are set on the wrong channel, no one may hear you.
2. Switch the zone to one of the counties closest to you (e.g., Jackson County or Shasta County). Within these zones, there are a variety of sheriff and fire fighting settings. Attempt communication with any of these entities.

Useful Information

There are additional tidbits of radio usage that may help the radio operator.

Be patient – It takes time for a voice message to be received and transmitted. When talking, depress the PTT, wait a second, and then begin to talk. When you are done talking, finish by saying "OVER." This lets the receiver know that you are done talking, so that they can reply. The receiver should wait a few seconds before replying.

Push To Talk – Do not depress this button unless you are actively engaging in talk. Holding this button down will prevent others from talking on this frequency. You may anger people if you abuse the radiowaves.

Battery life – the battery should last 14 hours or so, for typical usage. If not transmitting or receiving, it should last considerably longer. Keep the battery charged as much as possible. Note that the battery can be charged detached to the radio if needed (e.g., charging a back-up battery). There is a battery life indicator on the display screen in the upper right hand corner. If you anticipate needing longer battery life, contact the Klamath Network office staff for extra batteries.

Signal strength – there is an indicator in the upper left corner of the display.

Scan – Function key "P_1" is set to scan. Depressing the button will cause the radio to scan all zones and all channels (except for NOAA weather forecast zone). Note that if squelch is set low, it may "pick up" static.

Squelch – Squelch is controlled through "user settings." Squelch is basically noise reduction, hiding the background static over a certain threshold. Depending on the channel and your location, the amount of static that needs to be reduced can vary. Generally, increase the squelch until the static just fades out. Changing the squelch will affect all channels in all zones. To set or adjust squelch, follow this procedure:

1. With the radio on, depress the "Monitor Switch," (**10**), until the radio beeps.
2. This will enter into a series of screens that the user can adjust; there should be little need to change any, except for the squelch.
3. Pushing the same button will cycle through options, push repeatedly until SQL appears. A number will be next to it, from 0 – 255. If you are hearing just static, increase the squelch. If you are not hearing transmissions, decrease the squelch.
4. Use the up/down switch (**12**) to adjust the squelch.
5. Push and hold the "Monitor Switch" (**10**) until the radio beeps again and goes into standard operating mode.
6. The effect of changing the squelch will only be heard when you go back into the standard operating mode (e.g., while changing the squelch, you will not get real-time feedback on your changes).
7. Adjust as necessary.

Light – You can create a backlight on the screen by depressing button "P_2."

Compander – The compander function can create a clearer signal, if both the receiver and transmitter are equipped with this function. Compander can be turned on and off by depressing button "P_3."

Waterproof – Although the radio is waterproof – down to 1 meter for 30 minutes, do not test this. The radio is very expensive (about 2 weeks of pay for a field technician!).

NOAA Radio – There are seven different NOAA radio weather forecast frequencies programmed in the radio. If you can pick up a signal, the forecast should be applicable to your area.

Troubleshooting

Although every attempt has been made to ensure that the radios are properly functioning, problems may arise.

"The radio does not turn on."

- Confirm that the battery case is fully snapped into place. Depress the latch on the bottom of the radio, and reinsert the battery.
- Change the battery. If the radio is equipped with a battery unit using AA batteries, change these batteries.

"I can't hear any transmission, and nobody responds to me."

- Antennae may be loose – tighten it up.
- You may be on the wrong channel – try changing channels, and repeat.
- Squelch may be to high – adjust squelch to a lower setting, and repeat.
- You may be out of range – either try to move closer to the base station or repeater, or move to higher ground to establish line of sight.

For additional problems, return radio to Klamath Network office staff.

Table 8. Currently assigned channels and zones for Klamath Network Icom Radios (as of 2 July 2009). Names are derived from park supplied lists, and are set up according to park specifications (e.g., "channel 1 on a CRLA radio should be channel 1 on KLMN radio, when set to Zone 1).

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10
	CRLA	**LABE**	**LAVO**	**ORCA**	**REDW**	**WHIS**	**KLMN LE**	**NOAA**	**Jackson Co.**	**Shasta Co.**
Channel 1	CLNPWA	LABE Local Transmitter	LNP Direct	ORCA Main	NPS Direct	WHIS 1	CLNPWA	NOAA 1	JackSheriff1	CDF dis
Channel 2	CLNPSC	LABE Schonin Repeater	LNP Peak	ORCA Repeater	NPS Crescent City	WHIS 2	CLNPSC	NOAA 2	O.P.E.N.	CountyNet
Channel 3			LNP Hark		NPS Requa	WHIS 1 N	LABE 2	NOAA 3	JackSheriff2	CottonwoodFi
Channel 4			LNP Pros		NPS Red Mtn.	WHIS 2 N	SISK SO	NOAA 4	AshlandPOdis	AndersonFi
Channel 5			LNP Tactical 1		NPS School House		REDW DIR	NOAA 5	AshlandFDdis	ReddingFDdis
Channel 6			LNP Tactical 2		NPS Tactical		REDW REP	NOAA 6	AslandSkiPa	ReddingFDta1
Channel 7			NIFC 1		NOAA Weather		LNP PEAK	NOAA 7	PhoenixPOdis	ReddingFDta2
Channel 8			NIFC 2		CDPR Direct		LNP HARK		PhoenixPOtac	ShastaCoSher
Channel 9			LNF Dir		CDPS Pt. St.		WHIS 1		TalentPOdis	ShastaCoStac
Channel 10			LNF Pros		CDPR Requa		WHIS 2		TalentPOtac	ForestNet
Channel 11			LNF Trnr		CDPR Red Mtn.		DOI LE		SoCountFD	ForestNetRep
Channel 12			USFS A2G		CDPR Prairie		KLMNTAC1		MedfordPOdis	TravelNet
Channel 13			CALCORD						MedfordPOtac2	USFSTac1
Channel 14			TGU LOCL						MedfordPOta3	
Channel 15									MedfordFDdis	
Channel 16									NOCountFD	

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix F: Field Data Sheets and Logs

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix details the data sheets developed for times when data is manually recorded, as a backup to the Tablet PCs. In order, they are:

- Field data sheet for the collection of physical, chemical, and biological data.
- Data sheet for fish collections
- Log sheet for Equipment calibration/failure/replacement.
- Log sheet for Event change (change to protocol, personnel, etc.)
- Log sheet for Training (recording when, who and what is trained)
- Chain-of-custody form

All details for filling in fields and recording data are detailed in the relevant SOPs. For printing, these documents are located on the Klamath Network server at:

S:\Monitoring\Stream Monitoring\Stream_Data\Datasheets\Seasonal_Data\Original_Sheets

For use, a unique identification number should be added to the upper right corner, along with an attached sampling year stamp. Also, printed field sheets should be on weather-resistant paper (e.g., Rite-in-the-Rain or similar).
:

TORRENT EVIDENCE ASSESSMENT FORM

Site ID:_____	QAQC Initials:_____
STREAM NAME:_____	DATE:_____

Torrent Evidence (take photos)

Mark ALL that apply

Evidence of Torrent Scouring:

	01 – Stream channel has a recently devegetated corridor two or more times the width of the low flow channel. This corridor lacks riparian vegetation with possible exception of fireweed, even aged alder or cottonwood seedlings, grasses, or other herbaceous plants.
	02 – Stream substrate cobbles or large gravel particles are NOT IMBRICATED (meaning that they **do not** lie with the flat sides horizontal, like roof shingles) . Stones laying unorganized, lying "every which way." Substrate may be angular (not water worn.
	03 – Channel has little evidence of pool-riffle structure. (Could you ride a mtn. bike down the stream>)
	04 – The stream channel is scoured down to bedrock
	05 – There are gravel or cobble berms (levees) above bankfull height
	06 – Downstream of the scoured reach, there are massive deposits of sediment, logs, or other debris.
	07 – Riparian trees have fresh bark scars at main points, at very high levels above the channel bed
	08 – Riparian trees have fallen into the channel as a result of scouring near their roots

Evidence of Torrent Deposits:

	09 – There are massive deposits of sediment, logs, and other debris in the reach. They may contain wood and boulders, that in your judgment, could not have been moved even at extreme flood stage.
	10 – If the stream has begun to erode newly laid deposits, it is evident that these deposits are "matrix supported" (meaning that large particles are not necessarily touching, but have silt and sand in between them and these fine material support the larger particles).

No Evidence:

	11 – No evidence of torrent scouring or torrent deposits.

Comments:	

STREAM VERIFICATION FORM

Site ID:_____	QAQC Initials:_____
STREAM NAME:_____	DATE:_____

STREAM/RIVER VERIFICATION INFORMATION

Stream/River verified by (X all that apply): ☐ GPS ☐ Local Contact ☐ Signs ☐ Roads ☐ Topo Map

☐ Other (Describe here):

☐ Not Verified (explain in Comments)

Coordinates	Latitude North	Longitutude West
GPS Unit type:	_ _._ _ _ _ _ _	_ _ _._ _ _ _ _ _

DID YOU SAMPLE THIS SITE?

☐ YES if yes, check one box below

Sampleable (Choose below)

- ☐ Wadeable
- ☐ Partially wadeable (Explain in comments)
- ☐ Wadeable interrupted (Explain in comments)
- ☐ Altered – Stream present, but not as on map

General Comments:

☐ NO if no, check one box below

Non-Sampleable –Permament

- ☐ Dry – visited
- ☐ Dry – not visited
- ☐ Wetland – no channel
- ☐ Map error – no waterbody/channel present
- ☐ Impounded (under lake)
- ☐ Other (explain in comments)

Non-Sampleable-Temporary

- ☐ Not wadeable at this time
- ☐ Other (explain in comments)

No Access

- ☐ Permission Denied
- ☐ Permamently inaccessible (explain in comments)
- ☐ Temporaily inaceesible (explain in comments)

Directions to site/Access notes:	Drive time:		Hike time:	

STREAM VERIFICATION FORM (v.2) Continued

Site ID:_____	QAQC Initials:_____
STREAM NAME:_____	DATE:_____

STREAM REACH DETERMINATION

Channel Width Used to Define Reach (m)	Distance (m) from X-site		Comments
	Upstream Length	Downstream Length	
_ _ _	_ _ _	_ _ _	

Pool/Riffle/Run categorization

(e.g. Pools: 0-2, 4-5, etc., where 0-2 is a two meter long pool from the bottom of A transect, extending 2 meters up)

Pools		Riffles		Run	

Name	Fish	Inverts	Algae	Physical Transects	Riparian	Discharge	Woody Debris	Slope	Observer/ other	Specify "other"
_____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
_____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
_____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
_____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
_____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____

SAMPLE COLLECTION FORM (v.2)

Site ID:_____	QAQC Initials:_____
STREAM NAME:_____	DATE:_____

WATER CHEMSITRY ☐ **YES** ☐ **NO Personnel filtering:**_____

Sampled at Transect:	Comments:
__ __	

Air Temperature:		Water Temperature:		

Targeted Riffle Benthos Sample

No. of vials	___	Comments:

	Nearest Transect	___	___	___	___	___	___	___	___	Substrate size classes
Dom. substrate	Fine/Sand (F/S)									F/S – ladybug of smaller (<2mm)
	Gravel (G)									G – ladybug to tennis ball (2 to 64 mm)
	Coarse (C)									C – tennis ball to car sized (64 mm to 4 m)
	Other (O) - define in comments									O – wood, bedrock, etc.

Periphyton Ash Free Dry Mass Sample

Number of cobbles scraped (0-11):	Nearest Transects:__ __ __ __ __ __ __ __ __ __ __

Flags:__ __ __ __ __

Flag definition: K = sample not collected (give reason); F1, F2, etc. = Crew defined flag – in comments

Comments:	

STREAM DISCHARGE FORM (v.2)

Site ID:_____ QAQC Initials:_____

STREAM NAME:_____ DATE:_____

Nearest Transect:_____

Stream Width at point of Dischare Calculation:_____

Measurements				
Distance Units ☐ Tenths ft ☐ cm		Depth Units ☐ Tenths ft ☐ cm		Velocity Units ☐ ft/s ☐ m/s ☐ cm/s
Final measurement should be LEFT Banks (start on the right) If not, note in comments				
Point no.	Distance from bank	Depth	Velocity	Flag
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Flag Codes: K = No measurement of observation made; U = Suspect measurement; Q = Unacceptable QC check with measurement; Z = Last station measured; F1, F2, etc. = Field assigned comments.

Model & KLMN no. of meter used:_____

Flag	Comments

FIELD CHEMISTRY AND CHANNEL CONSTRAINT FORM

Site ID:_____ QAQC Initials:_____

STREAM NAME:_____ DATE:_____

Probe Calibration Check/Time of day

	Standard	Check reading	Recalibrated? Membrane replace?
pH			☐
Cond.			☐
DO sat	100%		☐

Alkalinity readings (2 readings are minimum)

	Sample 1	Sample 2	Sample 3
Water Volume (ml)			
Titrant Strength (N)			
Reading			

CHANNEL CONSTRAINT

Channel Pattern (Check one)

- ❑ **One channel**
- ❑ **Anastomosing** (complex) channel – relatively long major and minor channels branching and rejoining.
- ❑ **Braided Channel** – multiple short channels branching and rejoining – mainly one channel broken up by numerous mid-channel bars

Channel Constraint (Check one)

- ❑ **Channel very constrained in V-Shaped valley** (i.e., it is very unlikely to spread out or erode a new channel during a floods)
- ❑ **Channel is in Broad Valley** but channel movement by erosion during floods is constrained by Incision (no real multiple channels present)
- ❑ **Channel is in Narrow Valley**, but not very constrained, but limited in movement by relativey narrow valley floor (< ~ 10 X bankfull width)
- ❑ **Channel is Unconstrained in Broad Valley** (i.e., during flood it can fill off-channel areas and side channels, spread out over flood plain, or easily cut new channels by erosion)

Constraining Features (Check one)

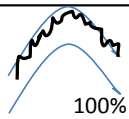
- ❑ **Bedrock**
- ❑ **Hillslope**
- ❑ **Terrace**
- ❑ **Human Bank Alterations**
- ❑ **No Constraining features**

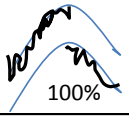
Percent of channel length with margin in contact with constraining feature: __ __ __ (0 – 100%)

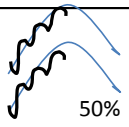
Bankfull width: __ __ __ (m)

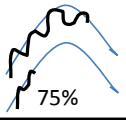
Valley width (visually estimated average): __ __ __ __ (m)
Include distances on both sides of valley border for estimate
❑ If you cannot see valley borders mark this box.

Percent of Channel Margin examples









Comments:

Site ID:_____ QAQC Initials:_____

STREAM NAME:_____ DATE:_____

SLOPE FORM

Transect	Upper reading	Lower reading	
A – B			
B – C			
C – D			
D – E			
E – F			
F – G			
G – H			
H – I			
I – J			
J – K			

Site ID:_____ QAQC Initials:_____

STREAM NAME:_____ DATE:_____

Transect ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J ☐ K Xtra side chan. ☐

Substrate Cross Sectional Info

	Distance LB	Depth	Size Class	Embed	Flag
Left					
Left Center					
Center					
Right Center					
Right					

Substrate size class codes	Embed (%)
RS – Bedrock (smooth) – larger than car	0
RR – Bedrock (rough) – larger than car	0
BL – Boulder (250 to 400 mm) Basket ball to car	
CB – Cobble (64 to 250 mm) Tennis ball to Basketball	
GC – Coarse Gravel (16 to 64 mm) – Marble to Tennis ball	
GF – Fine Gravel (2 to 16 mm) – Ladybug to marble	
SA = Sand (0.06 to 2 mm) – gritty, up to ladybug size	100
FN = Fine – Silt, Clay, Muck – Not gritty	100
HP = Hardpan (Firm, unconsolidated fine substrate)	0
WD = Wood (any size)	
OT = Other (write comment below)	

Bank Measurements

	Bank Angle (0 – 360)	Undercut dist (M)	Flag
Left			
Right			

Wetted width		
Bar width		
Bankfull width		
Bankfull height		
Incised height		

Flag codes: K = sample not collected; U = suspect sample, F1, F2, etc. assigned by crew. Explain in comments

Flag	Comment

Fish Cover/Other

0 = absent (0%)
1 = sparse (<10%)
2 = moderate (10 – 40%)
3 = heavy (40 - 75%)
4 = very heavy (>75%)

	Cover in Channel	Flag
Filamentous algae	0 1 2 3 4	
Macrophytes	0 1 2 3 4	
Woody debris > 0.3 m (BIG)	0 1 2 3 4	
Brush/woody debris (< 0.3) (small)	0 1 2 3 4	
Live Trees or roots	0 1 2 3 4	
Overhanging Veg = <1 m of surface	0 1 2 3 4	
Undercut Bank	0 1 2 3 4	
Boulders	0 1 2 3 4	
Artificial Substrate	0 1 2 3 4	

Canopy cover estimates

		Flag			Flag
CenUp			CenR		
CenL			Left		
CenDwn			Right		

VISUAL RIPARIAN ESTIMATES

0 = absent (0%)
1 = Sparse (<10%)
2 = Moderate (10 – 40%)
3 = Heavy (40 – 75%)
4 = Very heavy (>75%)

D = Deciduous
C = Coniferous
E = Broadleaf evergreen
M = Mixed *
N = None

Riparian Veg Cover	LEFT BANK	RIGHT BANK	FLAG
Canopy (> 0.5 m high)			
Veg. Type	D C E M N	D C E M N	
BIG Trees (> 0.3 m DBH)	0 1 2 3 4	0 1 2 3 4	
SMALL trees (< 03 m DBH)	0 1 2 3 4	0 1 2 3 4	
Understory (0.5 to 5 m high)			
Veg .Type	D C E M N	D C E M N	
Woody Shrubs & Saplings	0 1 2 3 4	0 1 2 3 4	
Non-Woody Herbs, Grasses, Forbs	0 1 2 3 4	0 1 2 3 4	
Ground Cover (<0.5 m)			
Woody Shrubs & Saplings	0 1 2 3 4	0 1 2 3 4	
Non-Woody Herbs, Grasses, Forbs	0 1 2 3 4	0 1 2 3 4	
Barren, Bare Dirt, Duff	0 1 2 3 4	0 1 2 3 4	

HUMAN INFLUENCE

0 = not present P = >10m C = Within 10 m B = on Bank

	LEFT BANK	RIGHT BANK	FLAG
Wall/Dike/Revement /Riprap/Dam	0 P C B	0 P C B	
Buildings	0 P C B	0 P C B	
Pavement/cleared lot	0 P C B	0 P C B	
Road/Railroad	0 P C B	0 P C B	
Pipes (inlet/outlet)	0 P C B	0 P C B	
LandfillTrash	0 P C B	0 P C B	
Park/Lawns/Camping/Firepits	0 P C B	0 P C B	
Pasture/Range/Hay Field	0 P C B	0 P C B	
Logging Operations	0 P C B	0 P C B	
Mining activity	0 P C B	0 P C B	

*Mixed is for if > 10% of each

Site ID:__________________ QAQC Initials:_________

STREAM NAME:_________________ DATE:_____________________

Continued on back!

Tran	Largest legacy tree visible from this station (V.2)						Invasive plants to the left AND right	
	Trees not visible	DBH (m) L R L R	Height (m)	Distance from margin	Type	Taxonomic category	Check all present	
A	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	L R ☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
B	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
C	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli

Instructions

Legacy trees are defined as the largest tree with the search area: Confine search to no more than 50 m from left and right bank and extending upstream to next transect. **Measure height with laser, and write as note in taxonomic category.**

Invasive plants – confine search to riparian plots on left and right bank, in a 10 X 10 M area

Comments:

Taxonomic Categories

Acacia/Mesquite Alder/Birch Ash Maple/Boxelder Oak Poplar/Cottonwood Sycamore Willow Unknown or other deciduous
Cedar/Cypress/Sequoia Fir (including Douglas Fir and hemlock) Juniper Pine Spruce Unknown or other conifer
Unknown or other Broadleaf evergreen
Snag (Dead tree of any species) NOTE: if you can identify a tree to a lower taxonomic level, do so!

Invasive species

RC Grass	Reed Canary Grass	*Phalaris arundinacea*
Eng Ivy	English Ivy	*Hedera helix*
Ch Grass	Cheat Grass	*Bromus tectorum*
Salt Ced	Salt Cedar	*Tamarix*
Can This	Canada Thistle	*Cirsium arvense*
M This	Musk Thistle	*Carduu nutans*
H Black	Himalayan Blackberry	*Rubus discolor*
Teasel	Teasel	*Dipsacus fullonum*
Spurge	Leafy Spurge	*Euphobia esula*
G Reed	Giant reed	*Arrundo donax*
C Burd	Common burdock	*Arctim minus*
Rus Oli	Russian Olive	*Elaeagnus angustifolia*

Tran	Largest legacy tree visible from this station (V.2)						Invasive plants to the left AND right	
	Trees not visible	DBH (m) L R L R	Height (m)	Distance from margin	Type	Taxonomic category	Check all present	
D	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	L R ☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
E	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
F	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
G	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
H	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
I	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
J	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli
K	☐	☐☐ 0 – 0.1 ☐☐ .75 – 2 ☐☐ .1 - .3 ☐☐ >2 ☐☐ .3 - .75	L ____ R____	L ____ R____	☐☐ Deciduous ☐☐ Coniferous ☐☐ Broadleaf ☐☐ evergreen		☐ None	☐ RC Grass ☐ Salt Ced ☐ Hblack ☐ G Reed ☐ Eng Ivy ☐ CanThis ☐ Teasel ☐ C Burd ☐ Ch Grass ☐ M This ☐ Spurge ☐ Rus Oli

Site ID:_____ QAQC Initials:_____

STREAM NAME:_____ DATE:_____

Woody Debris form v.3

Check here if blanks indicate NO Woody Debris for category: _____

Location	Length	Diameter	A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K
All or part of bankfull	1.5 – 5	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										
	5- 15	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										
	>15	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										
Above bankfull	1.5 - 5	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										
	5 - 15	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										
	>15	0.1 – 0.3										
		0.3 – 0.6										
		0.6 – 0.8										
		> 0.8										

Flag codes: K = no measurement; U = suspect measurement; F1, F2, etc. = flags assigned by crews. Explain all flags in comments. 1 = measure bar width at stat. 0 and midstati. (5 or 7)

Site ID:___________________	QAQC Initials:_________	Snorkeling: ☐	Wave Form:	AC DC Pulsed DC	
STREAM NAME:_________________	DATE:_____________________	Seine netting: ☐	Volts:	Watts:	
		eFishing: ☐	Pulse rate:	Amps:	Pulse width:
SPECIMEN COLLECTION	Not Fished ☐ None collected ☐	Water visibility: Good ☐ Poor ☐	Total shock time:	Total Fishing time:	Sampling distance:

Spec. no	Common name	Tally	Total Count	Length (mm) Minimum	Maximum	Anom. count	Mortality count	Flag	Transects
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J
									○ A ○ C ○ E ○ G ○ I ○ B ○ D ○ F ○ H ○ J

Flag	Comments

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix G: Example of Site Folder

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains an example of a site folder. This is a suite of information collected by the previous field crew on a site that the current field crew will be visiting and sampling at. Information included should be useful to the crew for:

- Finding the site.
- Planning total time taken to sample.
- Information of special note (e.g., new fish species, amphibians, or disease).

It is the responsibility of the Project Lead to develop these for new sites. Site folders should be updated each sampling cycle, incorporating information from multiple years.

Stream Name: East Fork Mill Creek Date of previous sample: 10 September 2009
Coordinates: 41.72948, - 124.09235 Unique Site ID: 14J

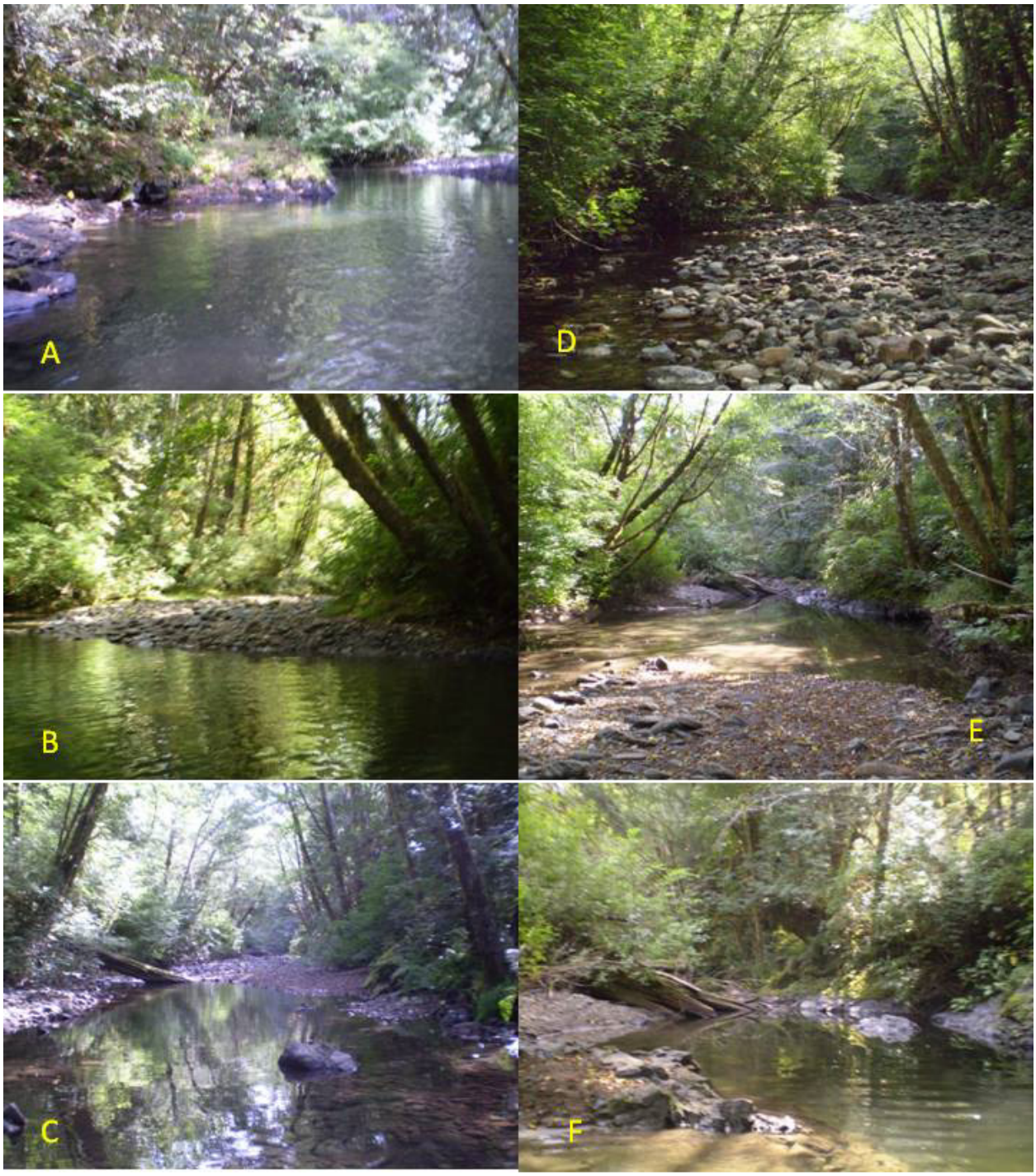
Directions to site: Take the 101 to Hamilton Road. Follow just over 2.7 miles to bridge over creek. Park near this bridge. Hike to the stream is about 0.3 miles

Drive Time: 35 minutes (From Requa Housing) Hike Time: 10 minutes

General Comments: Several deep pools within the reach, but generally easy area to work in.

Previous reach length: 280 m total Where discharge measured: Near Transect D

X-Point (F transect), looking in all four directions.



Bottom six transects (A-F), looking upstream

Top five transect (G – K) looking upstream

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix H: Example of Fish, Amphibian, and Invasive Species Guide

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains an example of a field guide to fish, amphibians, and invasive plants of Lassen Volcanic National Park. It was developed by searching NPSpecies database (http://science.nature.nps.gov/im/apps/npspp/) for the relevant taxonomic groups, and the invasives species list of the EPA EMAP protocol. This list was then used as a guide for finding digital photos from the public domain, and relevant short cut features for the crew to refer to. Note that the pictorial field guides are meant to supplement traditional guides, and not replace guides. There is every possibility that the crew will find previously undocumented species. These guides should be developed per park, then printed and laminated for field use, and referenced in conjunction with the field guides.

Invasive species guides were developed by Sean Smith, KLMN Botanist

Examples of potential fish and amphibians found in Lassen Volcanic National Park

- Quick guide for crew use only – images found on websites.
- Species list of potential species taken from NPSpecies (accessed August 2008)
- Guide is to supplement traditional guidebooks and keys, not replace them!

Minnows - Cyprinidae

- 1 stout dorsal spine

- Tui Chub *Siphateles bicolor*
- typically “chunky”; decurved lateral line
- up to 40 cm SL
- usually 8 anal fins
- snout does not overhang mouth
- caudal peduncle short and thick

- Golden Shiner, *Notemigonus crysoleucas*
- deeply depressed body, decurved lateral line
- up to 30 (usually < 15) cm SL
- usually 11-14 anal fins
- typically golden sheen
- fleshy keel between pelvic and anal fins

Minnows - Cyprinidae

- 1 stout dorsal spine

- Fathead minnow *Pimephales promelas*
- Head is short, blunt, broad on top
- Thickened first dorsal fin ray
- 7 - 9 anal fin rays
- back is dark, with scales outlined with pigment
- < 85 mm SL

- Speckled Dace, *Rhinichthys osculus*
- thick caudal peduncle
- usually less than 8 cm SL (occasionally 11 cm)
- caudal fin symmetrical
- Anal fins usually 6-7 rays
- Usually “speckled”

Minnows - Cyprinidae

- 1 stout dorsal spine

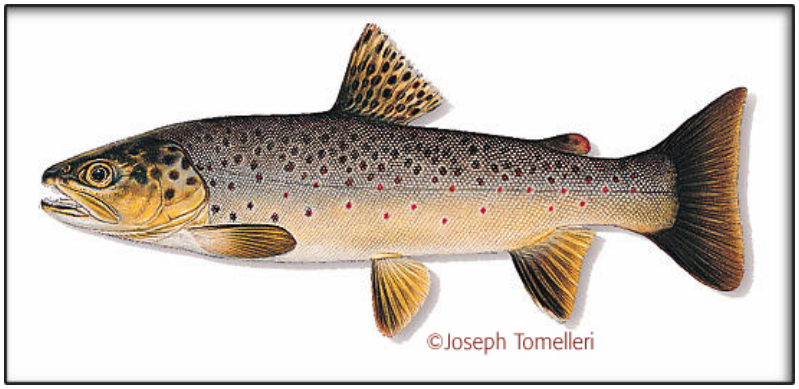
- Lahontan Redside, *Richardsonius egregius*
- Small and slender minnows
- Usually has visible dark stripe, even when not breeding - scarlet during breeding
- Two paler stripes on either side of dark stripe
- Anal fin rays 8-10

Trout - Salmonidae

- Brook Trout, *Salvelinus fontinalis*
- Dark, olive green green back with lighter, wavy lines
- Red spots with blue halos
- Tail not deeply forked

Trout - Salmonidae

- Rainbow Trout *Oncorhynchus mykiss*
- Very variable in size, shape, color
- Numerous spots on tail, adipose fin, dorsal fin and back
- Spots are NOT surrounded by “halos”
- Typically shiny



- Brown Trout, *Salmo trutta*
- Has both red and black spots
- Black spots are typically dorsal, red spots more ventral
- “Halo” present around spots, especially on dark spots on side
- Spots usually absent from caudal fin

Suckers - Catastomidae

- Tahoe Sucker, *Catostomus tahoensis*
- Subterminal mouth
- Dark olive on back, usually yellow or white undersides
- fleshy lips, with papillae
- dorsal fin with >10 rays

Salamanders and Newts, LAVO

Ensatina eschescholtzii platensis

Size Range total length (Min and Max shown)

Ambystoma macrodactylum

Max total size

Taricha granulosa

Max total size

Frogs and Toads, LAVO

Bufo boreas

Size Range (Min and Max shown)

Warty appearance,
Large, 55 – 125 mm
Variable color
Light stripe down back

Hyla regilla

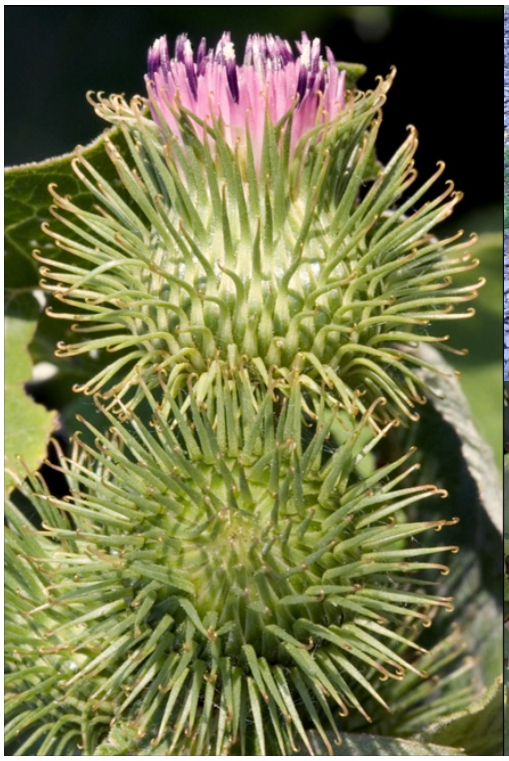
Max Size

Often green or brown, gray and red poss.
Black eye stripe
Small, < 50 mm

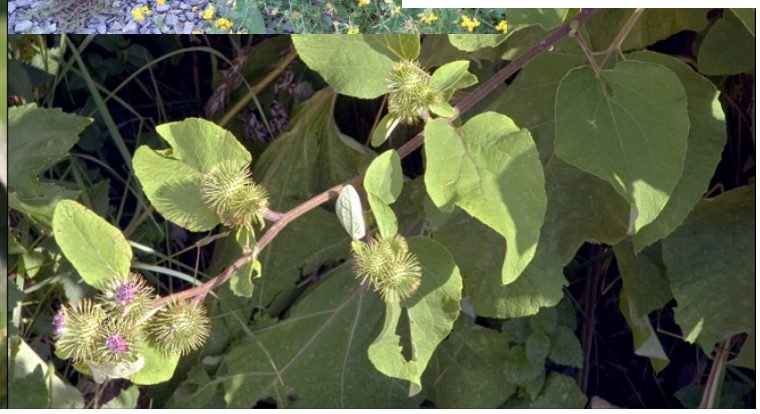
Rana cascadae

Max Size

Usually brown, olive brown
Medium sized, < 75 mm
Obvious dorsolateral folds



Arctium minus
common burdoc



Arctium minus

Habitat

- **Ecology:** Disturbed places
  Elevation: < 1200 m.
- **Watch for at: REDW; ORCA?; WHIS?**

Don't confuse with:

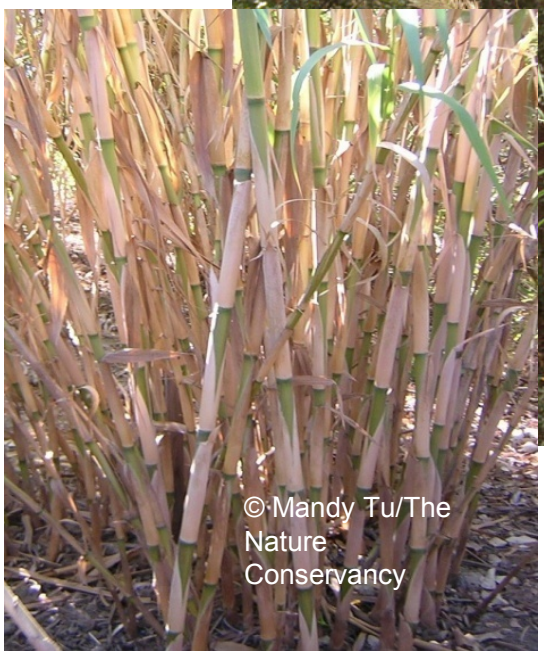
A. lappa which has flower heads 25-40mm; A. minus has heads 10-25mm

Description

- **Biennial**
- **Stems** < 15 dm
  1–several, branched above; branches stiffly ascending
- **Leaves** basal and cauline, alternate, long-petioled, widely ovate; base deeply heart-shaped; margin entire or toothed
- **Inflorescence** heads discoid, sessile to short-peduncled, in raceme- or panicle-like leafy-bracted clusters; heads phyllaries (sepals) overlapping in many series, bases appressed, tips stiffly radiating, hooked-spiny
- **Flowers** purple to pink.

Arundo donax

Giant Arundo



Arundo donax

Habitat

- Moist places, seeps, ditchbanks; < 500 m.
- Watch for at: WHIS

Don't confuse with:

• A distinctive species.

Description

- **Perennial** from thick rhizomes
- **Stem** erect, hollow, cane-like; < 8m
- **Leaves** cauline; blade < 1 m, 2–6 cm wide
- **Inflorescence** 3–6 dm, plume-like, branches ascending
- **Spikelet** 10–14 mm; glumes > lemmas, 10–13 mm, thin, brownish or purplish; lemmas 8–12 mm, tip 2-toothed

Bromus tectorum
Cheatgrass

Bromus tectorum

Habitat

- Open, disturbed places; <2200 m
- Watch for at: LABE, CRLA, ORCA, WHIS, LAVO

Don't confuse with:

•The lemma awns 0-15mm and long spikelet stalks (>10mm) and the open inflorescence of this species make it distinctive.

Description

- **Annual** 5–40 cm
- **Leaf** sheath generally densely soft-hairy; blade 1–5 mm wide, ± glabrous to densely soft-hairy
- **Inflorescence** 6–22 cm, open to ± dense; branches spreading to nodding
- **Spikelet** subcylindric to slightly compressed; glumes glabrous to short-hairy, lower 5–8 mm, 1-veined, upper 7–12 mm, 3-veined; florets 3–7; lemma body 9–13 mm, 5–7-veined, glabrous to short hairy, tip with 2 teeth 1–3 mm, awn 8–18 mm

Carduus nutans
Musk Thistle

Carduus nutans

Habitat

- Roadsides, pastures, waste areas 100–1200 m.
- Watch for at: LAVO

Don't confuse with:

•This species differs from other *Carduus* spp. by phyllaries >2mm and solitary conspicously peduncled heads.

Description

- **Biennial**
- **Stems** 4–15 dm, glabrous to woolly, narrowly spiny-winged
- **Leaves** basal 10–40 cm, 1–2-pinnately lobed; cauline glabrous or sparsely hairy
- **Inflorescence** heads generally solitary, often nodding; involucre 2–7 cm diam, spheric; phyllaries >2mm, spreading, spine-tipped
- **Flower** corollas 20–25 mm, purple; tube 12–14 mm

Cirsium arvense
Canada Thistle

Cirsium arvense

Habitat

- Disturbed places; < 1800 m
- Watch for at: LAVO, WHIS, REDW, CRLA, LABE

Don't confuse with:

•Other *Cirsium* spp., *C. arvense* is the only one with unisexual (dioecious) heads mostly <1.5cm.

Description

- **Perennial** 5–10 dm, dioecious; rootstock creeping
- **Leaves** 5–20 cm, mostly cauline, reduced upward, sessile, tapered at base, sometimes decurrent as spiny wings, subentire, dentate, or lobed
- **Inflorescence** heads several–many, cymes tight to ± open, rounded or flat-topped; peduncles 0–4 cm; involucre 1–2 cm, 1–2 cm diam, generally ± purplish, outer phyllaries tipped by spines ± 1 mm,
- **Flowers**: corollas generally purplish, dioecious

Dipsacus fullonum
Teasel

Dipsacus fullonum

Habitat

- Roadsides, pastures, old fields, sometimes moist sites; < 1700 m
- Watch for at: REDW

Don't confuse with:

•*D. sativus* which has a receptacle bract ending in a recurved, very stiff spine; involucre bract gen ± spreading or reflexed. Also a non-native.

Description

- **Biennial** armed with prickles, sometimes ± throughout
- **Leaves** pairs generally only shallowly fused around stem
- **Inflorescence** generally 5–10 cm, ovoid-cylindric; involucre bracts unequal, > flowers, linear, stiff; receptacle bract ending in a spine
- **Flowers** calyx limb cup-shaped, 4-lobed, persistent; corolla generally lavender, rarely white, tube long, lobes 4, unequal; stamens 4

Elaeagnus angustifolia
Russian olive

Elaeagnus angustifolia

Habitat

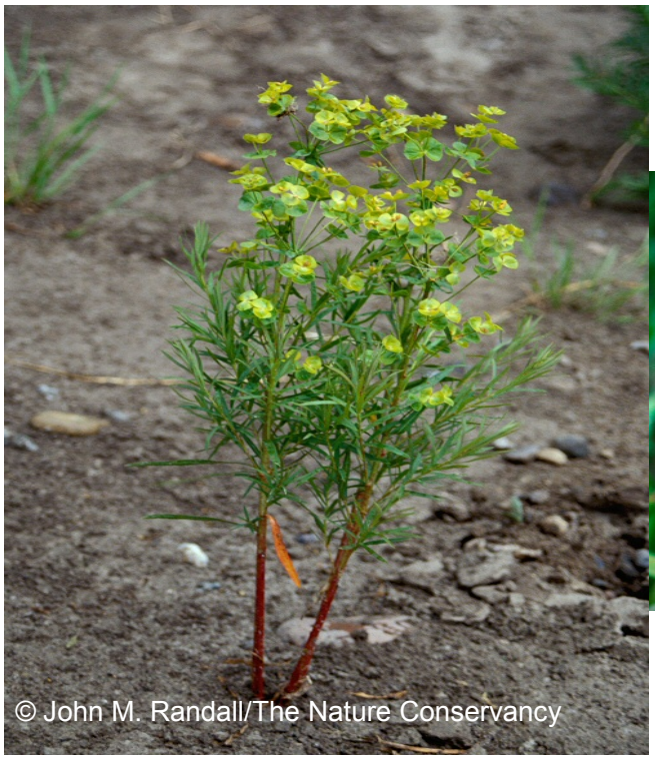
- **Ecology:** Uncommon. Disturbed, sometimes moist places
  Elevation: generally < 1500 m.
- **Watch for at:**

Don't confuse with:

Willows (*Salix* spp.) which have catkins.

Description

- **Shrub**, tree< 7 m, sometimes thorny
- **Leaves** alternate4–8 cm, lanceolate to oblong, more silvery on lower surface
- **Flower** bisexual; 5–10 mm, ± as wide at top lobes 4; hypanthium bell-shaped to salverform (long funnel-like) dark yellow inside; stamens 4, barely exserted; stigma ± elongate, on 1 side of style
- **Fruit** 10–20 mm, elliptic in outline,.



Euphorbia esula
Leafy Spurge

Euphorbia esula

Habitat

- Fields, pastures; < 1400 m
- Watch for at: LAVO, WHIS

Don't confuse with:

•This is a distinctive species.

Description

- **Perennial** stem erect, 3–8 dm, glabrous to hairy
- **Leaf** 2–6 cm, sessile; blade linear to oblanceolate, glabrous, tip acute, margin entire
- **Inflorescence** clustered; clusters generally umbel-like or cyme-like; glands 4, 1.5–2 mm
- **Staminate flowers** 5–many, generally in 5 clusters around pistillate flower
- **Pistillate flower** 1, central, stalked; ovary chambers 3, ovule 1 per chamber, styles 3, separate or fused at base, divided or entire

Hedera helix
English Ivy

Richard Old,
www.xidservices.com

Hedera helix

Habitat

- Disturbed areas; 0–1000 m.
- Watch for at: REDW

Don't confuse with:

•*Delairea odorata* (Cape ivy) which has small, yellow composite flowers and leaves with shallower lobes.

Description

- **Woody** vine
- **Stem** juvenile stems climbing by aerial rootlets; flowering stems fewer, nonclimbing
- **Leaves** simple, evergreen; those on juvenile stems palmately 3–5-lobed, < 35 cm; on flowering stems < 15 cm, ovate to ± diamond-shaped ± entire; stipules 0; hairs stellate
- **Flowers** petals and sepals 5

Phalaris arundinacea

Reed Canary Grass

Phalaris arundinacea

Habitat

- Wet streambanks, moist areas, grassland, woodland; < 1600 m.
- Watch for at: REDW, LAVO

Don't confuse with:

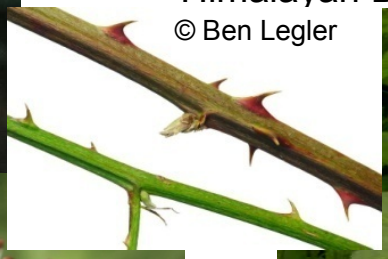
•*P. aquatica* which has smaller leaves, 3-8mm broad and a lobed or branched panicle.

Description

- **Perennial** from distinct rhizomes
- **Leaf** sheath open; ligule membranous, truncate; blade 7-17mm broad
- **Inflorescence** 7–40 cm, 2–11 cm wide, cylindric, interrupted near base; branches spreading in flower, appressed in fruit
- **Spikelet** glumes 3.5–7.5 mm, midvein scabrous, wing 0, tip acute; lower florets 2, 1–2.5 mm, awl-like, hairy; upper lemma 3–4.5 mm, ± 1.5 mm wide, narrowly lanceolate, glabrous to sparsely hairy

Rubus armeniacus (*R. discolor*)

Himalayan Blackberry



Rubus armeniacus

Habitat

- Disturbed moist areas, roadsides, fencerows; < 1600 m
- Watch for at: REDW, WHIS, LAVO

Don't confuse with:

•This is a distinctive species.

Description

- **Arched bramble**
- **Stem** 5–15 mm diam, 5-angled; prickles many, ± wide-based, generally ± curved
- **Leaf** compound; stipules linear; petiole ± 3–9 cm; leaflets 3–5, generally widest above middle, sharply toothed, white below; longest leaflet stalk ± 10–40 mm; longest leaflet blade ± 5–11 cm
- **Inflorescence** panicle, many-flowered, nonglandular
- **Flower** sepal tips generally ± 1 mm; petals 10–15 mm, obovate, white to pinkish; pistils > 15
- **Fruit** blackberry-like, ± oblong, black, ± glabrous

Tamarix spp.
Tamarisk

Tamarix spp.

Habitat

- Washes, roadsides, canyons; <800m
- Watch for at: WHIS

Don't confuse with:

• *Tamarix* spp. are distinctive. Be on the look out for any of them.

Description

- **Tree or shrub**
- **Stems** green, glabrous; twigs jointed, slender, often drooping
- **Leaves** on twigs, generally overlapping, awl- to scale-like, generally excreting salt
- **Inflorescences** generally in panicle-like clusters on current or previous year's twigs
- **Flower** sepals generally 5, persistent; petals generally 5, deciduous to ± persistent, white to reddish; stamens generally 5, filaments alternate or confluent with nectar disk lobes; nectar disk 4–5-lobed; styles 3

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Appendix I: Hach Digital Titrator Manual (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains partial text of the Hach Corporation Digital Titrator manual. For brevity, only the general description, alkalinity (used as "Acid Neutralizing Capacity" in this protocol) methods, and supplementary information are presented. Removed from this file are the techniques for other assays that can be carried out with the digital titrator, but not used by the Klamath Inventory and Monitoring Network.

The full text is available online here:
http://www.hach.com/fmmimghach?/CODE%3A1690008_24ED-210509|1

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Appendix J: Eureka Environmental Manta Water Quality Probe Manual (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the full manual for the Amphibian (computer module) and Manta (water quality multi-probe). This manual is included to supplement the appropriate SOPs on their use.

The full text is available at the KLMN website.

http://science.nature.nps.gov/im/units/klmn/Monitoring/vs/Streams/VS_Streams.cfm

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Appendix K: Trimble Yuma Tablet PC Manual (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the text of the Trimble Tablet PC used in the data collection phase of this project. This document is provided to give the crews a thorough understanding of the workings of the tablet PC, including day to day operations of battery replacement, charging, and troubleshooting.

http://trl.trimble.com/docushare/dsweb/Get/Document-456977/Trimble_Tablet_Users_Manual.pdf

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Appendix L: American Society of Ichthyology and Herpetology Amphibian and Fish Handling Manuals (link)

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the text of the American Society of Ichthyology and Herpetology Amphibian and fish handling manuals. The guidelines contained herein should be followed for all work with amphibians and fish encountered in the course of fieldwork as part of this protocol.

It is also available online here: http://www.asih.org/files/hacc-final.pdf

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix M: Equipment List

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the full list of equipment, quantities, and facilities needed for implementing the protocol, organized by material needed for each SOP.

General

- Large capacity backpacks
- Chest waders with lugged soles (no felt bottom)
- Inflatable life vests
- Safety whistles
- Field vests
- Rain gear
- Hiking Boots
- Tec-nu Poison Oak cleaner
- Patch kit for waders
- Sunscreen
- Insect repellent
- Dry clothes
- Radio, emergency procedures
- Cell phone
- Park, state, and federal permits, as required
- Multi-tool, general purpose
- First Aid kit
- Water bottles for drinking
- Water filter
- Binoculars (optional)

SOP #1. Preparations, Equipment, and Safety

1. **Preparing Dataforms**

- Access to KLMN Network Server
- Laser Printer
- Weather-resistant copy paper (e.g., Rite-in-the-Rain or similar) (250 sheets)

2. **Preparing Database**
   - Trimble Yuma Tablet PC
   - Tablet PC battery charger
   - Screen protectors
   - Stylus
   - Access to KLMN Network Server
3. **Acid Washing Bottles**
   - Fume hood
   - Protective eyewear
   - Protective gloves
   - Protective lab coat
   - Eyewash/body shower safety station
   - Baking Soda (2 or more lbs)
   - Concentrated HCl (~2 liters)
   - Access to distilled water
   - 1000 ml graduated cylinder
   - Large funnel
   - Shallow trays
   - pH meter
   - Glass stirring rod
   - 250 ml Amber HDPE collection vials (75)
   - 2 L Amber HDPE collection vials
   - 60 ml Amber Boston Rounds
4. **Filters for Dissolved Organic Carbon**
   - Muffle furnace
   - Aluminum foil
   - Whatman GF/F filters (product no. 1825-047) (75)
   - Sealable plastic baggie for storage
   - Permanent marker for labeling baggie
5. **Filters for filtered water samples**
   - Drying oven
   - Deionized water
   - Whatman GF/C filters (product no. 1822-047) (75)
   - Acid washed tub for soaking
6. **Preparing Dissolved Organic Carbon bottles**
   - Muffle furnace
   - High-temperature gloves
   - Large tongs for moving bottles in and out of furnace
7. **Preparing Electronic Equipment**
   - GPS unit
   - List of sites for the sampling period, with coordinates
   - Accessory cords for connecting to computers
   - Digital camera

- Memory card (>2 gigabytes)
- Laptop
- Carrying case for laptop
- Power cord for laptop
- Laptop peripherals (keyboard, mouse)
- Eureka Environmental *Amphibian* pocket PC
- Computer connection cord for *Amphibian*
- Battery charger for *Amphibian*
- Access to the KLMN server

SOP #4. Data Entry

1. **Computer Entry**
    - Trimble Yuma Tablet PC, charged batteries
    - Carrying case
    - Stylus
    - Screen protectors
2. **Backup Paper Datasheet Entry**
    - Clipboard
    - Pencils, mechanical preferred
    - Complete set of data forms on weather resistant paper
        - Stream Verification forms
        - Sample Collection form
        - Field Chemistry and Channel Constraint form
        - Torrent Evidence Assessment form
        - Stream Habitat Characterization form (minimum of 15)
        - Vertebrate Sampling form
        - Slope Data form
        - Dominant Tree and Invasive Species forms
        - Large Woody Debris forms
        - Stream Discharge form
        - Photo Logbook form
        - Event form
        - Calibration form

SOP #6. Site Arrival Tasks and Sample Reach Layout

1. **Locating the Sample Reach**
    - Topo Maps
    - GPS Unit (with coordinates loaded)
    - Compass
    - Park Atlas
2. **Prepare and Pre-label Sample Vials**
    - Electronic labeler
    - 1 inch wide label tape
    - Spare batteries for labeler
    - 250 ml Amber HDPE collection bottle (acid washed)
    - 60 ml Amber Boston round collection bottle

- 500 ml or larger macroinvertebrate collection bottle (minimum of 4)
- 60 ml LDPE Scintillation vials (2)
- Premade internal macroinvertebrate labels (minimum of 4)
- Pencil
- Vinyl tape
- Permanent marker

3. **Setup Stream Transects**
    - 50 m Transect tape
    - Surveyors flagging stakes
    - Permanent marker

SOP #7. Water Quality Multiprobe Calibration and Field Measurement

1. **Calibration and Measurement**
    - Eureka Environmental *Manta* Multiprobe
    - Calibration cup and cap
    - Weighted measurement cup
    - Calibration solutions
        - Conductivity
        - pH
        - Turbidity
        - ORP
    - Extra Dissolved Oxygen membranes
    - Dissolved Oxygen replacement electrolyte
    - pH reference solution
    - Toothbrush for cleaning probe

SOP #8. Water Chemistry Sample Collection and Processing

1. **Collection**
    - 2 liter Acid washed Amber HDPE collection vial
2. **Processing**
    - Clean field cloth for workspace
    - Filter forceps
    - Inline filter holder, with all fittings and O-rings
    - 60 ml Leur-lok syringe
    - Whatman GF/C filter, pre-rinsed in deionized water
    - Whatman GF/F filter, combusted
    - 250 ml Amber HDPE collection vial (2)
    - 60 ml Amber Boston Round Collection vial
    - Cooler pouch
    - Frozen ice pack
    - Latex gloves
3. **Acid Neutralizing Capacity**
    - Hach Alkalinity Kit
        - 0.16 and 1.6 N H_2SO_4 cartridges
        - Digital titrator
        - Erlenmeyer flask

- Graduated Cylinder
- Bromcrescol Green – Methyl Red powder pillows (3 minimum)
- Phenolphthalein Indicator powder pillows (3 minimum)
- Protective eyewear
- Latex gloves

SOP #9. Macroinvertebrate Collection

1. Collection and Processing

- D-frame net, 1 ft wide, 500 µm mesh
- 5 gal buckets (2)
- 500 µm sieve
- 95% Ethanol (2 L minimum)
- 500 ml or larger collection vials (4 minimum)
- Paper labels
- Pencil

SOP #10. Discharge Measurement

1. Measurement

- Flowtracker ADV module
- Staff (bottom and top)
- Batteries (8 AA)
- Thumb screw for attaching probe to staff (and spare)
- Philips head screwdriver for replacing batteries
- Mounting bracket for securing module to staff (optional)

SOP #11. Periphyton Collection

1. Collection

- Funnel
- 12 cm^2 area delimiter (3.8 cm diameter pipe)
- Stiff bristle toothbrush
- 1 L wash bottle (stream water)
- 1 L wash bottle (distilled water)
- 60 ml plastic syringe
- 60 ml scintillation vials (2)
- 0.45 µm, 47 mm diameter mixed cellulose filter, HAWP 047-00 manufacturer number
- Filter holder
- Filter forceps
- Aluminum foil

SOP #12. Stream Habitat Characterization

1. Substrate Cross-sectional Characterization

- Clinometer
- Meter stick or Biltmore stick
- Convex canopy densiometer
- 50 m Transect tape

SOP #13. Measuring Slope

1. **Measurement**
    - Abney level
    - Stadia rod, oval, 5 m tall, metric

SOP #14. Riparian, Invasive Plant, and Dominant Tree Characterization

- Tru-Pulse Laser Rangefinder 200B
- Invasive Plant identification cards

SOP #15. Aquatic Vertebrate Sampling

1. **Collection**
    - Smith-Root LR-24 backpack electrofisher
    - 6 ft. 2-piece electrode pole
    - 11 inch electrode ring
    - "Rat-tail" cathode
    - Battery (24 V, 7Ah) and spare, charged
    - Battery Charger
    - Shock proof collection nets (2)
    - 5 gallon bucket (2)
    - Battery powered aerators
    - Spare batteries for aerators
    - Rubber, insulated gloves for electrofishing
    - Permits
2. **Processing and vouchering**
    - Fish boards
    - Taxonomic guides to fish and amphibians
    - Aquarium nets
    - 2 L plastic collection vials for vouchers
    - Weather resistant paper for voucher labels
    - 10% buffered formalin for vouchers
    - Camera

SOP #16. Photo Points and Photo Management

- Digital camera
- Camera memory card
- Photos of all transects from previous sampling years
- Photo logbook or Tablet PC with data form

SOP #17. Post-site Tasks

1. **Disinfection**
    - Spartan Metaquat Germicidal disinfectant
    - 13 gal trashcans (4)
    - Protective gloves
    - Bleach

- Scrub brush

2. **Sample storage**
   - Freezer (-20 °C)
   - Refrigerator (4 °C)
   - Storage bins
3. **Sample shipping**
   - Ice chests
   - Chain of custody forms
   - Reusable ice packs
   - Vinyl tape
   - Packaging tape
   - Bubble wrap or other
   - Garbage bags for lining coolers
   - Pre-paid shipping labels
   - Large zipper-type sealable plastic bags
   - Weather resistant paper with sample inventory
4. **Data Backup**
   - Laptop computer
   - Power supply (either ample battery power, or wall sockets)
   - Connection cables or card readers (camera, *Amphibian*, Tablet PC, GPS units)
5. **Miscellaneous**
   - Battery chargers (Tablet PCs, rechargeable batteries, GPS units, *Amphibian*, cameras, etc.)
   - Inverter for charging from vehicles if crew is camping out

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix N: Job Hazard Analyses

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the job hazard analyses for the protocol. As a part of training of new field crews, these specific hazards will be related to the crews, and signed off. This does not replace Appendix C: USGS Safety Manual, Chapter A9, but is meant to codify and establish a method of insuring coverage of safety issues with the crew. *The crew must still read and be responsible for the material in Appendix C.*

JOB HAZARD ANALYSIS (JHA)		Date: 6 November 2009	■ New JHA ☐ Revised JHA
Park Unit: KLMN	Division:	Branch:	Location: Ashland, Oregon
TASK TITLE: Driving KLMN vehicles or personal vehicles in the course of one's job.		JHA Number: KLMN JHA 1	Page ___1___of __4___
Job Performed By: All	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	Employees driving as part of their duties must have a valid state issued driver's license.
Required Training:	Standard drivers training; need to know how to change tires.
Required Personal Protective Equipment:	Seat belts must be used.
Tools and Equipment:	

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Starting vehicle, basic operation	• Lights not functioning, visibility impaired. • Brakes non-functional. • Low tire pressure. • Low fluid levels. • Spare tire not in vehicle or deflated. • Low gas.	BEFORE DRIVING: • Test headlights, turn signals, brake lights before leaving site. • Test brakes. • Test for tire pressure in all four tires. • Check fluid levels. • Check status of spare; ensure that jack, properly sized lug wrench, and all necessary tools are present in vehicle. • Check gas.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 1	Page __2__ of __4__
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Using 4 wheel drive, if applicable.	• Not knowing how to engage, getting stuck in the field. • Unsafe driving procedures due to perceived safety of 4 wheel drive.	• Practice engaging 4 wheel drive. • Engage 4 wheel drive prior to rough conditions. • Use 4 wheel drive when: slippery conditions, increased traction necessary; e.g., steep slopes, slick conditions, snow. • Note that 4 wheel drive increases traction and some control – BUT DOES NOT HELP THE VEHICLE STOP. • Even in 4 wheel drive, use common sense and defensive driving practices.
Driving in reverse	• Hitting objects, people, wildlife.	• Check area behind vehicle prior to leaving site. • Use a person outside the vehicle (other crew member) to direct traffic. • Back into parking spots, so leaving sites after long field day is easier.
Transporting gear and heavy equipment	• Gear flying around, hitting driver and passenger in accident. • Damage to gear during turns or stops.	• Ensure that gear is adequately stowed. • If the gear comes with protective gear (e.g., electrofisher; properly stow in container). • Do not put gear on top of vehicle; stow inside.
Passenger/driver safety	• Distracted driving.	• **Wear seatbelts at all times while driving.** • Practice safe and defensive driving habits. • Obey traffic laws. • Do not text or talk on cell phones. • Clean the windshields; check for windshield fluid. • Drive with both hands on the wheel. • Do not pick up hitch hikers. • Use turn signals/indicators. • Know, in advance, where you are going. • Make sure seat and mirrors are properly adjusted for driver. • **Use headlights, even during daytime driving.**

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 1	Page __3__ of __4__
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
	• Driving on narrow, single lane roads with bumpy or "washboard" surfaces.	• Maintain a safe speed (this may be *below* the legal limit). • Stay to the right, especially on curves, and be aware for oncoming traffic. • If turning around, "face the danger," in other words, turn towards a steep slope, instead of backing into a steep slope cliff.
	• Driving with limited visibility, as in heavy rain, fog, or dust.	• Keep windshield cleaner fluid full. • Slow down. • If necessary, wait for hazard to pass. • Drive with lights on; in some conditions, low lights may penetrate better than brights.
	• Road obstacles.	• Get out and move rocks in the road as necessary, if large amounts of rockfall or trees, report to the park staff. • If you hit rocks, stop and check tire conditions (wear, sidewall, and inflation) for damage. • If obstacle is an animal, slow down! Be aware of high animal traffic areas and drive appropriately. It is better to "ride out" an impact, rather than a sudden swerve – **DO NOT SWERVE**. This is true for animals of all sizes, from squirrels to cattle.
	• Fatigue driving.	• Be aware of signs of fatigue. Pull over and catnap if necessary, eat a snack, or have a partner drive. If in doubt, do not drive.
	• Storm conditions (snow, mud, wind).	• Keep informed of the weather (see radio SOP). • If excess wind (tree top swaying, twigs falling), consider postponing trip. • Avoid wet clay roads as much as possible.
	• Logging truck traffic.	• Drive with windows down, with radio off, listening for oncoming truck brakes (jake brake).

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 1	Page __4___ of __4___

Text Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date: 6 November 2009	■ New JHA ☐ Revised JHA
Park Unit:KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Remote field site access/ trail travel/ cross-country travel		JHA Number: KLMN JHA 2	Page __1___of __3___
Job Performed By: Field Crews	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	Crew members should be physically fit, and okayed by a medical professional for hard strenuous work
Required Training:	None required.
Required and/or Recommend Personal Protective Equipment:	Footwear appropriate to terrain (probably hiking boots); pants if hiking through brush or poison oak; Tec-nu poison oak wash, park radio with charged batteries, cell phones; maps; GPS units, safety glass, first aid kit.
Tools and Equipment:	Appropriate backpacks

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Hiking on trails	• Getting lost. • Physical injury (e.g., twisted ankle, broken bones).	• Use and be trained in navigation techniques using both maps and GPS units. • Allow ample time to access site and return. • Bring safety gear (e.g., radio); extra clothes, water, food, etc. • Look at notes from crews that previously accessed this site. • Wear appropriate footwear, preferably boots with vibram soles and tops above the ankle, broken in prior to field season. • Walk cautiously and don't run. • Take breather breaks as necessary. • Stay physically fit. • Know basic first aid. • Be trained in radio SOP. • Avoid talus slopes. On steep slopes, avoid walking directly below others. • Take care walking on wet or slippery ground, especially bridges.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 2	Page __2__ of __3__
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
	• Hitting fellow crew member with tool, implement, or vegetation branch.	• Maintain 6 foot spacing. • Warn people behind of "snap-back" from vegetation branches; wear safety glasses (or other glasses).
	• Carrying heavy loads.	• Use backpack appropriate to load; do not carry heavy items in arms or hands – make hands available to break a fall. • Properly fit backpack. • Use crew member to assist in putting pack on. • Be physically fit. • Report problems or issues to supervisor. • Stay hydrated.
Off-trail travel	• Loose footing; falls, broken bones, etc.	• Avoid steep slopes. • If unavoidable, walk at angle up slope; not straight up. • Wear good boots. • Do not go up hazardous slopes. • Watch for branches, wet, slick rocks, etc. Avoid as necessary. • Take your time, ascending and descending. • Plan your route so that hazardous terrain is minimized, and the use of trails is maximized. • Do not travel alone – e.g., if one crew member is faster, only travel as fast as your slowest person.
	• Branches and trees, other dangerous obstacles.	• Examine for the safest way around. • Do not jump off trees. • Avoid going underneath large trees that could shift and crush a person.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 2	Page __3___ of __3___

Text Description of Task When it is Done Safely

Crew returns safe from the field day/season, with no injuries, damages, or law suit.

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date: 6 November 2009	■ New JHA ☐ Revised JHA
Park Unit: KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Field work - Environmental Exposure		JHA Number: KLMN JHA 3	Page __1___of __3___
Job Performed By: Field Crews	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.
Required Training:	None.
Required Personal Protective Equipment:	Common sense, appropriate clothing for conditions.
Tools and Equipment:	

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Being outdoors, far from facilities for long time periods	• Hypothermia.	• Consult First Aid book for treatment. • Seek assistance. • Recognize the signs: shivering; numbness; drowsiness; muscle weakness; dizziness; nausea; unconsciousness; low, weak pulse; large pupils. • Practice prevention – stay dry; wear appropriate clothing; Cotton kills; Wear layers, shed layers as needed – don't overheat – sweat can cause hypothermia; Watch or listen to the weather forecast (see Radio SOP) and plan accordingly; stay hydrated, cover head with warm clothing, stay active. • Be aware of the role that wind-chill can play in hypothermia; under certain conditions, hypothermia can occur without any rain or being wet.
	• Hyperthermia (heat exhaustion; heat stroke).	• Consult First Aid book for treatment – but generally get the victim to cooler conditions. NOTE: HEAT STROKE IS A LIFE THREATENING CONDITION. • Recognize signs: above normal body temps; headaches, nausea, cramping, fainting, increased heart rate, pale and clammy skin, heavy sweating, etc.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 3	Page __2___of __3__
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
	• Electrical Storms – lightning.	• Practice prevention: Stay hydrated – in the midst of the summer, it may be necessary to drink 1 liter of water per hour; wear a broad brimmed hat; Take rest stops in shade. • Watch the sky for signs of thunderstorms, and seek shelter *before* the weather deteriorates. • Stop work in streams and lakes. • If caught in electrical storms, seek shelter inside a vehicle or building; keep away from doors and windows, plugged in appliances, and metal. Avoid contact with metal objects in vehicles. • Do not use telephones. • If outside with no shelter, do not congregate. In case of lightning strike, someone must be able to begin revival techniques (e.g., CPR). • Do not use metal objects. • Avoid standing near isolated trees. • Seek lower elevations such as valleys or canyons – avoid being on peaks and trees. • *If you feel your hair standing on end and your skin tingling, this is a sign that lightning might be about to strike – crouch immediately (feet together, hands on knees).*
	• Sunburn.	• The risk of sunburn is higher when working at high elevations, or when working around water (from reflection). In these conditions, you can be burned even in overcast conditions. • Wear protective clothing and use sunscreen.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 3	Page __3___of __3___
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
	• High wind events.	• Severe wind events can create "windthrows" where strong winds can blow down trees, causing hazardous conditions to field personnel – crews should avoid areas during high wind, exhibiting obvious previous wind damage.
	• Altitude sickness.	• Know and recognize signs of "acute mountain sickness:" headaches; light-headedness; unable to catch your breath; nausea, vomiting. • Practice prevention: acclimate to high elevations slowly, stay hydrated. • If symptoms progress, and include: difficulty breathing, chest pain, confusion, decreased consciousness or loss of balance, descend to lower elevations immediately and seek medical attention.
	• Giardia.	• Treat, filter, or boil all drinking water. Do not drink untreated water from streams, lakes, or springs.

JOB HAZARD ANALYSIS (JHA)		Date: 9 November 2009	■ New JHA ☐ Revised JHA
Park Unit:KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Field work - Wildlife encounters		JHA Number: KLMN JHA 4	Page ___1__of ___3__
Job Performed By: Field Crew	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	None
Required Training:	None
Required Personal Protective Equipment:	None
Tools and Equipment:	None

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Being in the field	• Rattlesnakes.	• Be alert – be especially cautious if wearing headphones. • Do not put your feet or hands where you cannot see. • Do not pick up rattlesnakes. • Give a wide berth. • Avoid stepping over logs, when you cannot see the other side (see above!). • If bitten, seek immediate professional medical attention – send someone for aid. • Remove jewelry, lower bitten extremity below heart, cover wound with sterile band while enroute to medical attention.
	• Bears.	• Be alert, stay calm. • Work in teams of two to deter bear attacks. • If you encounter a bear, give it as much room as possible. • Try to leave the area – but DO NOT RUN. Back away slowly, but if the bear follows, stop and hold your ground. • Wave your arms, make yourself look big, and talk in a normal voice.

	JHA Number: KLMN JHA 4	Page __2___of __3___
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
	• Mountain Lions.	• If the bear makes contact, surrender! Fall to the ground and play dead. Typically, a bear will break off its attack once it feels the threat has been eliminated. If the bear continues to bite after you assume a defensive posture, the attack is predatory, and you should fight back vigorously. • Be alert, calm, and do not panic. • If you see a mountain lion, do not run; you may stimulate its predatory nature. Shout and wave arms to let it know that you are not prey. FIGHT BACK.
	• Ticks.	• Use DEET based repellants on exposed skin. • Check for ticks during and after field work. • Remove with tweezers within 24 hours, preferably immediately. • DO NOT leave the head imbedded. • DO NOT extract with matches, petroleum jelly, or other coatings (e.g., motor oil).
	• Roughskin newts (*Taricha granulosa).*	• Avoid handling Roughskin newts; their skin contains a potent neurotoxin. If necessary for the protocol, handle only when wearing gloves. Do not "lick" for "killer buzz." People have died from attempting to eat roughskin newts.
	• Bee stings.	• If you know or suspect you are allergic, carry appropriate allergy kits, prescribed by a doctor, for treating anaphylactic shock. Carry and take diphenhydramine (a.k.a. Benadryl), following the label instructions for allergy control. • Inform your supervisor if you suspect you are allergic. • Watch for ground nests.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 4	Page 3 of 3

Text Description of Task When it is Done Safely

Field crew returns with no injuries or lawsuits.

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date: 9 November 2009	■ New JHA □ Revised JHA
Park Unit: KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Field Work – plant hazards		JHA Number: KLMN JHA 4	Page __1___of ___2___
Job Performed By: Field Crews	Analysis By: Eric Dinger	Supervisor: Daniel Sarr	Approved By:

Required Standards and General Notes:	None
Required Training:	None
Required Personal Protective Equipment:	None
Tools and Equipment:	None

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Travel, movement or work in area with Poison Oak	• Allergic reaction to poison oak plants.	• Learn to recognize Poison Oak. • Avoid contact, wear long pants and long-sleeve shirts if travelling in dense areas. • If skin contact is made, flush with cold water as soon as possible. • DO NOT flush with warm water or use soap – this can open your pores and increase the reaction. • Use Tecnu or similar product to wash and rinse with cold water to remove oils (follow label instructions).
Encountering irrigation pipes, marijuana plantation, or grow operations.	• Unfriendly encounters with criminal elements.	• Do not wear uniforms. • Carry radio in backpack, not visible. • Act like tourists (a.k.a. act dumb). • Work in pairs of larger groups. • If working in areas likely to contain operations, check in with park staff when leaving vehicle and returning to vehicle. • Do not confront strangers. • Watch for suspicious vehicles, people and report to rangers. • Watch for black piping or other signs. • If finding a definite grow operation, LEAVE IMMEDIATELY, note location, and report to park ranger.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 4	Page __2___ of __2___

Text Description of Task When it is Done Safely

Field crews return safe and sound, with no injuries.

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date:10 November 2009	■ New JHA ☐ Revised JHA
Park Unit: KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Water Chemistry preparation work		JHA Number: KLMN JHA 5	Page ___1__ of ___2__
Job Performed By: Lakes/Streams Project Lead, Field Crew	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	None
Required Training:	Must be trained in KLMN Stream Protocol SOP #1: Preparations, Equipment, and Safety.
Required Personal Protective Equipment:	Lab coat, fume hood, protective gloves, safety glasses, eyewash stations, emergency showers.
Tools and Equipment:	Detailed in SOP #1: Preparations, Equipment and Safety.

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Acid washing bottles	• Acid spills.	• Work in a confined area, so that the spill is contained. • Be familiar with spill clean-up: Neutralize with baking soda and then wipe up with paper towels. These can be safely disposed in the trash once neutralized. • Wear protective gear (gloves, eyewear, and lab coat) in case of spill on body. • If skin contact made, flush with running water for 15 minutes. Do not rub or wash. • Be familiar with location of eye wash stations and showers. DO NOT wash in areas without these safety items. • Use eyewash stations in case of eye contamination. • Inform others that you are performing this work, so they can check on you. • Use fume hood to control potential acid fumes. Note that the fume hood fan must be turned on, and protective glass lowered as much as possible to properly function.
Muffle furnace to ash filters and dissolved organic carbon bottles	• Burns from hot glass/filters.	• Allow glass to fully cool before touching. • Do not pull glass out of furnace before cool – setting on a cold countertop can fracture the glass and pose a safety hazard. • When removing or placing bottles/filters to be combusted, use tongs and gloves to protect from burns.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 5	Page 2 of 2

Text Description of Task When it is Done Safely

Bottles are successfully washed, filters prepped without damage to employees' health or facilities.

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date: 10 November 2009	■ New JHA ☐ Revised JHA
Park Unit: KLMN	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Field acid neutralizing capacity assays		JHA Number: KLMN JHA 6	Page __1___of __2___
Job Performed By: Lakes/streams field crews	Analysis By: Eric Dinger	Supervisor:	Approved By:

Required Standards and General Notes:	
Required Training:	Training in KLMN Streams Protocol, SOP #8: Water Chemistry Sample Collection and Processing.
Required Personal Protective Equipment:	Protective gloves and protective eyewear
Tools and Equipment:	Personal protective gear, acid neutralizing test kit

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Addition of 1.6N or 0.16N Hydrochloric acid to sample container	• Using the digital titrator, it is possible to spill or inject acid onto ones' self.	• Follow the manufacturer's instruction for loading the acid cartridge into the digital titrator. Ensure a proper fit before depressing the plungers. • Do not force the titrator. • Wear appropriate protective gear: safety glasses and protective gloves (as in latex). • In general, point titrator away from one's self when operating.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 6	Page 2 of 2
Text Description of Task When it is Done Safely		
SOP #8: Water Chemistry Sample Collection and Processing completed with no bodily harm.		

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

JOB HAZARD ANALYSIS (JHA)		Date:18 June 2001	■ New JHA ☐ Revised JHA
Park Unit: KLMN/REDW	Division:	Branch:	Location: Ashland, OR
TASK TITLE: Electrofishing		JHA Number: KLMN JHA 8	Page __1___of __2___
Job Performed By: Streams Field Crews	Analysis By: Baker Holden III / David Anderson	Supervisor:	Approved By:

Required Standards and General Notes:	This covers specific issues that could occur during electrofishing the sample reach.
Required Training:	Training in Streams Protocol
Required Personal Protective Equipment:	Chest Waders, Linesmen Gloves; both with no leaks
Tools and Equipment	As required by Lakes Protocol

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Electrofishing	• Electrocution.	• Wear proper chest waders, sticky rubbered soled shoes "without any leaks," and polarized glasses. Wear linesmen gloves "without any leaks." Do not put hands in water when shocker is on (even if wearing gloves). Crew should discuss field methods, safety procedures, and communication prior to beginning electrofishing. All people must be CPR and First Aid Certified.

JHA - CONTINUATION SHEET	JHA Number: KLMN JHA 8	Page 2 of 2
Text Description of Task When it is Done Safely		
Vertebrate Survey accomplished with no harm to crew.		

Authorized Employee Information

Employee ID	Last Name	First Name	Qualifications/Remarks

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix O: Tolerance Values, Life History Characteristics, and Standard Taxonomic Effort

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix details the values used for calculations of IBIs and MMIs for the streams of the Klamath Network. These values are the most useful in an electronic format and are provided as such. Upon finalization of the Wadeable Stream protocol, both invertebrate and vertebrate values will be available from the Klamath Network Internet site:

http://science.nature.nps.gov/im/units/klmn/index.cfm

Here, they are provided as electronic Microsoft Excel spreadsheets on the included Compact Disk.

The Vertebrate file is named: EPA_EMAP_Vertebrate_Tol_Life_History_20100507.xlsx

The Vertebrate file has been provided by:

Dr. Thom Whittier
Faculty Research Assistant
Department of Fisheries & Wildlife
Oregon State University
c/o U.S. EPA
200 SW 35th St.
Corvallis, OR 97333

Note that there are two sheets within the spreadsheet, one for the values and one for the metadata (codes to column headings, etc.).

The Invertebrate file is named: Pacific_NW_Invert_Tol_Life_History_20100507.xlsx

The Invertebrate file was developed by:

Robert Wisseman, Senior Scientist
Aquatic Biology Associates, Inc.
3490 NW Deer Run Street, Corvallis, OR 97330
Phone/FAX 541-752-1568
www.aquaticbio.com
bobwisseman@mac.com

And is available online at: http://www.cbr.washington.edu/salmonweb/

As in the Vertebrate file, there is a second sheet detailing the metadata (codes to column headings, etc.).

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix P: Literature for IBI Calculations

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the following reprints that provide the development and basis for Indices of Biological Integrity (IBIs) and Multi-Metric Models (MMIs) used in the data analysis of this project.

The following literature is used and available from the KLMN website:

http://science.nature.nps.gov/im/units/klmn/Monitoring/vs/Streams/VS_Streams.cfm

Rehn, A.C., P.R. Ode, and J.T. May. 2005. Development of a Benthic Index of Biotic Integirty (B-IBI) for Wadeable Streams in Northern Coastal California and its Application to Regional 305(b) Assessment. Final Technical Report. Surface Water Ambient Monitoring Program. California Department of Fish and Game Aquatic Bioassessment Laboratory, Rancho Cordova, California.

Oregon Watershed Enhancement Board. 1999. Water Quality Monitoring: Technical Guide Book. Salem, Oregon. (ABRIDGED to include only Invertebrate IBI)

Stofford, J.L., D.V. Peck, A.R. Olsen, D.P. Larsen, J. Van Sickle, C.P. Hawkins, R.M. Hughes, T.R. Whittier, G. Lomnicky, A.T. Herlihy, P.R. Kaufmann, S.A. Peterson, P.L. Ringold, S.G. Paulsen, and R. Blair. 2005. Environmental Monitoring and Assessment Program (EMAP) Western Streams and Rivers Statistical Summary. EPA/620/R-05/006. U.S. Environmental Protection Agency, Washington, D.C. (ABRIDGED to include only Invertebrate MMI and Vertebrate MMI)

Herbst, D.B. and E.L. Silldorff. 2009. Development of a Benthic Macroinvertebrate Index of Biological Integrity (IBI) for Stream Assessment in the Eastern Sierra Nevada of California. Final Technical Report. Surface Water Ambient Monitoring Program. Department of Fish and Game Aquatic Bioassessment Laboratory, Rancho Cordova, California.

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix Q: Smith-Root, Inc, LR-24 Backpack Electrofisher Manual

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This appendix contains the product manual for the Smith-Root, Inc. LR-24 Backpack Electrofisher.

http://www.smith-root.com/support/

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix R: Operational Checklist

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

These checklists have been developed to help manage the complicated task of implementing this protocol. Completed checklists, along with dates for accomplishments of tasks (where applicable), should be scanned into .pdf format, along with event, calibration, and other logs. Checklists are not static, and although an effort should be made to ensure ease of use, it is anticipated that these checklists will grow and be revised over the implementation of the protocol.

Table 9. Hiring Pre-Season

Task		Targeted Deadline	Date Achieved
Hiring	☐	**January to May**	
Send REDW Job Analysis Forms	☐	**January 15th**	
Send REDW Form 226	☐	**January 15th**	
Interview Candidates	☐	**April 15th**	
Check Selected References	☐	**April 30th**	
Send REDW Form 232	☐	**May 15th**	
Follow-up: Hiring/paychecks/background checks	☐	**May 31st**	
Send Employees background/housing info	☐	**May 31st**	

Table 10. Necessary communications

Task		Targeted Deadline	Date Achieved
Network Coordinator: Budget/Logistics/Issues/Purchasing	☐	**November 31st**	_____
Data Manager: Deliverables/timeline/GIS/Contacts/Site List	☐	**March 30th**	_____
GIS Specialist: ArcPad needs/data correction	☐	**March 30th**	_____
Park Contacts: Field schedule/housing/logistical needs/permits	☐	**February 28th**	_____

Table 11. Checklist for Post-site tasks.

Task	
Record time leaving; QA/QC data prior to leaving	☐
Disinfect gear	☐
Double check samples properly labeled	☐
Samples in proper storage (DOC, Filtered water, Unfiltered water, Chl a filters)	☐
Data transferred (photos, multiprobe, GPS, field computer)	☐
Multiprobe data processed	☐
Recharge all batteries	☐
Check and replace consumables for next field site (vials, bottles, gloves, filters, etc.)	☐

Table 12. Post Season task list.

Task		Targeted Deadline	Date Achieved
Download all data and place in proper places	☐	**October 31st**	
Empty batteries out of all electronics	☐	**October 31st**	
Check gear back in with Data Manager	☐	**October 31st**	
Clean and inventory remaining equipment	☐	**November 15th**	
Communicate with GIS specialist about needs and timelines	☐	**October 31st**	
Scan dataforms and any logs into PDFs	☐	**November 30th**	
Ship remaining samples to contract laboratories	☐	**October 31st**	
Return keys to Parks (if any)	☐	**October 15th**	
Complete Investigator's annual report (IAR)	☐	**March 31st**	
Complete Annual Report	☐	**June 30th**	

Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Appendix S: Park Maps and Preliminary Sampling Sites

Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

NOTE: This appendix is treated as sensitive data. For additional information, contact the protocol authors or current implementation staff.

http://science.nature.nps.gov/im/units/klmn/index.cfm

The attached maps are preliminary site maps for sampling in all five parks covered by this protocol (CRLA, LAVO, ORCA, REDW, and WHIS). Shown are 30 survey sites, with an additional 30 oversample sites for dealing with unsafe, non-perrenial, or other issues preventing the sampling of the original 30 survey sites. The exception is ORCA, which only has three sites selected by park staff.

After initial implementation, the maps will be updated showing the final location of sampling sites.

Due to the possibility that Threatened and Endangered species may be found in the course of implementing the protocol, this appendix should be treated as Sensitive Data and follow the procedures in SOP #21: Sensitive Data for release to the public.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 963/121241, June 2013

National Park Service
U.S. Department of the Interior

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