Field Protocol Manual

Aquatic and Riparian Effectiveness Monitoring Program

Regional Interagency Monitoring for the Northwest Forest Plan

2003 Field Season

Contacts

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Introduction

The Northwest Forest Plan (hereafter referred to as “the Plan”) was approved in 1994. The Plan includes an Aquatic Conservation Strategy that requires the protection, rehabilitation, and monitoring of aquatic ecosystems under the Plan’s jurisdiction (USDA-USDI 1994). The Aquatic and Riparian Effectiveness Monitoring Program (AREMP or the monitoring plan) was developed to fulfill these monitoring requirements. The primary purpose of AREMP is to determine the current condition of 6^{th} field watersheds and track changes in watershed condition over time. A total of 250 watersheds will be monitored under AREMP. One of the most important aspects of the program is the collection of consistent data throughout the Northwest Forest Plan area to provide comparative data for assessment of watershed condition.

The field data collected are combined with upslope and riparian information to estimate watershed condition. Condition is determined using a decision support model that evaluates individual indicators then aggregates the evaluation scores. The stream data collected in the field represent about 2/3 of the data included in the decision support model. As natural variance both within and between the watersheds is quite high, it is imperative that errors due to sampling and observer bias are minimized. The data collected will be used as the basis for management decisions throughout the Pacific Northwest. The data will comprise one of the largest data sets that exist, both spatially and temporally. Therefore, it is of the utmost importance to make the effort to produce the highest quality data possible.

This document is addresses section 11.1 Standard Operating Procedures of the Quality System Management Plan (Palmer, in prep).

Site Work

Thermograph Placement

Onset Stowaway thermographs are placed in all watersheds before the field season starts. Temperature data are collected June 1 through October 1 of an individual calendar year.

1. A field coordinator should program each thermograph before it is placed into the stream.
2. Place the thermographs into a portable metal housing (typically 6-inch steel pipe 2.5-inches in diameter) and secure with a bolt.
3. The thermograph should be placed in the lowest portion of the watershed on federal land in the mainstem channel. If the watershed is a composite watershed (see Composite watersheds below) and the mainstem is too large to wade, then the thermograph should be placed in the lowest portion of the largest tributary on federal land.
4. Place the thermograph in the thalweg or other area that will remain underwater even if the water level drops.
5. Secure the thermograph with rocks and attach the thermograph with a cable to the bank or other secure structure.
6. Document the location of the thermograph in detail.
    a. Take a GPS waypoint at the thermograph location.
    b. Take several photos documenting the location from a variety of angles. Take both close up photos of the location and overview photos of the area.
    c. Flag the site as close to the thermograph as possible, unless the area receives high use. If the thermograph is placed in a high use area (recreational areas), do not use flagging.
    d. Draw a map of the location. Include detailed instructions on getting to the site.
7. Thermographs should be removed from the watershed by the middle of October. When retrieving the thermograph, pull any flagging and the cable as well.

Field Site Selection

Field site access

1. Use maps to become familiar with the watershed and to facilitate the location of sample sites and access routes.
2. Know the local site conditions and possible hazards in the area (e.g., poison oak, rattlesnakes).
3. Have an emergency plan in case hazards are encountered and medical attention is required.
4. If anyone is concerned about entering an area for safety reasons, he/she may choose not to go.
5. Refer to the field recon sheets in your field notebook for information about the area in which you'll be working.

Site reconnaissance

The purpose of site reconnaissance is to determine which sites can be sampled and to find the easiest access routes to those sites. The criteria for determining whether a site can be sampled are presented in the next section. Take notes on the easiest route to the site and, if needed, use flagging to mark the route. Include detailed instructions on getting to and from the sites, including road names or numbers and direction taken at road junctions. Be sure to take note of hazards such as cliffs, bee's nests, and poisonous plants.

Site selection

If reconnaissance has not been conducted in the watershed, time can be saved by having 1 or 2 people scout out the watershed to determine which sites can be sampled. Quad maps will be supplied for each watershed that identify 80 potential sampling sites. The first 20 site numbers will be colored red and the remaining 60 will be colored blue. To select sites, start with number 1 and continue numerically through the list, omitting the sites that cannot be sampled. For each site deemed unsamplable, record the site number and the reason why it was not sampled on the Site Selection data form. Example data sheets are included in Appendix 1. Example data sheets.

Reasons for not sampling a site include:

1. The site is located on private land.
2. The site is not safely accessible; i.e., the site cannot be reached without putting the crew in danger. Long hikes down into steep canyons do *not* qualify.
3. The stream is too small or not physically samplable. The minimum stream size is 1 meter wide (wetted width) and 0.1 meters deep in riffles.
4. The stream is too large to physically sample and is a safety concern for crews. To qualify, the stream should have pools that are too deep to wade, picking up pebbles on the bottom would require a wet suit, and wading across the stream is only possible in few, if any, riffles.
5. The site is located on a glacier or in a lake.
6. Hiking time (round trip) is over four hours to get to and return from the site.

The goal is to sample as many sites as possible within a watershed.

Note: Do not, under any circumstances, conduct any sampling on private land. Do not walk on private land to access sample sites. Your presence on private land is considered trespassing, regardless of what you are doing.

Composite watersheds

A composite watershed is defined as a drainage basin that has water input from outside of the basin. A watershed boundary that includes a section of a mainstem river and the associated tributaries would be en example of a composite watershed. Crews should survey the mainstem river of a composite watershed if the channel is wadeable. If the mainstem channel is too swift for wading, i.e., a safety concern, then the crew *should not* survey the main channel, but instead focus on surveying sites in the tributaries.

Using a GPS unit to locate sample sites

Site locations should be programmed into the GPS units prior to leaving for the field. If sites are not yet programmed into the GPS unit, you will need the following: a list of site locations (UTM coordinates), GPS unit, cable, map software, and a laptop. To input the site locations into the GPS unit:

1. Connect the GPS unit to the laptop.
2. Turn the laptop and GPS unit on.
3. Open the MapSource file on the laptop that contains the site coordinates.
4. In MapSource, choose *Save to GPS* from the *File* menu.
5. Save maps and waypoints to the GPS. Click *Ok*.
6. Verify that the points have been saved to the GPS unit.

When in the field, use topographical maps or GPS unit to find the approximate location of the site from the road, then go down to the stream. Use the Go To feature of the GPS units to guide you toward the point. As you approach the site and zoom in with the GPS unit, you will likely notice that the site is not on the stream but rather on the hill slope. Continue on the stream channel, watching both the distance from the site and its location on the hill slope relative to the GPS pointer. When you are directly down slope from the site, your distance from the site may still be several hundred feet away. If you continue, the distance from the site will start to increase. At this point you need to turn around and walk back until you minimize the distance from the site. At this location you should be directly down slope from the site on the GPS unit.

From this point, locate the nearest pool tail crest and mark the pool tail crest as “Transect A.” If no pools are present within 50 m up or downstream of the original location, then Transect A may be located in a riffle. Do not locate Transect A in the middle of a pool. Use the GPS unit to take the UTM coordinate at Transect A and record the UTM on the stream data form.

Special Case - If the reach above Transect A is not samplable (e.g., there is an impassable waterfall or the water flows below the surface), but the area downstream is samplable, you may make this point (the UTM coordinate) Transect K in non-constrained reaches or F in constrained reaches. The procedure is to make an estimate of how long the stream reach is based on bankfull at Transect “F or K” and walk down stream that distance. Initiate site layout as described in the next section. At new Transect A, record GPS coordinates on the data sheet with the reason for not sampling upstream from the original location.

Recording the site UTM coordinate

1. From the Main Menu of the GPS unit, select *Waypoints*, then press *ENTER*.
2. Press the *MENU* button and select *New Waypoint*. Press *ENTER*.
3. Toggle to move up to the waypoint symbol (black square). Press *ENTER*.
4. Toggle up to the *Tall Tower* symbol. Press *ENTER*.
5. Toggle to the waypoint number and change it to 10+ site number (e.g., site 37 would be 1037) for the original crew or 90+site number for QAQC.
6. Hit the *MENU* button, scroll to *Average Position*, then hit *ENTER.* Place GPS unit on flat surface near Transect A and start other work, let the unit log at least 2500 measurements.
7. Once all the measurements have been recorded, press *ENTER*, scroll to the *DONE* box, and press *ENTER*.
8. Enter the UTM coordinate in the appropriate box on the Stream data form.
9. Turn GPS unit off.

The Site Selection data form

For each site, indicate whether the site was sampled and the name of the creek. If tributaries are sampled that are not named on the map, enter “Unnamed trib” in the creek name column. If the site was not sampled, indicate the reason that the site was not sampled. It is only necessary to fill in sites that were omitted during the sampling. For example, if the last site sampled was site 30, you must fill in comments for all sites up to and including 30, however 31-80 may be left blank.

Site Layout

Bankfull indicators

Examine the bankfull indicators throughout the reach to identify bankfull elevation. Recognize that all indicators are rarely present in individual sites. For a more complete discussion, see Harrelson et al. (1994).

1. Examine stream banks for an active floodplain, a relatively flat, depositional area that commonly is vegetated and above the current water level.
2. Examine depositional features such as point pars. The highest elevation of a point bar usually indicates the lowest possible elevation for bankfull stage. However, depositional features can form both above and below the bankfull elevation when unusual flows occur during years preceding the survey. Large floods can form bars that extend above bankfull whereas several years of low flows can result in bars forming below bankfull elevation.
3. A break in slope of the banks and/or change in the particle size distribution from coarser bed load particles to finer particles deposited during bank overflow conditions.
4. Define an elevation where mature riparian woody vegetation exists. The lowest elevation of birch, alder, and dogwood can be useful. Willows are often found below bankfull elevation.
5. Examine the ceiling of undercut bank. This elevation is normally below the bankfull stage.
6. Stream channels actively attempt to reform bankfull features such as flood plains after shifts or down cutting in the channel. Be careful not to confuse old floodplains and terraces with present indicators.

Site length

Measure the bankfull width at Transect A. Take four additional measurements, two upstream and two downstream of Transect A. Each measurement should be at least one bankfull width apart (i.e., if the bankfull measurement at Transect A is 5 m, take the next measurement a minimum of 5 m upstream or downstream of Transect A). Record the 5 bankfull measurements on the Stream data form and calculate the average bankfull width. Use the average width to determine the site length from Table 1. The minimum stream length is defined for each width category and is equal to 20 times the width category. The upstream and downstream boundaries of the reach are located at a pool tail crest (or a riffle if no pools are present). Therefore, the upstream boundary is located at the first pool tail (or riffle) encountered after the minimum length has been attained.

Table 1. Site length based on bankfull width categories.

Average bankfull width in meters	Minimum reach length in meters
< 8	160
8.1 to 10	200
10.1 to 12	240
12.1 to 14	280
14.1 to 16	320
16.1 to 18	360
18.1 to 20	400
20.1 to 22	440
> 22	480

Measure the site length with a tape measure, following the thalweg as closely as possible. At the upstream end of the site, look for a pool tail crest to end the site. If there is not a pool crest at the end point, proceed upstream or downstream to the next pool tail crest. Do not exceed 50 m upstream or 10 m downstream beyond the original site length. If no pools are located within this 60 m band, end the site at the original location. Place a flag labeled Transect F (or K) to denote the end of the site.

Divide the total adjusted reach length by 10 and hang flags every 1/10 of the reach length.

Determining constrained and non-constrained reaches

Look at the valley where the site is located to determine whether the stream channel is constrained or non-constrained. Estimate the number of bankfull widths that will fit on the valley floor (distance between the valley walls). This number is the Valley Width Index (VWI). Determine the channel type using the following definitions:

- **Constrained** – streams are typically high gradient (>3%) and have narrow valleys. The VWI is less than 2.5.
- **Non-constrained** – streams are typically low gradient (<3%) have VWI > 2.5. Non-constrained streams have fairly broad valley floors, and the stream has room to move laterally without being confined by the valley walls.

Sometimes streams are entrenched, but are located in broad valleys (VWI > 2.5). These streams are considered non-constrained. It is important to look outside the stream channel to determine whether the stream is constrained or non-constrained.

Transect layout

All sites will be laid out similarly. In all reaches, 11 transects will be laid out and should be labeled A-K in non-constrained sites and A-F in constrained sites. In addition to the six transects in constrained sites, five intermediate transects will be used for pebble counts and periphyton collection. Site information should be documented on the Stream data form. An overview of the site layout and sampling strategy is presented in Figure 1.

Transect layout – non-constrained sites

1. Take bankfull measurements and determine site length as previously described (Site length section).
2. Divide the site length by 10 to obtain the increment between transects.

EXAMPLE: Reach length is 160 m according to Table 1. The distance between transects would be 160/10=16 m.

3. Measure distance between transects using a tape and place a flag in an obvious area near eye level at each cross section (transect) location. Label the flag on with the transect name (A, B, C…K). Place an additional flag on the flood prone transects labeled “FP” (flood prone transects are found on the Stream data form).
4. Leave the flagging up until all sampling has been completed. Crew leaders will know which sites are for QA/QC; leave the flagging up at these sites.

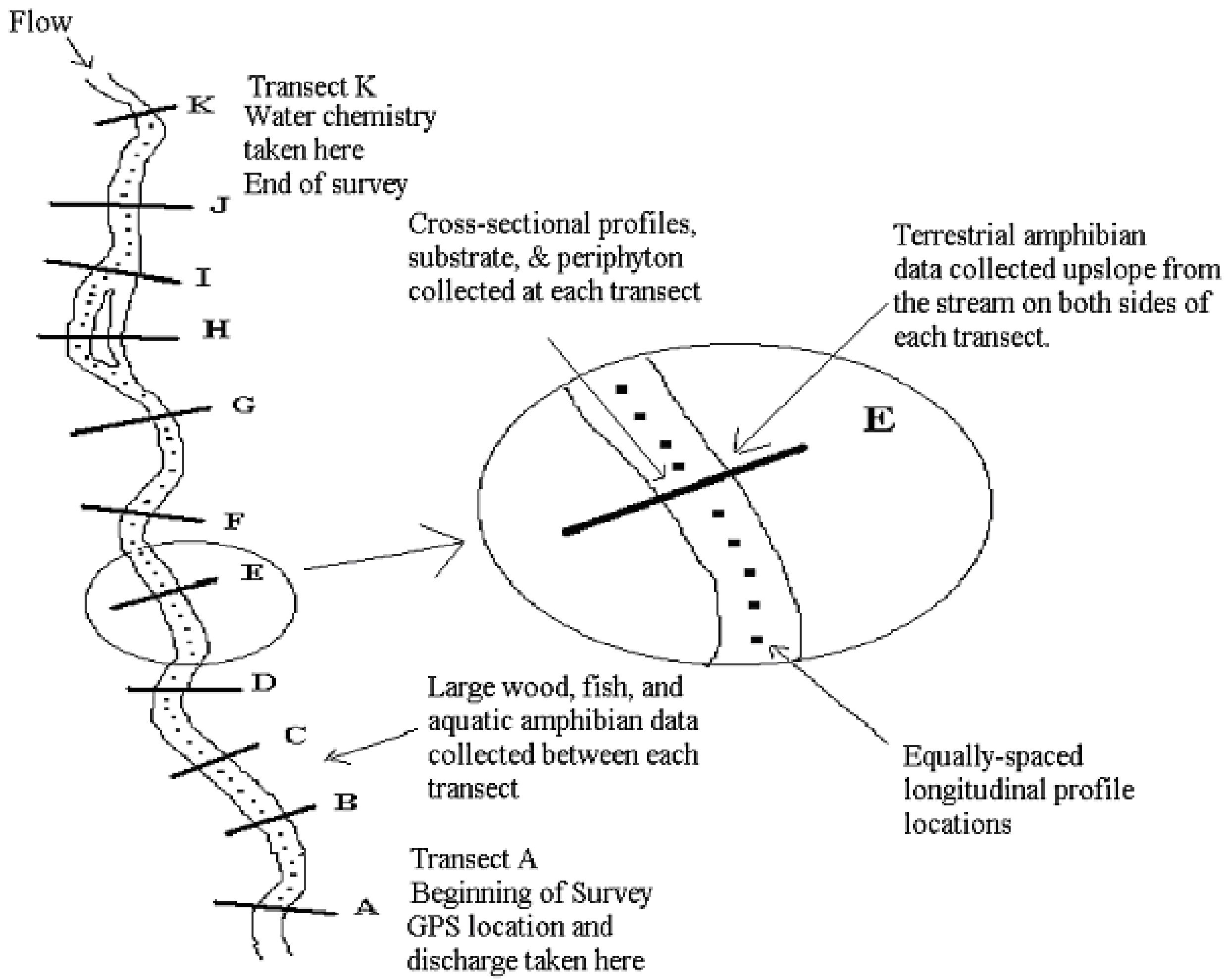

Figure 1. Overview of site layout and sampling strategy for non-constrained sites.

Transect layout – constrained sites

1. Take bankfull measurements and determine site length as previously described (Site length section).
2. Divide the site length by 10 to obtain the increment between transects.

EXAMPLE: Reach length is 200 m according to Table 1. The distance between transects would be 200/10=20 m.

3. Measure distance between transects using a tape and place a flag in an obvious area near eye level at each cross section (transect) location. Label the flag on with the transect name (A, A2, B, B2…K). Place an additional flag on the flood prone transects labeled “FP” (flood prone transects are found on the Stream data form).
4. Leave the flagging up until all sampling has been completed. Crew leaders will know which sites are for QA/QC; leave the flagging up at these sites.

Possible problems

Occasionally logjams or other obstructions cover the stream channel making it impossible to conduct cross-sectional or longitudinal profiles. If the obstruction is small and blocks only one transect, move the transect to the nearest suitable location (upstream or downstream a few meters). However, if the obstruction is large, it should be excluded from the survey.

1. Begin site layout as previously described.
2. When the obstruction is encountered, measure the distance from the last transect to the beginning of the obstruction. Place flagging labeled "STOP SURVEY" at the obstruction.
3. Go to the upstream end of the obstruction and hang a flag labeled "RESUME SURVEY." Continue measuring up to the next transect location.
4. Make sure the laser operator puts a note into the HP48 and on the Stream data form.

EXAMPLE: The distance between cross sections in a constrained reach is 20 m. From Transect C2, it is 9 m to the downstream end of a large logjam. Place a flag labeled "Stop Survey" at the end of the logjam. Go to the upstream end of the logjam and place a flag labeled "Resume Survey" and measure upstream the remaining 11 m to Transect D.

The Stream data form

1. In the top section, enter the name of the watershed in the Site Name box, the date, the site ID, and UTM coordinate.
2. In the Reach Determination section, enter the 5 bankfull widths used to calculate average bankfull width, the average bankfull width, and the reach length. Next mark the distance upstream or downstream the site was laid out relative to the GPS start point. Then check the appropriate box for the reach type, constrained or non-constrained. Finally, include the compass declination used in the watershed (taken from the AREMP generated field maps).
3. In the Weather Conditions section, document the percent cloud cover, the level of precipitation, the air temperature, and the time of day (in military time).
4. In the Gradient and Flood prone section, the random flood prone transects are provided with two alternate transects. Circle the transects surveyed for flood prone. Z-values for gradient calculation (left wetted at transects A and F/K) should be entered in the remaining boxes. If the first 2 measurements are not within 10 % then, a third measurement must be taken (see Gradient section).
5. In the Crew Personnel section, write the full name of each crewmember, and include a 5-character code. The code is based on the first, middle, and last initial of the crewmember, then "01" or "02" if two people have the same initials. For example, Jacob Lee Chambers will have a code of JLC01. Jennifer Leanne Cox would have a code of JLC02. Use the character codes for each crewmember to fill in the duties that each crewmember performed at the site.
6. Random start points for periphyton and sample locations for macroinvertebrates are also present on the form.

Channel Morphology

Photo Documentation

Information about each site will be documented in photographs and on the data sheets. Panoramic photographs will be taken at Transect A of each sample site. In addition, photographs should be taken of rare or unique features in sample reach, including culverts, logjams, beaver dams, or vertebrates that are difficult to identify.

The digital photos collected in the field will prove invaluable when relating individual sites to watershed condition. These photos bring to life much of the data collected in the field and allow this information to be relayed to the public in a way that can be more readily understood. AREMP will use these photos in several different ways. These photos will be linked to GIS, which will provide for more meaningful interpretation of the field data. These photos will be retaken at 5-year intervals, which will provide a means to discern changes in the area over time. Additional information about photographs is located in Appendix 10. Frequently asked questions about photographs.

Getting started

The physical habitat crews will be responsible for taking the bulk of the digital photos in the field, including the photos taken at Transect A.

1. Ensure that the batteries in the GPS unit are good and the camera battery is fully charged. Carry extra batteries for both units.
2. Turn on the GPS unit and wait until it has an active read on the satellites. It is possible that due to the position of satellites or the depth of the canyon you are in, you will not be able to get GPS coverage. In this case, walk around close to the area where you will be taking pictures in an attempt to obtain satellites.
3. Turn on your camera and do the following:
    a. Verify the image quality is set on “FINE”. Set the top disc to SETUP and use the navigation disc (on the back of the camera) to choose Image Quality menu option. Under this option, select “FINE”.
    b. Verify the image size is set on “FULL”. Set the top disc to SETUP and use the navigation disc (on the back of the camera) to choose Image Size menu option. Under this option, select “FULL”.
    c. Make sure that the date/time on the camera is in sync with the date/time on the GPS unit.
        i. To display the time on the GPS unit go to the Main Menu, scroll down to Setup, and scroll across to Time. The time displayed is the time to set the digital camera to. To do this put the camera in “Setup” mode with the dial on the top of the camera. Press the “Menu” button and used the disc to scroll down to “Date.” Use the disc again to enter the date and time.
4. At the beginning of each day, open the screen on the GPS unit that displays the time and take a photo of it with the digital camera. This photo serves as a backup in case the time is set incorrectly on the digital camera.
    a. On the GPS unit “Acquiring satellites” page, press the Page button once.
    b. You should now be viewing a screen showing time and date at the bottom with a UTM coordinate of your current position.
    c. Take a picture of this screen, attempting to minimize glare. Look at the picture on the viewfinder to ensure that the numbers on the GPS unit can be read.
5. For the physical habitat crews, take a series of photos at Transect A. Position the tripod in the center of the streambed if possible or near the stream bank if the stream is too deep and mount the camera on the tripod. The camera should be low to the ground and *level* on the tripod. The first photo taken should be of the white board, which should then be placed on the left bank. Take the first panoramic picture of the left bank (where the white board should be); then rotate the camera clockwise to take the next photo making sure that there is 30-40% overlap of the two photos. The overlap is necessary so that the photos can later be “stitched” together to provide a panoramic view of the site. Continue taking photos until your last photo overlaps your first one (back at the left bank). Ask all other crew members to stay out of the photos. Gear in the photos

is OK as long as it does not move between pictures. Keep gear bundled up to avoid the “yard sale” look.

6. The white board should contain the following information:
    a. Location (i.e., Watershed code name and site number): For Site 3 on the Wadeable Creek you would put “ORWAD1003”
    b. Date (Day Month Year): “3 July 2003”
    c. View: “view of left bank Transect A.”
7. At the end of the day, download the track log with the software provided on the laptop. Use the icon on the desktop entitled “GPLdown.exe” to launch the software. Plug the GPS unit into the laptop and push the download button. Create a folder with the days date under C:/Crew #/Stint #/GPS_camera. An example filename for the tracklog would be 2003-06-08. In this folder is the track log file entitled track.csv.
8. Attach the USB cable to the camera, remove the lens cap, turn the camera on and plug the USB cable into the laptop. Locate the photos on the camera card and copy them into the folder with the .csv file extension from the GPS download folder (i.e., in the date folder, as above). When you are done, locate the icon on the task bar that allows you to unplug the USB cable from the laptop safely (the green arrow icon). Review the photos and make sure that the comment sheet is filled out correctly.

Photos to take

Take photos that will help give those people who might never visit the area an idea of what it is like. These photos should help show the condition of the areas sampled, species captured at each site, land disturbances, etc. Take pictures of the following:

- Features such as logjams, waterfalls, deep pools, and beaver dams.
- Land disturbances such as fire, landslide, extensive blow down, etc.
- Unusual species and species that are difficult to identify; this info should also be entered into the “Comments” section along with the photo number (see the Photographs of Biota section).
- If possible, take a picture of the overall watershed (from a road/clearing).
- Scenic shots and people working are good too.

The Photo Log data form

At the end of each day, enter the appropriate information detailing the site ID (ORWAD10), the UTM coordinate, the time the photo was taken, the photographer, and the photo number. In the comments section, describe the subject of the photo (e.g., transect photo, unidentified salamander) or describe habitat or other distinguishing features for biota.

Physical Habitat Surveys

Channel cross-section measurements provide insight on the relationships of width and depth, streambed and stream bank shape, and bankfull and flood prone area. All are important attributes of channel condition and indicators of health in aquatic and riparian ecosystems. The ratio of bankfull width to depth describes the conditions available for aquatic fauna and flora and of riparian vegetation.

Cross-sectional and longitudinal profiles will be conducted at all sample sites. The same protocol is used in all sample reaches, however the number of cross-sectional profiles differs in non-constrained and constrained reaches. In non-constrained reaches, 11 profiles will be mapped. In the constrained reaches, 6 profiles will be mapped.

Cross-sectional profiles – non-constrained sites

Cross-sectional profiles will be conducted at 11 transects (A-K).

1. Locate the bank with the best bankfull indicator. If good indicators are not present, locate the nearest good indicator up or downstream and follow that line up to where the Transect flagging is located.
2. Starting on the left bank (looking downstream), insert the bank pin through the end of the tape and then into the bank at the best bankfull location.

3. Stretch the tape across the channel (perpendicular to flow). Insert the other bank pin (the one with the clip) into the bank, stretch the tape tight and hold it with the clip. Ensure that the tape is level.
4. Thirteen to sixteen measurements will be taken per profile. Two measurements will be taken outside bankfull (one on each side) at the slope break nearest the bank pin. Begin shooting points on the left bank (looking downstream). Label the first point A*LE for "Transect A Left End." Eleven measurements will be taken on increment within the bankfull, beginning and ending with the bank pins marking bankfull (labeled LB and RB for "left bankfull" and "right bankfull", respectively). To determine the interval for the measurements, divide the bankfull width by 10. Label codes are presented in Appendix 2. Label codes for cross-sectional profiles.
5. In addition to the 11 incremental measurements, shots will be taken at each wetted edge and in the thalweg (Figure 2).
6. At two randomly selected transects, measurements will be taken for flood prone width (Be sure to circle the flood prone transects on the Stream data form; and justify not using the first two flood prone transects). Take the first and last measurement outside flood prone (Figure 3), and then take as many measurements as necessary to capture slope breaks and other features. Take measurements inside bankfull as described in step 4 above.
7. At the thalweg point on a cross-section to tie a flag onto the tape that indicates where to re-shoot the thalweg start point on a longitudinal profile.

Cross-sectional profiles – constrained reaches

Cross-sectional profiles in constrained reaches will be conducted as they are in non-constrained reaches, however fewer profiles will be completed. Six transects will be completed in constrained reaches (A, B, C, D, E, F). Use the protocol previously described in the Cross-sectional profiles – non-constrained sites section.

Adjusting the prism pole to survey hard to reach spots

Frequently, large branches, logs, or undercut banks get in the way of surveying. The prism pole (Rod Height (HR)) can be adjusted to prevent moving the laser unit. **Remember to change the target height on the HP 48 data processor each and every time you change the height of the prism.** If the rod height is not changed, the data will be incorrect and will require editing at a later date. In the case of an undercut bank, it is important to capture the wetted edge at the point where you can see the wetted edge and shoot the point on the surface of the water only. Make a note of the undercut bank in the HP48, and measure the distance of the undercut that is wetted. In very tight situations, you may have to invert the prism pole or remove the prism from the pole and place the prism in the desired location. In this case, the rod height should be set at 0.08, the distance from the edge of the prism to the center of the glass.

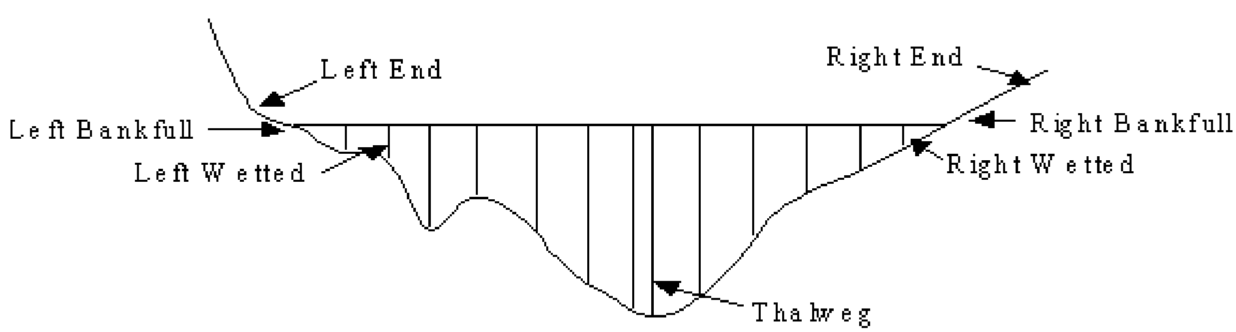

Figure 2. Example cross-sectional profile with point labeling and measurement increments.

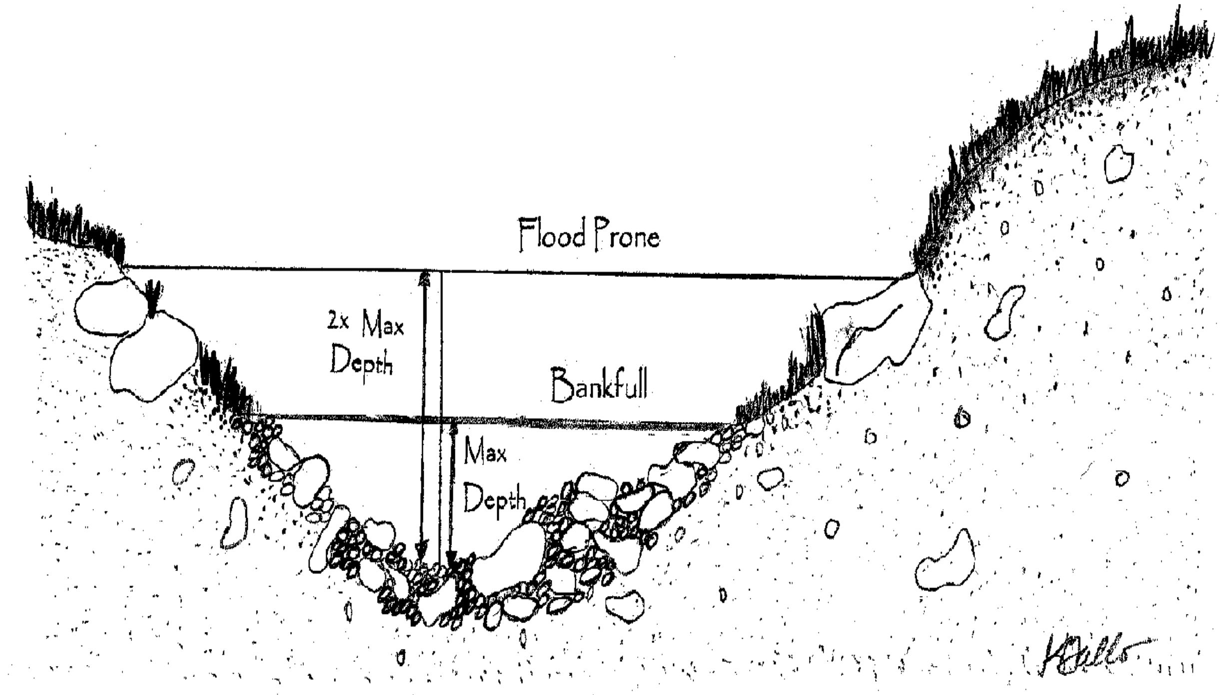

Figure 3. Example cross-sectional profile depicting bankfull width and flood prone.

Longitudinal profiles

Several indicators are calculated using longitudinal profiles, including gradient, sinuosity, and pool frequency. Gradient is used to classify channel types and provides understanding of the geomorphologic processes that shape the channel. Similarly, sinuosity is used in channel classification and provides an estimate of how well the stream is connected to the floodplain. Pools are important habitat components for aquatic organisms. In addition to other functions, pools typically provide deep-water refuge and cooler temperatures for fish.

1. Longitudinal profiles are measured between each Transect by following the thalweg of the main channel. A minimum of 100 incremental measurements should be taken within the site.

EXAMPLE: If the total length of the reach is 240m, the increment between longitudinal measurements is 240/100=2.4 m. Round this value to the nearest 0.5 m. In this case use a 2.5 m increment.

2. Start shooting points from the thalweg point of the previous cross section (at the tape) up the channel at the proper increment.
3. In addition to the increment points, shoot points at pool tail crest, pool maximum depth, and at the head of each pool. The pool maximum depth is found by probing with the prism pole until the deepest point is located. See definition of pools below.
4. Take the last measurement where the tape crosses the channel thalweg at the next transect.

Gradient

Stream gradient is the elevation change from the water surface at the downstream end of the reach to the water surface at the upstream end (pool-tail to pool-tail). The change in elevation is measured using the left wetted edge measurement at Transect A and Transect F or K (depending on the reach type).

At Transect A, write down the Z-value at the left wetted edge on the Stream Data Form in the A(1) column. At Transect F or K record the Z-Value for the left wetted edge in the F/K(1) column. Follow these steps to find the Z values in the HP48 (you will need to exit out of the main menu and observe the coordinate file to retrieve the z-coordinates for the gradient calculations, during the laser survey):

1. Observe the (FS) point number for the left wetted edge shot on Transect A or F/K.
2. Press exit while in survey mode.
3. Press **[G]** Open/Edit a job.
4. Press **[J]** Edit coordinates.
5. Press **[D]** for the RCL (recall) option on the screen.
6. Type in the point number (FS) that corresponds to the FS number from step 1.
7. Press **Enter**.
8. The next screen displays the northing, easting, and elevation. The elevation is the Z-coordinate.
9. Write the number down in the appropriate column on the Stream Habitat Form and follow the steps below to make the calculations.

When the habitat survey is complete, re-shoot the left wetted edges at Transects F or K and A a second time. You may need to traverse downstream to re-shoot Transect A. In the HP48, label the secondary or tertiary (gradient points) as A *LW and F/K *LW and insert a note about which point set the gradient is referring too.

Calculate the elevation change using the Z-values for each measurement as follows:

1. Calculate F/K(1)-A(1)=Z-Value($_1$)
2. Subtract Z-Value($_1$)-[0.10*Z-Value($_1$)]
3. Add Z-Value($_1$)+[0.10*Z-Value($_1$)]
4. Calculate F/K(2)-A(2)=Z-Value($_2$)
5. If the values calculated in steps 2 & 3 are greater than the value calculated in step 4, then you are done, otherwise go to step 6.
6. Re-shoot Transect A and F or K for the third time.
7. Record values on Stream Data Form (A(3), F/K(3))
8. Stop

For example, after shooting the four points (two at each transect) you have the following values:

Point Set	Z-Value A(#)	Z-Value F/K (#)	Z-Value difference	Lower 10 %	Upper 10 %
1 (Initial)	100.5	125.5	25	22.5	27.5
2 (Secondary)	101.2	125.8	24.6		

If the Z-Value difference is within the 10 % range (as demonstrated in this example), then do not shoot a tertiary set of gradient points.

Pools

The person conducting the substrate measurements will identify and mark all pools in the reach. This person will flag the pool tail crests *and* pool heads with a small piece of flagging ("PT" and "PH" for Pool Tail Crest and Pool Head, respectively) tied to adjacent vegetation, rocks, or sticks. It is important to note on the flags whether the pool is a mid-channel or full channel pool. If the pool width is >50% (at the widest point in the pool) and <90% of the wetted channel width, then label the pool flags with an "M" (M = mid-channel). If the pool width is >90% of the wetted channel width, then label the pool flags with an "F" (F = full-channel).

Pool definition

1. Pools are bounded by a head crest (upstream break in slope) and a tail crest (downstream break in slope).
2. Include only main-channel pools (the thalweg runs through the pool) and not backwater pools caused by wood or rootwads.

3. Pools are concave in profile.
4. Pools occupy greater than half of the wetted channel width.
5. Pool length is greater than its width.
6. Pool depth is at least 1.5 times the pool tail depth.

Unusual situations

Since stream channels come in a variety of sizes and shapes, situations will frequently arise that are not addressed in this protocol. In this case, the crew leader should make the best logical decision and document the situation in the notes section of the HP48 and the Stream data form comments section.

1. If a large log, waterfall, or other obstruction is located at the Transect, move the Transect to the nearest suitable location.
2. If multiple channels (or gravel bars) are located within bankfull of the main channel, survey these as described for cross section but include extra measurements on each side of the additional channel at the wetted edge. Be sure to label these as right and left wetted. Take a thalweg measurement only in the main channel (the one with the most flow). Label the increment measurements shot on the gravel bar (See Appendix 2 for note codes).
3. If side channels are present but separated from the main channel by an island that is higher than bankfull (typically these have permanent vegetation on them), do not survey the side channel, but make a note of it in the laser notes.
4. If multiple channels are encountered during the longitudinal survey proceed up the channel with the most flow (thalweg).
5. If a large debris jam covers the entire main channel making it impossible to conduct a longitudinal or cross section, see Possible Problems in the Site Layout section of this manual.
6. If a culvert is located within a site, take a point on the longitudinal up to the culvert, then move to the other side of the culvert and resume shooting. Label the shots taken on either side of the culvert as “CULVERT.” Under no circumstance should you ever pick up and move the laser without shooting a new origin (AKA “Traverse”).

General Procedures for using the Compass, Laser Rangefinder, and HP48

1. First and foremost, the laser and the electronic compass are very expensive ($ 5,000 for both). Therefore, always treat them with care. When moving it in the field, walk slowly and cautiously so you don’t drop the laser and smash it into bits on the rocks.
2. The laser and its components are water resistant, which means you can use it in the rain, but do not submerge the unit underwater or drop it in the creek. The compass is not water resistant and needs a zip-lock bag placed over the top in the event of rain or snow.
3. Read the laser user’s manual and consult it at any time you have questions.
4. The laser requires a direct line of sight. If shrubs or branches are in the way, it is usually best to have someone either hold them out of the way or cut them out of the way with the Swedish safety brush axe (AKA Sandvik). You can also use the filter (instructions in Using the filter option section under the Using the Laser Rangefinder section below.
5. Make every effort to avoid your or another crewmember’s anatomy when wielding the Swedish safety brush axe.
6. If you are shooting a point and are unsure whether the laser hit the target or a branch, either shoot the branch or the person holding the prism to determine what the approximate distance to the prism should be and re-shoot the point, before classifying the point on the HP48.
7. Try not to bump the laser so that it is no longer level. If the laser is not level, re-adjust the tripod legs without moving the center post.
8. Data files should be downloaded each night. The fewer mistakes that are made in the field, the fewer corrections that will have to be made in the evening. If mistakes are made, it is very important for you to make notes about it in the HP48. Correcting errors without notes is difficult and time consuming. Make sure to document all problems, missed increments, or mislabeled points as soon as the error is discovered.

Using the compass

The compass is a precision instrument that calculates heading based upon the earth's magnetic field. The compass is equipped with a calibration feature to account for variations in the magnetic field. The compass should be calibrated before each use. For best performance, calibrate the instrument each time you start a new site or the laser or HP 48 is changed.

Keep the compass away from magnetic interference including ferro-magnetic materials (e.g. iron, steel, portable radios, metal watch bands, belt buckles, bank pins, and etc.) and strong magnetic fields (overhead power lines).

Cable connections

The compass comes equipped with two cables, one that connects it to the HP48, and the other that connects it to the laser. The cable running to the HP48 has one round end and one box-type end, and the cable that runs to the laser has two round ends. The HP48 cable should be attached to the bottom left side of the compass when looking at the compass display, and the laser cable should be attached to the bottom right side of the compass. If the cables are on the wrong side on the compass, the data will not be transferred to the HP.

Powering on and off

The compass is powered pressing the ON button located in the lower right hand corner of the compass face. Simultaneously pressing and holding the two upper buttons power off the compass. The compass may power itself off after a period of inactivity to help conserve battery life. Simply press ON to restart the compass. It will *not* power back on when a new measurement is taken.

Warning and error conditions

If the compass detects a problem during measurement, warning or error messages will appear. Warning messages will not prevent a measurement from being taken. They appear at the bottom to the screen as a number with the warning symbol to the right.

The warning/error symbols appear as a dark triangle with a light exclamation point in it. The numerical warning codes and their meaning are presented in Table 2. Additionally, error messages will occur. Error messages indicate when the instrument is unable to calculate azimuth due to excessive interference. An error message interrupts the measurement cycle and overwrites the measurement in the display area. Error messages and their meanings are presented in Table 3. A low-pitch beep will sound if an error message is displayed while attempting to take a measurement.

Table 2. Mapstar compass warning messages and their meanings.

Code	Warning Message
1	User-defined tilt limit exceeded
2	Instrument unsteady
3	Compass core is unsteady
4	Warnings 1 and 2 present
5	Warnings 1 and 4 present
6	Warnings 2 and 4 present
7	Warnings 1,2, and 4 present

Table 3. Mapstar compass errors and their meanings.

Code	Meaning
E01	15.1 degree tilt limit exceeded
E02	Instrument shaking excessively
E03	E01 and E02 present
E04	Compass core overloaded by strong magnetic interference
E05	E01 and E04 present
E06	E02 and E04 present
E07	E01, E02, and E04 present
E60-E65	Huge problem, contact Laser Technology of problem persists

Compass keys

The “**FWD**” and “**BACK**” menu keys will scroll through the top-level menus until the “**ENTER**” button is pressed to advance into a submenu (Figure 4). Once in the submenu the **FWD** button moves from option to option and pressing **BACK** once will display the previous option while pressing **BACK** again exits the submenu and returns to the top-level menu. **EDIT** ↑ or **EDIT** ↓ scrolls through the predefined settings. These keys also provide a means for entering numeric settings into the compass.

Edit mode

The compass has an edit mode that will allow numerical values to be changed in the compass. When an option can be edited, the left digit will be flashing. The following are how the edit keys work:

- **EDIT** scrolls through each digit that can be edited from left to right,
- **EDIT** ↑ increases the digit value,
- **EDIT** ↓ decreases the digit value,
- **EDIT** ↑ and **EDIT** ↓ may also toggle the left digit between + (indicating positive values) or – (indicating negative values),
- Pressing **FWD** saves the edited value and moves to the next option. Pressing **BACK** twice will save the edited value and return to the top-level menu.

If a value is entered that exceeds the limit of the compass a tone will sound and the value will be reset.

Instrument tones

During operation, numerous tones and beeps may be sound. The sounds are indications of what the instrument is doing. Table 4 explains the different audio tones produced by the Mapstar compass and the meanings of those tones.

Magnetic Declination Offset

First, perform a field calibration on your compass (see Calibrating the compass below), *and then* enter your local magnetic declination before you begin logging the data. Otherwise, the accuracy of your measurements could be compromised. Once on site, the laser operator should be the one conducting calibration and making sure all necessary equipment is attached properly. Failure to do so could result in inaccuracies.

To set the magnetic declination offset:

1. Use **FWD** or **BACK** to scroll to the North Menu.
2. Press **ENTER** to advance into the submenu. A small “**d**” appears at the bottom of the screen to indicate the declination entry.
3. Use the edit ↑ or edit ↓ buttons to edit a declination value.
4. Press **BACK** twice to return to the main menu.

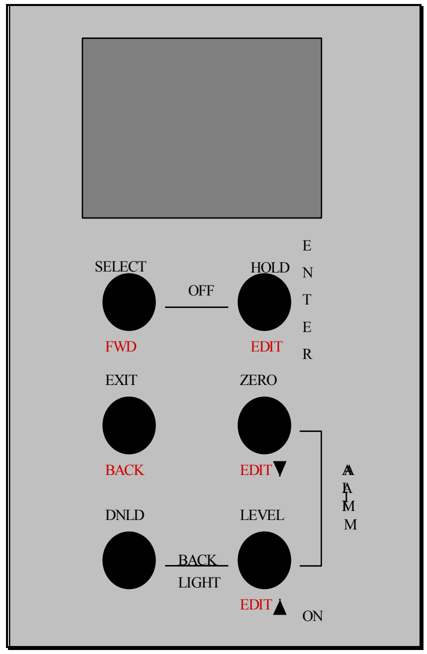

Figure 4. The Mapstar compass button panel showing the navigation keys. Note the different options for each button.

Table 4. Mapstar compass audio tones and their meanings.

Tone	Meaning	Explanation
Double high pitched beep	Good tone	A valid azimuth has been held. A calibration point has been logged. A calibration has been successfully completed.
Single low pitched beep	Bad tone	An azimuth could not be held due to an error. You are trying to edit a value outside of an acceptable range. A calibration has failed.
Persistent steady tone	Aim assist tone	Rising – the instrument is nearing the aiming point. Failing – the instrument is moving away from the aiming point. Silent (after hearing the tone) – the instrument “on target.
Persistent multi-tone beep	Level assist tone	Falling – the instrument is moving closer to level. Rising – the instrument is moving farther off level. Silent (after hearing the tone) – the instrument is within the tilt limit.

Measurement limits

The instrument can express measurement units in either degrees or grads. For our purposes *the degrees option should always be used*. To change units:

1. Use **FWD** or **BACK** to display the system menu then press enter to advance into the submenu.
2. Press **FWD** repeatedly until the screen displays **SEL**:
3. The units symbol will be flashing. Degrees are represented by ° and grads by **G**. Press either **EDIT** button to switch between the two units.
4. Press **FWD** to move to the next system option, or press **BACK** twice to back out to the top-level menu.

Calibrating the compass

The compass should be calibrated prior to use at each site to account for varying magnetic conditions. The quality of a calibration is dependent upon various factors:

- The intensity and stability of the ambient magnetic field
- The physical stability of the compass during calibration
- The number of calibration points used (preset)
- The amount of data taken at each calibration point (preset).

To calibrate, make sure the compass is as level as possible and all the instruments (laser and HP) are securely attached. The laser operator should conduct the calibration. All other people, equipment, etc. need to be several feet away from the compass so as not to interfere with the calibration. To initiate the calibration routine:

1. Press **FWD** or **BACK** until the calibration menu is reached (the symbol looks like a little meter). Press **ENTER** to advance into the submenu.
2. Press **FWD** until either “Auto” or “Hand” appears. Use the edit buttons until the display is on “Auto”. This should always be the option used to calibrate the compass.
3. Press **ENTER** to accept “**Auto**”. The instrument will prompt, “YES?” to verify that you want to proceed with the calibration. Press **ENTER** to proceed or **EXIT** to decline.

Once you proceed, the calibration routine has begun and you will hear an aiming tone to help locate each point in a clockwise manner. Rotate the instrument according to the aim assist tone (the higher the pitch, the closer you are to the point). The first point will be magnetic north. Once the point has been located this tone will end and you may also hear the multi-beep level assist tone (the lower the pitch the closer to level you are; this may or may not occur).

Do not move the instrument when all tones are silent. This is the first calibration point. The compass emits a double beep and the aiming tone sounds again once the instrument is ready to proceed to the next calibration point. Continue in a clockwise fashion until all points have been calibrated. After logging the last point, the instrument will emit a double high-pitched (“good”) tone will sound and it is safe to proceed. If a calibration fails, the compass will emit an error tone and display “bad” on the display.

Failed calibrations rarely occur, but if one does, try leveling the instrument and checking for magnetic interference. Then attempt to calibrate the compass again. If the error persists, contact your supervisor so that Laser Technology can be contacted.

When calibrating in a high wind, the instrument may be shaking enough so that the tilt and stability requirements cannot be met, so it may be necessary to shelter the compass from the wind during calibration.

Pressing **EXIT** at any time before a calibration has been completed will abort the calibration.

Using the Laser Rangefinder

Powering on and off

1. To turn the laser on, press the button closest to the back (where the function screen, battery tube cap, and wire are located) of the laser on either side.

2. To turn the laser off, simultaneously press the middle and front buttons on the left hand side of the laser.

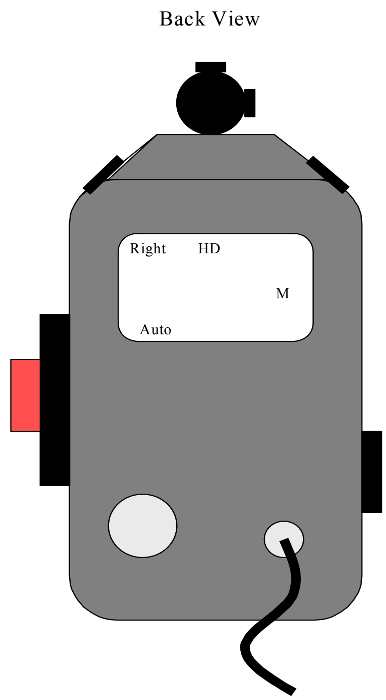

Figure 5. LTI 200 LCD screen showing the correct settings for using the laser.

Using the laser

Once the laser is turned on, the following should be visible on the LCD screen (Figure 5):

- "**Right**" in the upper left corner of the screen,
- "**HD**" in the upper center of the screen,
- "**Auto**" in the lower left corner of the screen, and
- "**M**" in the right central portion of the screen.

It is very important that these indications are present as absence of or different messages will produce data not suitable to this project.

To take a measurement, press the rear right button once to turn the laser dot in the scope on (if not already present) and then press the button again to take the measurement. A beep will sound when the measurement is taken. A number will be displayed in the center of the LCD screen; this is the horizontal distance to the target. Watch the horizontal distance to ensure the readings make sense.

The button panels

The primary button panel is indicated in the upper left hand corner of the LCD screen (Figure 5; "Right" indicates the right panel is primary and the left is secondary; this is the common setup.) Specific button functions are affected by the length of time the button is depressed. A "short" press means the button is pressed and released immediately and a "long" press means the button is depressed for about two seconds before being released.

For simplicity, the buttons on the primary panel will be called "A", "B", and "C" (Figure 6). A is the button to the rear of the laser, B the middle button, and C the button to the front of the laser. The secondary button panel will follow the same button sequence, but be known as "A2", "B2", and "C2". The button functions are described in Table 5.

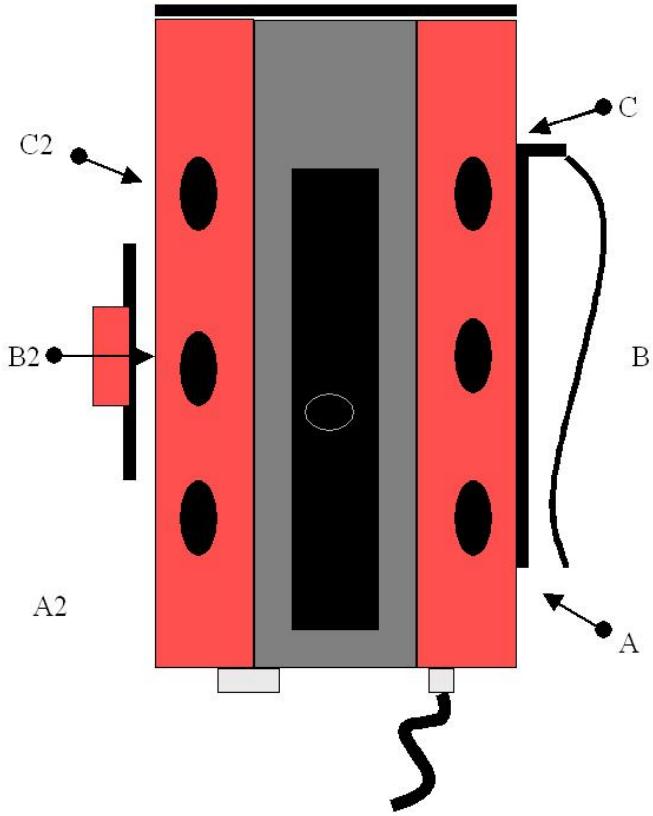

Figure 6. Button panels for the LTI 200 laser rangefinder.

Table 5. Laser button functions for the LTI 200 laser rangefinder.

Button	Function
A	Powers on the laser. Turns on the red dot in laser scope. Fires the laser. Selects the option listed in submenus (HT, GATE, MULTI, SYS). In system setup functions, selects or toggles values. In edit mode, accepts a manually entered value.
A2	No function in measurement operations. In system setup functions, invokes optional “edit mode” so a value can be entered Once in edit mode, advances to the next digit.
B	Moves “forward” in the menu. In edit mode, the first press restores the edit value, the second press abandons the edit.
B2	Adjusts the brightness of the dot in the sighting scope. When press simultaneously with C2, turns off power. In edit mode, increments the digit value.
C	Moves “backward” in the menu, selects the previous option or backs out of the menu. In edit mode, first press restores the edit value, second press abandons the edit. Long Press: clears out the current measurement value.
C2	Turns the screen backlight on or off. In edit mode, decrements the digit value. When press simultaneously with B2, turns off power.

Selecting the measurement units

The laser can express both English and metric units. Units are indicated in the right-hand central portion of the LCD screen. A displayed “M” means the units are set to metric, while a displayed “F” means the units are in feet. Metric units should always be used and are set as the default. The following procedure should be used only if the units were switched, and will return the operator to default settings for this protocol.

1. Use “B” or “C” as needed to display the SYS indicator.
2. Press “A” to select the SYS option.
3. Press “B” until the UNITS indicator at the bottom center of the LCD screen begins flashing, and SEL shows in the numeric display area.
4. Press “A” to toggle between the F (feet) and M (meters) indicators.
5. Press “B” to select the M indicator. The D (degrees) or G (gradient) indicator will begin flashing.
6. Press “A” to toggle between D and G.
7. Press “B” to select D. The % indicator flashes, and OFF should show in the numeric display.
8. Press “C” twice to accept the new settings and back out to the main display.

Note: Changing the units in the laser will not change the units on previously stored data. Those points must be shot again, or a note must be entered in the data recorder (HP48) to change the units once downloaded.

Using the filter option

In areas brushy areas, the laser will often reflect off of unwanted targets giving incorrect values. To avoid errant points, the filter option may be used. With the filter option on, the laser will only reflect off of highly reflective targets, such as the prism, rather than leaves or brush. The filter does not work when a clear line of sight is present. To use the filter:

1. Press C to get to the SYS option.
2. Press A to select the SYS option. The filter indicator will blink, and ON or OFF will be shown in the center of the screen.
3. The A button will toggle between ON and OFF.
4. Press C to save the desired settings and back out to the main display. The FILTER indicator will be displayed on the screen.

Error conditions

The central area of the screen is also where error codes are displayed. If an error occurs, a low-pitched tone will sound and an error code will be displayed. Most errors are trivial and require repositioning and/or shooting the point again. Error codes and explanations presented in Table 6.

Table 6. LTI 200 Laser rangefinder error codes and their meanings.

Code	Explanation
doF	Display overflow. Distance or measurement angle too large.
EoF	Editor overflow.
E01	Failure to lock on target. Reposition and retake measurement.
E02	Target lost during measurement. Reposition and retake measurement.
E03	Unstable aim. Steady the instrument and retake measurement
E04	Invalid tilt sensor reading. Contact Laser Technology if persists.
E05	Tilt reading outside limit on height measurement. Reposition or retake measurement.
E06	Tilt calibration error. See company manual and contact your supervisor.
E52	Temperature too hot. Stop operation.
E53	Temperature too cold. Stop operation.
E60, E61, E62	Calibration or code memory checksum failure. Contact Laser Technology.

Initial laser setup

Set the laser and tripod up in a location that provides a clear line of site to the first transect and longitudinal. It is best to minimize the number of times the laser needs to be moved. When setting up the laser, the middle tripod pole should be on a hard flat surface (usually a rock). The legs should be firmly dug into the ground so the tripod and laser are steady. The legs will have to be adjusted so that unit is level, using the bubble on the tripod. Check the compass to ensure that the laser is level within 0.5 degrees. An alarm on the compass will sound if it is too far out of alignment. Do the 12-point compass calibration at each site location (use the laminated cheat sheet to take you through this process). The LCD screen on the laser should always be set to HD (Horizontal Distance) and M (Meters).

IMPORTANT: Be sure the middle tripod pole is firmly placed on a flat surface, and the remaining legs are secured to the ground. A reasonable method is to place a heavy rock around the tip of the tripod legs to keep the whole unit from wobbling.

TDS Software

If the TDS software is not running on the HP 48, press the following keys in sequence: α α T D S 4 8 ENTER. This should bring up the main menu.

Opening a new file

Open a new file at each new site location. All points taken in the site should be stored in a single file. The following steps are the procedure for opening and naming a new file.

1. Press G Open/Edit a Job.
2. Press G Create new job.
3. Under Job name, type in the two character state code and the site ID (e.g. site 14 in Glade Creek in Oregon would be labeled as ORGLD14).
4. Be sure that Raw data is turned ON.
5. Start point should be 1.
6. Change the northing and easting coordinates both to 100.000.
7. Press the CREAT key (A on the button pad).
8. For the description for point 1 type in ORIGIN 1, then ENTER.
9. You should now see the current job info screen. Press EXIT.
10. To return to the main menu, press EXIT.

Shooting points

1. From the main menu, press J Traverse/Side shot.
2. Be sure you are on the correct foreshot number (FS). FS is the next shot to take in sequential order. Occupy point (OC) only changes when you traverse (create a new origin point).

On your first shot of the day the OC will be "1" and the FS will be "2", which is left end on Transect A. All subsequent shots (FS) will proceed in numerical order from 2 until you have taken your last shot at Transect F or K. When you create another origin point the OC will change once you have traversed. Example: The survey proceeds through all the points up to Transect B, the OC = 1 and the FS = 97. When you shoot a traverse at FS = 98, at this point, the OC changes to 98 and the FS = 99.

3. Aim the laser to the center of the prism and shoot the point.
4. Check the distance on the laser display to determine whether you have hit the prism. If you are not sure you hit the prism, take another shot. If you did hit the prism, press SIDES.
5. Enter the description. For the left end of Transect A, type A*LE then press ENTER. For a mid-pool tail crest on the AB longitudinal, type AB*MT. For an increment shot on Transect C, simply type C. The HP48 carries the descriptor from the previous shot. If you do not need to change the descriptor, press ENTER. A complete list of codes is presented in Appendix 2.
6. Enter rod height and press ENTER. If you do not need to change rod height, simply press ENTER.
7. You are now ready to shoot the next point.

Hint: Signal to the prism person when you have the shot, so he/she can move to the next point while the laser operator classifies the shot. Develop a set of hand signals for distinguishing codes between the prism person and laser operator in the field for pool codes.

Editing points

1. To change a point descriptor, Exit into the main menu.
2. Press “G” Open/Edit a Job.
3. Press “J” Edit coordinates.
4. Use Pt+ to increase point numbers incrementally, use PT- to decrease point numbers incrementally, or RCL to go to a specific point.
5. Arrow down to the descriptor field and type in the correct code.
6. Press STORE, then press YES to overwrite the point.
7. Press EXIT twice to return to the main menu.

Editing the rod or instrument height

1. In the shot screen, replace the FS number with the point number that needs to be changed.
2. To change instrument height, arrow down to the HI field, and type in the correct height.
3. Reshoot the shot.
4. Press SIDES.
5. Change rod height, then press ENTER.
6. Press YES to overwrite the point.
7. The HP will return you to the original shot screen. Type the FS number you are on, and resume shooting points.

Moving the laser – TRAVERSE

1. Have the prism person choose a good location with a clear line of site upstream and downstream to place the laser. See the Initial laser setup section above.
2. Take a shot to the new point.
3. Press TRAV.
4. Type the new origin number in the descriptor field (see Appendix 2).
5. Enter the rod height, then ENTER.
6. Next, keep a tally in the field notebook for the number of origins (traverses) in each site and compare it to the actual number when downloading.

Downloading the HP 48

1. Turn HP48 and computer on.
2. Connect the HP48 to the laptop.
3. Plug the hardware key (dongle) into the large port in the back of the computer.
4. To log onto the computer, *fssetup* is the username, *root* is the password (no italics), and Domain is *Local workstation*.
5. Click on the **Link32.exe** icon on the desktop. If the software does not open, make sure the dongle is plugged into the appropriate port, then click the *Search for hardware lock again* button.
6. Select *Send/Receive* in the **Transfer** menu.
7. For **Which Data Collector or Total Station Used**, ensure that *TDS Data Collector – HP48* is entered. The output file should be **sequential**. Be sure that the **Get File Name from Data Collector or PC** file is checked. In the **Store In** box, select the *Choose Directory* button and navigate to the **TDS-downloads_crew#** file on your C-drive.
8. To prepare the HP48, press [*F*] to enter the main menu, then [*S*] *File Transfer*. Set file type to RAW. Type [*A*] to send the data.
9. Select the file to be downloaded then press [*A*] for *SELCT*.
10. On the laptop press the *Receive* button on the transfer screen.
11. When the file transfer is complete, hit the *Close* button on the transfer screen.
12. Open the file you just saved.
13. Make corrections as necessary.

Editing data files

To change instrument height or rod height:

1. Highlight the line above the line that needs to be changed, and select **Insert Line** from the **Edit** menu.

It is important to insert the line above the point you want to fix.

2. Click on the HI/HR tab then enter the correct instrument and rod heights then select *Store*. Select *Done* to exit **Edit** mode.
3. This procedure changes all points below this line to the next instrument height. THEREFORE, if you need to change only one point, you will have to insert lines *above and below* the point with the unique instrument or rod height.

Changing point labels

1. Highlight the appropriate line, and then edit the note. Type the entire descriptor; the laptop doesn't know the codes. Click on *Store*.
2. To view the descriptor file on the HP, from the main menu, press [H] Open/Edit

Making a scatter plot of the file

Select **Generate Coordinates** from the Conversions menu. A conversions screen will open. Select the name of the file to convert. The **Output** file should be sequential. Ensure that the **Convert File** box is NOT checked. Click *OK*.

1. In the Conversion menu, select **Convert File Format**. A convert screen will appear. Select Coordinate File. Output file type should be ***ASCII 2***. The output file should be named the same thing as the original file, with the .asc suffix. Save the output file in the same TDS crew download folder. Click on the *Convert* button.
2. In the Start menu, open Microsoft Excel.
3. In excel, open the ASCII file just created. The Text Import Wizard will open.
4. Click the circle to the left of **Delimited**. Select *Next*.
5. Check the box next to **Tab** to turn it off, and then check the box next to **Comma** to turn it on. Click on *Finish*. This should produce a spreadsheet with 5 columns containing the point numbers, the X, Y, Z coordinates, and the descriptors.
6. Click on the graph button, select *XY plot,* click *Next* and highlight columns B and C. Click *Next* twice and then *Finish.* A graph should appear. This graph should appear as a bird's eye view of the reach. If it does not make sense, make a note of the problem and save it to the comments spreadsheet on the desktop of your field laptop.

Making a longitudinal profile graph

Right click on the tab at the bottom of the Excel screen that labels the currently open "sheet". Select *Move or Copy*, check the box next to **Create a Copy** and select *OK*. This should create an identical "sheet".

1. Highlight columns B and C then delete them.
2. Highlight the new column C, open the **Data** menu, select **Sort**, make sure *Expand the Selection* is selected, click **Sort**, and sort by column C. Select *OK*.
3. Column C should now be ordered by longitudinal, then origin number, then Transect. Delete all the rows with information pertaining to origins and transects.
4. Highlight column A, go into the **Data** menu, and expand the selection to sort by column A. This will put all the points into the order in which they were shot.
5. Highlight all the values in column B (not the entire column, just the values). Click on the Chart **Wizard** button, **Line Graph** option, then **Finish.** This will create a graph of the longitudinal profile of the stream. It will look like a cross section and will show the elevation gain of the stream (the first z-value should be 100, because the initial origin was created in the file as 100,100,100). If there are any odd points or elevation gains and/or losses make note of what may have happened. Also make a note if a significant "jump" in the profile was due to a waterfall(s) or other gradient changes, such as culverts or debris slides.

Deleting files on the HP48

Delete files ONLY if the file has been downloaded to the laptop and has been checked for errors.

1. From the main menu, press G Open/Edit a Job.
2. Press L Delete job.
3. Use the arrow keys to scroll to the file you want to delete, press SELCT.
4. Press YES.

Editing the data file in Survey Link

Use Appendix 7. Common problems with survey link software for further discussion on how to edit a data file in the Survey Link software on your laptop. The appendix also includes information on problem solving and how to fix errors.

Taking notes

IMPORTANT: Notes may be stored in the site file by pressing the NOTE button on the HP48. Use this function to record problems, errors and all comments about the stream, habitat and data. The notes will appear after downloading the data at the point they were entered into the HP48.

Use a Dura-rite notebook to keep notes about the laser operation at each site. Notes should include:

1. Site number, date, laser crewmembers, and their tasks.
2. File names with the longitudinals and transects that are included within the file.
3. The origin or traverse X, Y, Z coordinates used each time the laser is moved, including the tally for the number of origins. Writing down the traverse coordinated for each origin will allow the laser operator to return to the previous origin if an error occurred while traversing.
4. Anything unusual with the laser or the files, such as presence of side channels, undercut banks, or other features in the site that may or may not have been captured by the habitat mapping.
5. These notebooks can be used for anything of interest pertaining to the field season, e.g., landslides, problems with equipment, flora and fauna observations, past management activities, roads not on a map, etc.

Physical Habitat

Substrate – Pebble Counts

Bed and bank materials of a stream are key elements in the formation and maintenance of channel morphology. These materials influence channel stability and resistance to scour during high flow events. The frequency of bed load transport can be critically important to fish spawning and other aquatic organisms that use the substrate for cover. The pebble count procedure was originally designed to quantify streambed substrate without having to collect substrate samples and take them back to the lab for sieve analysis. The procedure requires taking measurements of substrate on an increment within the bankfull channel.

Pebble counts – non-constrained reaches

1. Rocks should be measured at the 11 cross-section locations (Transects A – K) on increment within the bankfull channel. Substrate measurements are taken at the same locations used in the cross-sectional profile measurements. To determine the increment, divide the bankfull width by 10 and round to the nearest 5 cm. Do not measure rocks at the wetted edge or the thalweg unless the measurement falls on an increment.
2. The first and last measurement should be located at the left and right bankfull pins, respectively.
3. At each location, reach down to the tip of the meter stick and pick up the first substrate that you touch with the tip of your finger. DO NOT LOOK while you are selecting the substrate.
4. Measure the substrate along the intermediate axis with a ruler (scale = mm). The intermediate axis is the median side (B axis) of the rock, it is not the longest side (length-wise) or the short side (depth) of the rock. Visualize the B axis as the smallest width of a hole that the particle could pass through.
5. If the substrate has a smooth dirt feel and is not gritty call it "SILT". If it is gritty and is < 2 mm call it "SAND." Anything greater than 2 mm should be measured. Bedrock (BDRK) is defined as a boulder large enough to park a car on (>4096 mm). If in doubt, measure the substrate. If you are unable to access the substrate due to a large piece of wood, use the code "WOOD" on the data form. Only use the WOOD code if you are unable to get under the log*. Don't call it "wood" if it is a piece of bark or a twig.*
6. On larger boulders, you may have to flip the ruler end-over-end several times to get a measurement or use a field tape.
7. If rocks are embedded you may have to feel for the intermediate axis with your hand and use your fingers as calipers. Sometimes sticking the ruler underwater also works.
8. Enter all data on the Substrate data form, starting with Transect A. Write each measurement in the appropriate blank, using either a number or one of the codes (SILT, SAND, BDRK, WOOD). DO NOT use codes such as "muck", "slime", or "debris." If it is not possible to measure the substrate, perhaps because of a deep pool, write "NOMT" for no measurement on the data form.

Pebble counts – constrained reaches

Substrate measurements in constrained reaches are collected in the same way as in non-constrained reaches. However, since only six cross-sectional profiles are measured in constrained reaches (Transects A-F), it is necessary to measure substrate at the intermediate transects (Transects A2-E2) as well. Complete all transects as described in the non-constrained reach pebble count procedure above: set the tape up at bankfull, divide bankfull width by 10 to determine the increment, then measure 11 pebbles beginning at left bankfull and ending at right bankfull. Data should be recorded on the Substrate data sheet.

The Substrate data form - pebbles

1. To complete the pebbles portion of the substrate form, measurements should be taken at the appropriate transects and recorded in the appropriate location.
2. If you are at a constrained site, take measurements and record at all main and sub-transects and circle the appropriate code. You should circle A, A2, B, B2, C, C2… F.
3. If your site is non-constrained, take measurements and record data for only main transects (A, B, C…K).

4. For all measurements, enter either a number (mm) or the appropriate code for type of substrate encountered.

Substrate - Fines

Watershed and stream bank disturbance often result in increased erosion and sediment input to streams. Increased fine particles in the stream have been shown to impair aquatic food production and decrease survival of young trout. This protocol was taken from the USFS Region 5 Stream Condition Inventory Guidebook (USFS 1998).

Where to take measurements:

1. Collect measurements in the first 12 scour pools of each reach beginning at the downstream end.
2. Measure surface fines in pools that are formed by scouring and not in pools formed by damming (such as large woody debris), even if less than 12 pools are sampled.
3. Sample within the wetted, flowing area of the pool-tail and not in non-flowing areas or within the adjacent riffle.

How to take measurements:

1. Assess surface fines using a 14 x 14 inch grid with 7 equally place horizontal and vertical partitions.
2. Take 3 measurements per pool by placing the grid 25%, 50%, and 75% of the distance across the wetted, flowing area of the pool-tail crest. Place the grid perpendicular to the crest with the downstream edge of the grid along the pool-tail crest.
3. Record the number of intersections (49 plus the upper right corner) in which the intersection is underlain with fine sediment < 2mm in diameter at the intermediate axis. Note that a maximum of 50 fines counts may be recorded on the data sheet. Place a 2mm wide piece of colored electrical tape on a ruler and use this to assess the particle size under each intersection.
4. Aquatic vegetation may be growing on the substrate. First, attempt to identify the particle size by moving the vegetation and measuring the particles underneath. If this is not possible, then record the number of non-measurable intersections.
5. Wood and other obstructions can also inhibit a clear view and result in non-measurable intersections. Make a note in the comment section of the datasheet about any obstructions that interfere with the grid sampling.
6. Repeat the entire process changing the definition of fines from a maximum of 2 mm along the intermediate axis to a maximum of 6 mm along the intermediate axis.

The Substrate data form - FINES

For fines measurements, place the grid and record data at every pool determined by the substrate/bankfull person until all pools (maximum of 12 pools) are surveyed. In addition, classify the pool based on the width of the pool. The determination of the pool type is made by the crewmember collecting substrate information and should be available on the flags left by that person. If the pool width is >50% (at the widest point in the pool) and <90% of the wetted channel width, then use the pool labels that begin with “M” (M = mid-channel). If the pool spans more than 90% of the wetted width, then use the pool labels that begin with “F” (F = full-channel).

Large Wood

Large wood is important to the morphology of many streams. It influences channel width and meander patterns, provides storage for sediment and bedload, and is often the most important factor in pool formation in small streams. Large wood is also an important component of in-stream cover for fish and it provides habitat for aquatic insects and amphibians. The large wood protocol has been adapted from that used in the Oregon Department of Fish and Wildlife’s Stream Habitat Surveys (Moore et al. 1999).

1. The minimum size piece of wood to consider is 30 cm diameter at breast height (dbh) and 3 m total length.
2. Count all pieces that meet the minimum size criteria and that are contained at least partially within or suspended over the bankfull channel. No live woody material is counted. Pieces in logjams (>5 pieces) should not be included in the count.

3. Estimate the length and dbh of each piece of wood, including the portion outside the active channel. The *recorder* is to measure (in meters) the length and dbh of the first 10 pieces of wood and every 5th piece thereafter. For *consistency, the estimator is not allowed to know the actual measurement, so that the estimation can be calibrated at a later time.*
4. Indicate the grouping of pieces in individual accumulations by drawing brackets around the appropriate rows in the comment column of the wood data form.
5. If there is no wood found in the longitudinal, circle the appropriate letters in the "longitudes with no wood" section. Do not enter it into the spaces provided for longitudinals with wood.
6. If a logjam is encountered, fill in the "log jam" section. Do not estimate or measure the number of pieces and of these pieces, just count the approximate number of pieces that meet the minimum size requirements. A logjam should contain a minimum of five pieces.

The Wood data form

1. Using the procedure outlined above, the estimator and recorder will complete the large wood survey. The recorder will fill out the data sheet, using the appropriate codes provided in this document and the cheat sheet the crew leader will have.
2. In the comments section, fill out any info that details any pieces that could not be measured (due to extreme height or unsteadiness) or any other relevant wood information.

Table 7. Codes to be used with the wood data form.

Code Type	Definition
# Pieces Touching	
S	**S**ingle piece
Acc	**Acc**umulation (2-4 pieces)
Wood Type	
N	**N**atural (broken ends or entire trees)
C	**C**ut end
A	**A**rtificial (part of a man-made structure)
RN	**R**oot wad attached to trunk with **N**atural end (broken or entire tree)
RC	**R**oot wad with opposite end **C**ut
Wood Location	
S	**S**ide of the channel
M	**M**id channel
I	**I**sland
F	**F**ull channel (Completely across the channel within bankfull. Portions may be above the wetted channel)
O	**O**ver the channel (Suspended over the active channel with the ends above the active channel. Include debris with suspended bole but with branches in water).

Water

Discharge

Site selection

Discharge should be measured at one location in each sample reach. A good spot for measuring discharge with the flow meter should have even flow (laminar flow) across the channel, have no eddies on the sides, and be free of large rocks or wood. Check in pool tail crests and riffles for areas with undisturbed flow. Measurements should not be conducted in the middle of a pool. It is OK to go outside the sample reach to get a good spot, however do not go more than 20 m from the beginning or end of the reach, and do not sample near a tributary junction. If a tributary joins the creek within the sample site, take the measurement below the junction. Prior to starting the measurements, move rocks or obstructions as necessary to get a clear area to measure. However do not move objects once you have begun taking measurements.

Using the flow meter

1. Calibrate the flow meter every other watershed; approximately once a month. Instructions for calibration are included in the manual for the meter.
2. Attach the sensor to the top setting rod so that the screw on the sensor is turned up, parallel to the rod. Turn the meter on and make sure it is reading in M/S (meters per second).
3. Stretch a tape across the wetted portion of the channel at the desired location.
4. Determine the wetted width of the channel and divide by 11 to give you 10 equally spaced cells. The minimum cell width is 10 cm. If the stream is small it may not be possible to take 10 measurements within the channel. Under these circumstances, take as many measurements as possible, 10 cm apart.
5. The increments near the banks may need to be widened in order to get a location that is deep enough to measure the velocity. Be sure to indicate the cell size at both banks on the data sheet.
6. Take measurements in the center of the cell as shown in Figure 7.At each increment, record the cell width, the distance from the initial point (left wetted edge), water depth, and the velocity (in m/sec) on the data sheet.
7. Use the top setting rod to determine the depth. If the channel depth is less than 0.75 m (approximately 18 inches), take measurements at 0.6 * actual depth. If any depth is > 0.75 m, you will need to take two measurements per increment, at 0.2 and 0.8 * depth. These two readings will be averaged for the velocity measurement back in the office. You will need to have two velocity measurements for one cell. It is best to look for a shallow location to avoid taking two measurements.

EXAMPLE: The stream has a wetted width of 5.7m. The cell width is 5.2/11 = 0.5m or 50 cm (it's ok to round). The measurement for the first cell should be taken at 25 cm. Subsequent measurements should be taken at 75 cm, 125 cm, and so on.

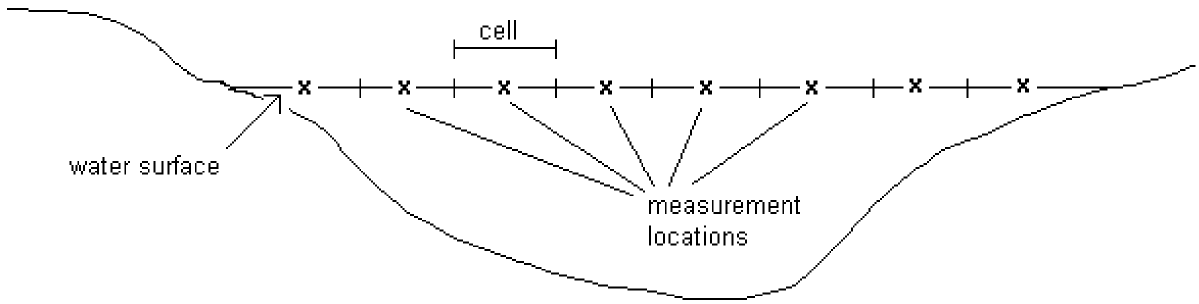

Figure 7. Discharge measurement locations.

The Discharge data form

The instructions for completing the Stream Discharge Data Form are located on the datasheet. Follow the instructions for calculating the cell width and distance from wetted edge, before you begin the survey.

Water Chemistry

Nutrient water samples

Water for total nitrogen (TN) and total phosphorus (TP) analyses should be collected in an acid-washed Nalgene bottle.

1. Prior to going to the field, the bottle should be labeled with the watershed, date, and the initials of the collector.
2. Take the water sample at the lowest most point within the watershed on federal land.
3. First, fill and rinse the bottle out repeatedly (three times) with the stream water before taking the initial sample.
4. Fill the bottle with water and tighten cap securely. Ensure there is adequate headspace in the bottle prior to freezing.
5. Place the bottle on ice in a soft-sided cooler immediately upon collection. Freeze the sample upon returning from the field.
6. At the end of the sampling session, samples should be placed in the freezer in the warehouse.

NOTE: it may be best to take the water sample the day of departure and keep cold for the drive back to the office. However, if that is not possible, be sure to store them in the field coolers at a temperature that is colder than the temperature of the stream being surveyed (i.e., on ice).

On-site water chemistry

Water temperature, dissolved oxygen, conductivity, and pH will be taken during the time (approximately 2 hours) you are at each site using the YSI 556 MPS meter. The protocol is the same for constrained and non-constrained reaches. Take chemistry measurements at the upstream end of the reach. All data are recorded on the Stream data form. Include also the collector's name and the time of day (in military time) that the measurements were taken.

Important: If a tributary junction enters the middle of the reach, do not place the YSI meter at the top of the reach. Instead, place it sufficiently below the tributary junction. The criteria are the same for multiple tributaries and follow the guidelines of flow measurements.

The YSI meter

The YSI meter and probe module is an extremely precise and delicate piece of equipment and should be handled with care. The probe module should always be stored inside the calibration/transport cup with ½ inch of water, and when it is in the stream it should be protected by the probe sensor guard. Do not touch the pH bulb or the DO membrane with your hands or any other object except a clean cotton swab when cleaning the unit.

The YSI meter will need to be calibrated for pH and dissolved oxygen daily before being used in the field. Once each month you will need to change the DO membrane and calibrate specific conductance. It is best to calibrate in the morning and out of the sun to ensure that the temperature remains stable. Calibration standards are best stored in a relatively cool, temperature-stable location. Before calibrating dissolved oxygen, the DO probe will need to warm up for 20 minutes, therefore it is best to calibrate pH prior to DO to allow the probe time to warm up.

For additional information on cleaning, calibrations, and operation of the YSI 556 Multi-Probe System (MPS), please consult the Operations Manual that comes with the YSI unit.

Deploying the YSI

1. Calibrate the YSI for pH and dissolved oxygen daily, prior to going out into the field. This will ensure that the temperature is fairly stable during the calibration.
2. Remove the calibration/transport cup and replace it with the probe sensor guard.

3. At transect F or K, place the probe into the stream in an area with good flow such as a riffle or pool tail crest where the water flowing past the probe is representative of the water in the stream, but not in an area with turbulent flow where the DO is elevated. A pool is not a good place, since there tends to be temperature gradients at different depths and there is not adequate flow to replenish the DO probe. Place some rocks onto the cord to hold the probe in place.
4. Turn on the YSI 556MPS and allow it to warm up for five to ten minutes.
5. Write down the parameters on the Biological Stream Data Form.
6. To begin logging:
   a. In the upper left corner of the screen, scroll down to "Start logging" and press ↵
   b. Enter the file name as follows: state code (two letters), watershed code (three-letters), 1 or 9 to indicate if it is an initial survey or QA/QC, and the site number (two characters). **Example: ORELK103**
   c. When you are finished typing in the filename press ↵and scroll to the right and select "OK".
   d. The YSI will begin logging data every five minutes until the "Stop logging option is selected and the ↵button is pressed. Allow the YSI to log data for at least two hours.
7. When you are finished logging data, turn off the YSI and replace the probe sensor guard with the transport/calibration cup and ½ inch of distilled, filtered or tap water.

Cleaning the probes (as needed)

An invisible film gradually builds up on the probes of the YSI. To ensure accurate readings and calibrations, the probes should be cleaned at least one time at the end of each stint. If the pH and DO readings tend to drift or are difficult to calibrate, the probes should be cleaned.

1. Rinse all three probes thoroughly with distilled water using the squirt bottle, paying close attention to the inside of the conductivity probe and around the pH bulb.
2. Using the bottle brush included in the maintenance kit, scrub the inside of the conductivity probe using 15 to 20 strokes.
3. Wet the end of a cotton swab and use it to gently wipe the pH bulb, DO membrane and thermister. Do not touch the bulb or membrane with anything other than a cotton swab, and be very careful not to force the swab around the sides of the bulb. Wipe down the outside of the probes to remove any biological material.

Calibrating pH (daily)

1. Rinse the YSI probe module and calibration cup **three** times with distilled water. Open the cap and pour one inch of water into the cup. Replace the cap and rinse, swirling the water inside the cup and around the probes for at least 10 seconds during each rinse. Shake the excess water out of the cup between rinses.
2. Pour a small amount (about 1/2 inch) of pH 7.0 buffer solution into the cup and rinse one time as above with the pH 7.0 buffer solution.
3. Fill the calibration cup to the pH line on the side of the cup with the pH 7.0 buffer solution. Replace the cap and gently turn the probe on its end.
4. On the YSI meter, note the temperature of the solution then press escape to get to the main menu. Scroll to "Calibrate" and press ↵
5. Select "pH". Select "2-point" calibration.
6. The YSI will prompt you to enter the first pH. Look at the temperature-pH chart on the label of the buffer solution bottle to determine the correct pH at the current temperature. Enter it into the YSI and press ↵
7. The parameters will be displayed and "continue" will be highlighted in the upper left hand corner of the screen. Wait a few minutes for the temperature and pH to stabilize. The pH has stabilized when it has not changed for 30 seconds. If it continues to drift in one direction it is not stable, but if it continues to fluctuate back and forth between two values it is stable. If it takes a very long time for the pH to stabilize or if it continues to drift, it is a good indication that the probe needs to be cleaned or is not working properly. When it is stable write the values of the temperature and initial pH on the data sheet. Press ↵ "Continue" will be highlighted in the upper left corner. Write the final pH value on the data sheet. Press ↵
8. Rinse the probe **three** times with distilled water and once with a small amount of pH 4 buffer solution. Fill the calibration cup to the pH line with pH 4 solution.

9. The YSI will prompt you for the next pH value. Look on the chart of the pH 4 buffer solution to find the proper pH value. Repeat the same process (steps 6 and 7) as with the pH 7.
10. Rinse the probe three times with distilled water when finished calibrating pH.

Calibrating dissolved oxygen (daily)

1. Remove the entire calibration cup from the probe module. Shake the excess moisture off of the probes and, using a clean cotton swab, gently dry off the thermister and the DO membrane. When calibrating DO, inspect the membrane and make sure it is in tact and there are no air bubbles inside the membrane. If there is a large (greater than 1/8 inch) bubble in the membrane, the membrane will need to be replaced.
2. Pour ½ inch of water into the calibration cup.
3. Place the probe module on its end into the cup and screw the cup onto the probe only ½ to one turn so that the cup remains loosely fitted onto the module. Make sure the thermister is not submerged in the water and the DO membrane remains free of water.
4. Wedge the probe into a place where it will not be disturbed for at least 10 minutes. Make a note of the time. The probe should be in the shade, out of sunlight, where the temperature is stable.
5. On the "Calibrate" menu of the YSI select "Dissolved Oxygen (DO)". Select "DO%".
6. The YSI will prompt you for the barometric pressure in mm Hg. On the barometer find the barometric pressure in inches Hg. Multiply this number by 25.4 to obtain the value in mm. Enter this value into the YSI and press ↵. Write this value on the data sheet.
7. The parameters will be shown on the screen. After ten minutes has passed (since the probe was placed undisturbed) write the initial DO value on the data sheet. Press ↵to calibrate the probe and write the final DO value on the data sheet. Press ↵to continue.

Storage of the probe module

The calibration/storage cup should be screwed on snugly with approximately ½ inch of water (distilled, tap or filtered) inside to keep the DO membrane and pH probe moist, but not submerged in water. It is very important that the probes stay moist, as they may need to be replaced if not stored properly. If the water leaks out, the O-ring on the calibration cup may need to be replaced. If there is no other water available, stream water can be used temporarily. However, do not store the probe overnight in stream water and be sure to rinse the probe well if it has been stored in stream water.

Calibrating specific conductance (monthly)

1. Rinse the YSI probe module and calibration cup **three** times with distilled water. Open the cap and pour one inch of water into the cup. Replace the cap and rinse, swirling the water inside the cup and around the probes for at least 10 seconds during each rinse. Shake the excess water out of the cup between rinses.
2. Pour a small amount (about 1/2 inch) of 1000 μS/cm conductivity calibrator into the cup and rinse one time as above with the calibrator.
3. Fill the calibration cup to the line on the side of the cup with the conductivity calibrator. Replace the cap and gently turn the probe on its end.
4. On the YSI meter, note the temperature of the solution then press escape to get to the main menu. Scroll to "Calibrate" and press ↵.
5. Select "Conductivity". Select "Specific Conductance".
6. The YSI will prompt you for the specific conductance in **mS/cm**. Enter "1" and press ↵.
7. The parameters will be displayed and "calibrate" will be highlighted in the upper left hand corner of the screen. Wait a few minutes for the temperature and conductance to stabilize. When they have stabilized, write the initial value and temperature on the data sheet. Press ↵ to calibrate. Write the final value on the data sheet and press ↵to continue.
8. Rinse the probe three times with distilled water.

Changing the DO membrane cap (monthly)

1. Unplug the probe from the YSI.
2. Thoroughly clean the probe module.
3. Unscrew the DO membrane cap from the DO probe and discard it.
4. Rinse the probe with distilled water.

5. Using the sanding disk in the maintenance kit, gently wet-sand the gold cathode with a twisting motion two to three times to remove any tarnish or silver deposits. Clean the silver anode by wrapping the sandpaper around the anode and twisting to remove the any dark build-up on the anode. Rinse the probe well and wipe thoroughly with a wet paper towel making sure that all grit has been removed.
6. Rinse the probe well with distilled water
7. Prepare the electrolyte solution according to instructions on the bottle. Try not to shake up the solution just before use as it may cause air bubbles to form.
8. Carefully fill the new membrane cap at least ½ full with electrolyte solution trying not to form air bubbles. Tap the side of the cap gently to release any air bubbles in solution.
9. Tip the DO probe down and gently screw the membrane cap onto the probe moderately tight. Do not touch the DO membrane with your hands. A small amount of electrolyte solution should overflow.
10. Rinse the probe thoroughly and replace the storage cup with about ½ inch of water. The membrane should sit for 24 hours before use.
11. Some YSI probes require confirmation of the membrane cap you are using in the "Sensor" menu. From the "Sensor" menu scroll to "DO_______" (not all YSI's have this). Make sure that the color in parentheses matches the color of the membrane cap. If it does not, press ↵and select the proper membrane cap color. When finished, escape out of the menu.

Downloading the YSI

The following is an outline for downloading the YSI file into the EcoWatch Program:

1. Connect the YSI to the laptop using the cable that is labeled YSI.
2. Turn on laptop and open EcoWatch on the desktop.
3. Turn on the YSI, and press **ESC** to access the main menu.
4. Scroll down and highlight the **File** selection
5. Press **Enter**
6. Scroll down to **Upload to PC**
7. Press **Enter**
8. Highlight the file you want to download
9. Press **Enter**
10. With the EcoWatch window open, select the "Dynamite" icon on the toolbar
11. Make sure the **COM 1** is selected and press **OK**
12. The data file should be uploaded to the EcoWatch program

Merging EcoWatch files:

The EcoWatch program allows the merger of two .DAT files. This option is useful for AREMP, because it will allows merging multiple sites within a watershed into one file. Once the data is downloaded onto the laptop and a comma delineated file is created the user can place one excel file into the YSI folder for analysis later. The caveat is the merge option will only merge two files at one time and both files must still be a .DAT file.

1. Click on File.
2. Click on Merge File.
3. Use the Browse button to select which files to merge.
4. Then select the destination for the merged file. (This is in the YSI folder in the appropriate watershed folder.)
5. Click merge to complete the process.

Changing the parameters:

If the parameters that were set-up in the EcoWatch Program change or are displaying the incorrect units or parameters that AREMP measure, follow the guidelines below to correct the problem.

1. Open a .DAT file in EcoWatch.
2. Click set-up.
3. Click parameters.

4. Click add/remove for a specific parameter (this option can add or remove a specified parameter).
5. Click units (this option will allow you to change to the appropriate units).
6. Click on SAVE in the tool bar.
7. Choose the default option in the menu.
8. Be sure to overwrite the changes, click YES.

Exporting the EcoWatch file

The following are the instructions for downloading the EcoWatch file to the laptop:

1. Open up the EcoWatch Program on the laptop, Click on File in EcoWatch and open the file to send to the YSI folder on the laptop.
2. The file should open up in the EcoWatch Program.
3. First, de-select the graph icon and select the table icon on the top tool bar buttons, next to the arrow and question mark (?).
4. Next click **File**
5. Click **Export**
6. **Select DBF**…
7. This opens the DBF File Export box.
8. Double click on C:\
9. Double click on the Crew # folder
10. Double click on the Stint # folder
11. Double click on YSI folder
12. Click OK
13. After clicking OK, you will see a message that an error occurred, Click **Close** and the Click **Close** again.
14. Find the File on C:\Crew #\Stint #\YSI
15. Double Click on the DBF file.
16. A box will appear that will ask what program do you want to use to open the file? Scroll down and chose Excel (After the first download Excel may become your default program and this step will not need to be perform).
17. Once the file is in Excel, insert a line at the top and label it with the State code (2characters), creek code (3 characters) and site number (2 numbers). Also, identify the full site number.
    i. **Example: ORELK03 and 1003 or 9003 (depending on if it is a first survey or a QA/QC).**
18. Next, select **File** and click on **Save As.**
19. A box will appear, on the bottom that says **"Save as Type"** scroll down and choose Microsoft 97 – 2000.xls
20. In the same box, on the top scroll menu make sure the destination is under the same folder that the DBF file is located (it should come up by default).
21. Click save
22. Finally, check the spreadsheet for any errors.

Biological Sampling

Periphyton

The periphyton protocol used for both field collection and lab analysis is the same as that outlined by the EPA EMAP (Peck et al. 2000). Benthic periphyton samples should be collected at all sites. The sampling protocol is the same for both constrained and non-constrained reaches. Intermediate transects should be included in the sample for constrained reaches.

At each site, begin at Transect A and proceed upstream, collecting one subsample at each transect and intermediate transect. Subsamples are collected at an assigned sampling location (left, center, or right bank), alternating at each transect (Figure 8). Record how many samples (should always be 11) were taken from the site and who took the samples on the Biological Stream Data form.

1. Use the Biological Stream Data form to determine whether your starting point on Transect A is on the left, center or right in the stream channel.
2. Choose a rock from each location that is relatively smooth and has adequate exposed surface area.
3. Delineate an area of 12 cm^2 using a template (PVC pipe) provided.
4. Remove all attached periphyton inside the area with a toothbrush. Rinse the toothbrush into the sample jar. Approximately 45 seconds of scrubbing time should be sufficient to remove periphyton.
5. If rocks are not available, use a large bore syringe to vacuum the surface of the sediment within an area of 12 cm2. Add the contents of the syringe to the sample jar.
6. If the substrate at the transect is largely bedrock, place the template on the surface of the bedrock and use the syringe to suck and scrape to collect periphyton from the surface.
7. Subsamples from all transects within a site should be pooled into a single sample jar.
8. During the day, try to keep the sample jar out of the direct sunlight as much as possible to reduce chlorophyll degradation. While in the field, store the jar in the shade, preferably in water near your packs so it is not left behind.
9. Upon returning from the field, measure the water volume in the jar and record.
10. Shake the sample vigorously and pour 50 ml of sample into a clean jar.
11. Preserve the new sample with 1 ml formalin. Use a plastic syringe to transfer formalin into the sample jar. Close the lid carefully and shake the sample jar. Recap the formalin bottle immediately upon completion.
12. Label the sample jar with the date, watershed code, site number, collector, and the total volume of the sample preserved (should always be 51 ml).

CAUTION: Formalin is extremely toxic to all organisms including you. Use extreme caution when handling, use latex gloves and wash hands after use. Do your utmost to avoid spills. If the proper precautions are taken, no harm will come to you or your coworkers. If a spill should occur, use paper towels to absorb the formalin, then place the towels into ziplock bags before disposal. Use soap and water to clean up the spill area.

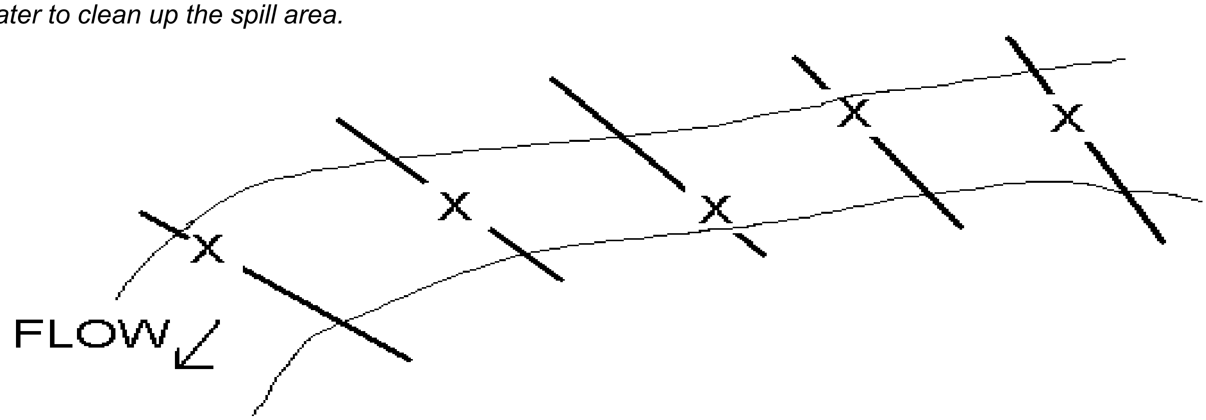

Figure 8. Location (x) of periphyton sample collection. Heavy cross lines represent transects.

Benthic Macroinvertebrates

The benthic invertebrate protocol is the same as that described by Hawkins et al. (2001). Benthic invertebrate samples should be collected at all sites. The sampling protocol is the same for both constrained and non-constrained reaches.

1. Benthic macroinvertebrate sampling will begin at the downstream-most riffle habitat in the site, then progress upstream to the next three riffle or run habitats. If fewer than four riffles are located in a sample reach, sample in pool tail crests.
2. Take two samples within each riffle (eight subsamples total in the site) and record how many samples were collected and who collected them on the Biological Stream data form.
3. A random numbers are used to determine the sampling locations within each riffle; the numbers are located on the Biological Stream Data Form.
4. Take the first number on each column of the datasheet. The first number represents the percent upstream along the habitat unit's length. For example, if the number selected is 50%, then the invertebrate sample should be taken in the middle (50%) of the habitat unit. The second number represents the percent distance across the wetted width of the channel from the left bank (looking downstream).
5. Repeat this process for the all subsequent samples, by progressing upstream using the numbers provide on the Biological Stream Data Form.
6. Many streams and habitat units will not be sufficiently large for this procedure. Under these circumstances, simply choose a suitable location to take the subsamples. An area is considered suitable if it has adequate space among the rocks to place the net and adequate flow to wash organisms into the net.
7. When taking the subsample, place the mouth of the kicknet so that the water flows directly into the mouth.
8. If there is no detectable flow, orient the net to facilitate washing material into the net.
9. The sample area is approximately one square foot. The mouth of the kicknet is one foot wide. Visually estimate the distance one foot upstream from the mouth of the net; sample only in this area.
10. Begin scrubbing rocks in the upstream part of the sampling area, and then work your way toward the net.
11. Scrub all rocks inside the sample area that are larger than a golf ball to remove attached organisms. Place scrubbed rocks outside the sampling area. Brush only the exposed areas of embedded rocks (don't dig them up).
12. When all rocks have been scrubbed, kick the substrate for approximately 30 seconds to disturb the entire sampling area.
13. Rinse the net well to wash organisms into the cup, then inspect the net and capture any remaining organisms. Release any fish or other vertebrates that may have been captured in the net.
14. Large debris should be inspected for clinging organisms and removed from the sample.
15. When all sampling is complete, wash the sample in the net to remove fine particles and excess water.
16. Place all subsamples in a single jar and drain out at least 95% of the water.
17. Label the jar with the AREMP site ID, date, number of subsamples, and initials of the collector, AND place a tag in the jar.
18. Add ethanol (95%) to preserve samples (be sure that all material is covered with ethanol).
19. Clean all threads on the lid and jar. Close the lid tightly and seal with duct tape.

Vertebrates

Fish and aquatic amphibians

1. Fish and aquatic amphibian sampling will be conducted at all sites within specified watersheds. The same sampling protocol is used in both constrained and non-constrained reaches. Please observe all safety requirements while using the electrofisher, before, during and after sampling is being conducted.
2. Before beginning the sampling, write down the conductivity from the YSI meter on the datasheet and record other background data on the Fish and Amphibian data form. Additional water

temperature measurements should be taken at Transect A, C, and E for a constrained reach or Transect A, E, and J on a non-constrained reach. Be sure to record data on the data sheets starting with Transect A. **Do not electrofish if water temperatures exceed 18 °C.**
3. At each site, perform a single pass with an electrofisher between each Transect.
4. Capture all fish and amphibians in the net and hold them in a 5-gallon bucket.
5. At the end of each longitudinal, record species, the number of individual captures, shocker settings, water temperature, effort (time in seconds), the life history stage for amphibians (juvenile or adult) and comments (e.g. weather, fish condition, water clarity).
6. You need measure only 10 –20 % of the fish captured at each site. Measure all fish and amphibians on both of the randomly selected flood prone transects. Record the length in millimeters (fork length for fish, total length (TL) and snout-vent (SV) length for amphibians for each individual), displacement, shocker settings, water temperature, effort (time in seconds), the life history stage for amphibians (juvenile or adult) and comments (e.g. weather, fish condition and water clarity) on the Fish and Aquatic Amphibian Data Sheet. Be sure to fill out the mortality (mort) column, to document the disposition (i.e. dead or alive) of each animal captured.
7. If you need to make comments about the number of fish or other vertebrates seen, but not captured us the Incidental Vertebrates Data Form.
8. If a random flood prone is selected, such as F or K, then you should measure the fish on EF longitude or JK longitude, so that you always measure vertebrates on 2 longitudinals in each site.

Example: You are sampling in a constrained or non-constrained reach. Transects C and F were selected as the random flood prone transects. Measure all fish captured between transects C and D (CD Long) and transects E and F (EF Long) for a constrained site or F and G (FG Long).

Important: If no organisms are captured on the "measuring" segment, measure the organisms on the next segment that organisms are captured.

Terrestrial Amphibians

Terrestrial amphibian searches will occur at each site within specified watersheds. Above all else, care must be taken when handling organisms. Remember that amphibians absorb substances through their skin, and the chemicals in sunscreen and bug repellent may be toxic to amphibians.

1. At each Transect within a reach, crewmembers should start at the wetted edge and search their way up the bank on either side of the stream for five minutes (ten minutes total at each Transect). Be sure to estimate the total area searched along each bank: area searched can be as small as 1 m x 1 m or as large as 10 m x 10 m. (Note: the area is not restricted to size just estimate as accurately as possible the area actually searched).
2. During this time, roll over rocks and logs, and dig carefully through leaves and soil. Make every effort to minimize your impact on the habitat. Return rocks and logs and other objects back to their original locations on the bank.
3. Any amphibians found should be identified and measured for total length and snout to vent length, in millimeters. When animals are returned to the field, place them in the same area you found them. If you found the animal under a rock, place it beside the rock rather than back under the rock to avoid smashing the animal.
4. Hot spot searches will also be conducted. Be sure to target riparian areas along both banks between transects that amphibians might use as habitat, e.g. seeps or springs.
5. Other data to record: estimate the length and width of the area searched in meters, the type of habitat searched (you will enter the appropriate code on the Terrestrial Amphibian Data Form), and the air temperature. If an amphibian was captured, identify which bank it was caught on (left or right looking downstream), habitat, condition of the habitat, location of specimen within the habitat, measure snout vent length (SV) what habitat it was in, the distance from the waters edge, the life history stage (juvenile or adult), and any mortality information.
6. It is important to be very specific about the habitat when an amphibian is found. This can include; slope aspect, distance from stream, and the specific habitat type. Write these conditions on the comments section next to the specific amphibian captured.

Photographs of Biota

Follow these general guidelines when taking photographs of animals.

- Please be aware that you may be working with threatened or endangered species in some areas and that handling all species with care is your first priority. Keep all individuals moist and place them back into their habitat as soon as possible. Only take a picture of the animal if it doesn't put any further stress on the individual.
- Use a small object for scale (e.g., pencil, ruler, fish board).
- Avoid having people in the picture (hands or fingers are ok).
- Zoom in to capture the specimen only.
- Re-take the picture if the clarity, color, focus, angle or lighting is poor.
- It is especially important to take pictures of specimens that cannot be identified.

Only take a few pictures of the representative sample of species found within your watershed. For example, we don't need 400 brook trout photographs within a watershed.

Fish

1. Place specimen on its side with the head facing the top of the fish board (0 mm). Be sure to capture the full length of the fish. The head of the fish should be on the left side of the photograph.
2. If the fish appears to have features resembling spawning colors take photographs of the abdomen.
3. If you don't know what the species is, take pictures of the key areas that are used in guidebooks (i.e., fin rays, leading edges of fins, vermiculations (trout) on the back etc.).
4. Take a picture of any distinguishing feature about the specimen.

Aquatic Amphibians

1. Place specimen on its abdomen at the top of the fish board and capture the full length of the amphibian.
2. Also, take any pictures on the ventral and lateral side that may help further identify the individual (same as fish).
3. Take a picture of any distinguishing feature about the specimen.
4. Take a picture if you can't identify the species or family.

Terrestrial Amphibians

1. Place active amphibians in a moist, aerated transparent bag and quickly take a picture (puff up the bag to protect the animal and place water inside).
2. Important: do not place amphibians in the hand, because they are heat intolerant and may become highly metabolic, which can cause death.
3. Hold gently in moist hand that is free of bug repellent and sun screen and take abdominal picture.
4. Take pictures from all angles, so that you can capture mottling, skin color, limbs and other distinguishing features.
5. Take a picture if you can't identify the species or family.

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Appendices

Appendix 1. Example data sheets

AREMP SITE SELECTION DATA FORM page 1 of 2				
WATERSHED NAME:			HUC:	
Site	Coordinates	Sampled(Y or N)	Reason for not sampling	Creek
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
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38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

AREMP Data Form. Please return to P.O. 1148, Corvallis, OR 97339 (541) 750-7017

AREMP BIOLOGICAL STREAM DATA FORM

WATERSHED NAME: | DATE: ___ ___/ ___ ___/ 2003

SITE CODE: | UTM:__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

WATER CHEMISTRY		FLOOD PRONE (circle the first two)				
D.O.	mg/l	E	C	F	A	Constrained FP Transects
Conductivity	μs/cm	E	I	A	J	Non-constrained FP Transects
Specific Conductance	μs/cm	**Using the comments section, justify**				
Temperature	°C	**reasons for not using first two FP's!**				
pH						
YSI Calibrator						
Surveyor ___________ Time_______ Hrs						

MACROINVERTEBRATE AND PERIPHYTON SURVEY INFORMATION

Macroinvertebrate Surveryor: _______________ # Samples:________ # of Jars________

Periphyton Surveyor: __________________ # Samples: ________ # of Jars________

CREW PERSONNEL Name and 5-character codes

		Periphyton Start →		Center
Field Operations:	( )			
Crew Leader:	( )	**% Up**	**% From Left**	**Benthic Sample Location**
Crew Member:	( )	80%	70%	Riffle 1
Crew Member:	( )	40%	60%	Riffle 1
Crew Member:	( )	10%	40%	Riffle 2
Crew Member:	( )	70%	60%	Riffle 2
Crew Member:	( )	30%	20%	Riffle 3
Crew Member:	( )	70%	60%	Riffle 3
Crew Member:	( )	30%	70%	Riffle 4
Crew Member:	( )	30%	80%	Riffle 4

Please indicate, using 5-character codes above, which tasks were completed by each crew member at each transect or pool.

Duty	A	B	C	D	E	F	G	H	I	J	K
Aquatic Surv.	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Aquatic Surv.	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Aquatic Surv.	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Terr. Surveyor	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Terr. Surveyor	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Terr. Surveyor	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___
Terr. Surveyor	___/	___/	___/	___/	___/	___/	___/	___/	___/	___/	___

COMMENTS

AREMP DATA INVENTORY FORM											
WATERSHED CODE:						HUC:					
SITE #:											
Habitat Data Form											
Bio Data Form											
Photo Log											
Discharge											
Substrate											
Fines											
Wood											
Terr. Amphib.											
Fish / Aq. Amphib.											
Periphyton											
Invertebrates											
YSI Download											
Camera Download											
GPS Download											
TDS Download											

AREMP SUBSTRATE DATA FORM

CREEK NAME:	DATE: ___ ___/ ___ ___/ 2003
SITE CODE:	HUC:

☐ Constrained ☐ Non-constrained

******************************* ***Note: All units should be mm*** ***********************************

Transects (Circle the correct letter for constrained or nonconstrained)

	A	A2 / B	B / C	B2 / D	C / E	C2 / F	D / G	D2 / H	E / I	E2 / J	F / K
Surveyor											
Recorder											
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											

WOOD = wood BDRK = bedrock SILT = silt SAND = sand NOMT = no measurement, too deep

FINE SUBSTRATES

NOTE: There can be no more than 50 fines in each measurement.

	Fines ≤ 2mm			Fines ≤ 6mm			Pool Type	# Pools =	
Pool #	**Left**	**Center**	**Right**	**Left**	**Center**	**Right**	**Mid or full**	**Surveyor**	**Recorder**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

AREMP WOOD DATA FORM

CREEK NAME:	Date: ___ ___/ ___ ___/ 2003 HUC: ___________________	page _1__ of ___
SITE CODE:	Estimator:	Recorder:

LONGITUDES WITH NO WOOD: (circle only those that apply) AB BC CD DE EF FG GH HI IJ JK

LOG JAMS:	Longitude	# pieces	Longitude	# pieces	Longitude	# pieces	Longitude	# pieces	NOTE: Log jams must have a minimum of five pieces touching that meet the size criteria. Do not write anything below if longitude has no wood, only circle above.

Piece #	Long-itude	Estimated Length	Estimated DBH	Measured Length	Measured DBH	# pieces touching	Wood Type (circle one)	Wood Location (circle one)	% Submerged (circle one)	Comments
1						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
2						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
3						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
4						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
5						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
6						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
7						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
8						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
9						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
10						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
11						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
12						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
13						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
14						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
15						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
16						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	

AREMP WOOD DATA FORM

SITE NAME: | **Date:** ___ ___/ ___ ___/ 2003 **HUC:** ___________________

SITE ID: | **Estimator:** | **Recorder:**

Piece #	Long-itude	Estimated Length	Estimated DBH	Measured Length	Measured DBH	# pieces touching	Wood Type (circle one)	Wood Location (circle one)	% Submerged (circle one)	Comments:
17						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
18						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
19						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
20						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
21						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
22						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
23						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
24						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
25						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
26						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
27						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
28						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
29						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
30						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
31						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
32						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
33						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
34						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
35						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
36						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	
37						Single Acc	N C A RN RC	S M F O I	<25% 25-50% 50-75% >75%	

STREAM DISCHARGE

CREEK NAME: HUC:

SITE CODE: DATE: ___ ___/ ___ ___/ 2003

Surveyor: Recorder:

INSTRUCTIONS

Select a spot suitable for flow away from upstream obstructions, consult protocol if necessary.
String tape across stream, LEFT TO RIGHT perpendicular to flow and between **wetted edges**.
The minimum depth is 0.06m. The flow rods are not designed to take measurements in water shallower than this.
If the center of the first or last cell is too shallow, you can make the cells in those areas wider.
Remember to indicate the cell width for cells one and ten if you widen the cells due to depth concerns.
Read values on tape in meters to two decimals (0.00) and use the formula below.

CELL WIDTH

Right wetted edge tape reading
- Left wetted edge tape reading
= Stream wetted width /10 = Cell width

PUT YOUR NUMBERS HERE:

____
- ____________
= ____________ /10 = ____________

Put the cell width in for all cell width values, rows 1-10.

DIST. FROM WET EDGE

Take the first cell width ________
Divide it by two = _______________
This is the row 1 Dist. from wet edge.

DIST. FROM WET EDGE

For row 2, add the row 1 Dist. from wet edge to the cell width.
For row 3, add the row 2 Dist. from wet edge to the cell width.
Add so forth, until you complete row 10. Survey accordingly.

READING ON TAPE

In the case that the left wetted edge does not match up with zero on your tape, use this section to determine where along the tape to place your survey rod. Add the value on the tape at the left wetted edge to the distance from wet edge for each row. (e.g. tape reads 0.48 at left wetted and distance from wet edge is 0.20, 0.40, and so forth down the column. Reading on tape column would be 0.68, 0.88, and so forth).
Rows 11 through 20 are on the form to allow room for cells deeper than one meter, see protocol. If you make an error use blank rows to make corrections. In this case, remember to cross out incorrect rows and write in correct row numbers.

Velocity Area

Row	Reading on tape (m)	Dist. from wet edge (m)	Cell Width (m)	Depth (m)	Velocity (m/s)
1	____.____	____.____	____.____	____.____	____.____
2	____.____	____.____	____.____	____.____	____.____
3	____.____	____.____	____.____	____.____	____.____
4	____.____	____.____	____.____	____.____	____.____
5	____.____	____.____	____.____	____.____	____.____
6	____.____	____.____	____.____	____.____	____.____
7	____.____	____.____	____.____	____.____	____.____
8	____.____	____.____	____.____	____.____	____.____
9	____.____	____.____	____.____	____.____	____.____
10	____.____	____.____	____.____	____.____	____.____
11	____.____	____.____	____.____	____.____	____.____
12	____.____	____.____	____.____	____.____	____.____
13	____.____	____.____	____.____	____.____	____.____
14	____.____	____.____	____.____	____.____	____.____
15	____.____	____.____	____.____	____.____	____.____
16	____.____	____.____	____.____	____.____	____.____
17	____.____	____.____	____.____	____.____	____.____
18	____.____	____.____	____.____	____.____	____.____
19	____.____	____.____	____.____	____.____	____.____
20	____.____	____.____	____.____	____.____	____.____

Surveyor:

Recorder:

Comments:

AREMP FISH AND AQUATIC AMPHIBIAN DATA FORM

CREEK NAME: | **DATE: ___ ___/ ___ ___/ 2003 page ___ of ___**

SITE CODE: | **SURVEYORS:**

HUC: | ☐ Constrained ☐ Non-constrained

Electroshocker Settings

Longitude	Voltage	Frequency	Duty Cycle	Effort(sec)
AB				
BC				
CD				
DE				
EF				
FG				
GH				
HI				
IJ				
JK				

Time of Day

Begin	Hours	**End**	Hours

Background Data

Water Temperature		**Conductivity**	
Transect	degrees C	Transect	µs/cm
A		F or K	
E or C			
J or E			

Flood Prone Transects ______ , ______

Amphibian Stage = A (Adult) or L (Larval)

				FISH		AMPHIBIAN			
Sample Section	**Species Code**	**# Captured**	**# Mort.**	**FL (mm)**	**Disp. (ml)**	**AMPHIB stage**	**SVL (mm)**	**TL (mm)**	**Comments**

Sample Section	Species Code	# Captured	# Mort.	FL (mm)	Disp. (ml)	Amphib stage	SVL (mm)	TL (mm)	Comments

AREMP Aquatic Data Please return to: P.O. Box 1148, Corvallis, OR 97339 or call (541) 750-7017

AREMP TERRESTRIAL AMPHIBIAN DATA FORM

CREEK NAME:	**HUC:**	**page ___ of ___**
SITE CODE:	**Date: ___ ___/ ___ ___/ 2003**	
SURVEYORS:		

	Air Temp	Time	Left				Right			
Transect	(deg C)	(hrs)	Effort (min)	Length (m)	Width (m)	Habitat Search Codes	Effort (min)	Length (m)	Width (m)	Habitat Search Codes
A										
B										
C										
D										
E										
F										
G										
H										
I										
J										
K										

Transect	Species Code	Lifehist A or L	Mortality Y or N	Bank Captured	SVL (mm)	TL (mm)	Comments (Habitat, Location and Condition)
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			
		A L	Y N	L R			

Habitat Codes/Location/Condition

Code	Habitat
Wood	Logs/Woody Debris
Scree	Talus/Scree/Rocks
Seep	Mossy Spring/Seeps
Duff	Duff/Leaf Litter
Forbs	Grass/Forbs
Splash	Splash Zone/Stream Side

Condition	Location
Dry	Top
Moist	Under
	Inside

* These are just general habitat codes to use in the absence of amphibs when filling out the amphib form. It is important to be very specific about the habitat when an amphibian is found. This can include aspect of slope, distance from stream, along with the specific code/s. Be sure to make a lot of relevant comments about the habitat search and amphibians.

AREMP Amphibian Inventory: Please return to P.O. Box 1148, Corvallis, OR 97339 or call (541) 750-7017

AREMP INCIDENTAL VERTEBRATES DATA FORM

CREEK NAME: **DATE: ___ ___/ ___ ___/ 2003 page ___ of ___**

SITE CODE: **HUC:**

AMPHIB Stage= A (Adult) or L (Larval)

					FISH		AMPHIBIAN			
Sample Section	Species Code	# Observed	# Mort.	Photo #	FL (mm)	Disp. (ml)	AMPHIB stage	SVL (mm)	TL (mm)	Comments

AREMP PHOTO LOG

WATERSHED CODE:	DATES: ____ ____/____ ____/2003 PAGE of
CAMERA #:	HUC:
Surveyors:	State / Forest:

		UTM				PHOTO		
DATE	SITE ID	ZONE	EAST	NORTH	EPE	#	INITIALS	COMMENTS (Remember to note the time you took the GPS photo)

Appendix 2. Label codes for cross-sectional profiles

Physical Habitat Mapping Codes

A	Transect A
B	Transect B
:	
K	Transect K
AB	AB Longitude
:	
JK	JK Longitude
LE	Left end
LB	Left bankfull
LW	Left wetted edge
TH	Thalweg
GB	Gravel bar
RW	Right wetted edge
RB	Right bankfull
RE	Right end
MT	Mid-Pool tail crest
MM	Mid-Pool maximum depth
MH	Mid-Pool head
FT	Full-Pool tail crest
FM	Full-Pool maximum depth
FH	Full-Pool head
1	Origin 1
2	Origin 2
:	
10	Origin 10

Appendix 3. Glossary of terms

Active channel – see bankfull channel.

Alluvial – is considered material deposited directly or indirectly from transport by streams, where deposition occurs in the channel, adjacent floodplains, and estuaries.

Bankfull channel – or active channel, is the area in which water, sediment, wood and other organic material are transported, deposited, and contained within the active area of channel formation (bankfull area), before flowing into the floodplain.

Bankfull stage – in many streams it is the height or flow at which water fills the active channel and at the point where the water begins to flow onto the floodplain.

Bankfull width – the distance between left bankfull and right bankfull, measured perpendicular to the flow of water. Indicators include: top of pointbars, change in vegetation, change in slope, change in bedload, bank undercuts and substrate stain lines (i.e. moss and lichen growth). The indicators occur at the point where bankfull stage (flow) shapes the morphological features of the entire active channel.

Braided channel – a stream habitat characterized by multiple channels flowing almost parallel to one another and separated by unstable, temporary islands (bars) of alluvium.

Channel gradient – the difference in elevation between a downstream point and an upstream point divided by the length of the segment. (elevation at mouth – elevation at source / length of stream).

Constrained reach – Valley width index (see definition in glossary) less than 2.5.

Deposition – a hydrologic or geologic process through which sediment materials are settled.

Diameter at Breast Height (DBH) – Used to measure riparian vegetation as the diameter measured or estimated at breast height above the ground. For our purposes, it is measured at the similar distance from the largest end of a downed piece of wood.

Discharge – the volume of water flowing at a given place and unit of time (area * velocity), measured in cubic centimeters per second (cm^3/sec) or cubic meters per second (m^3/sec).

Ecotone – is the transitional zone between two adjoining ecosystems, the upslope ecosystem and the aquatic ecosystem. Sometimes used to refer to the riparian zone.

Entrenchment ratio – the ratio of floodprone width to bankfull width (FP/BF).

Floodplain – a depositional area near the active channel of a stream that floodwater and other materials are transported and subsequently deposited. The width of the floodplain will vary, depending on whether the channel is confined or unconfined and can be indicated by the valleys floodprone width.

Floodprone width – measured from the base (change in slope) of left terrace (hillslope) to right terrace (hillslope). In field measurement is: floodprone width equals 2 times the bankfull height (FP= 2 x BF) and measured perpendicular to the active channel.

Fluvial – anything that is shaped or changed by the hydraulic characteristics of the stream (i.e. how the active channel is formed and changed over time).

Fluvial sediment – particles from geological or biological sources that are deposited, transported, and suspended in flowing water (i.e. sand, pebbles, cobbles, wood and leaves).

Habitat – is a channel characteristic that was shaped by substrate material and the actions flowing water. Aquatic habitat includes; fast and slow moving water, such as pools, riffles, falls and side channels.

Hydraulic control – an obstruction within a habitat where flow is restricted or re-directed that forces the flow of water to be altered in a manner that creates different habitats at various spatial scales. The control can be bedrock outcrops, large boulders, wood, riparian vegetation or sediment deposition that occurs at the tail end of a pool

Laminar flow – is non-turbulent stream flow. The flow of water and particles moves in a parallel manner, similar to the flow of water out of a hose. May be an appropriate area to take discharge measurements.

Large wood – is classified for estimation and measuring to be at least 3 meters in length and 30 centimeters at breast height. Large wood can be any downed tree species located within the active channel and may or may not be forming habitat by acting as a hydraulic control.

Low-gradient reach – a reach that has gradient less than 3 %.

Meander – occurs when the erosive forces of flowing water contribute to the creation of a series of sinuous curves or bends in the active channel of a floodplain.

Non-constrained reach – Valley width index > 2.5.

Point bar – an area of deposition after higher flows have receded in a stream.

Pool – a habitat of aquatic ecosystems that is characterized by "slower" flow of water and reduced turbulence. The habitat is identified by a zone of scouring (erosion) that creates the deepest area within the channel.

Pool head – the beginning of the pool habitat. Where water ceases to be "rough" as in the riffle or run above the pool.

Pool tail crest – The downstream end is called the pool tail, where the habitat gradually decreases in depth and increases in velocity (a point that designates a change in habitat unit).

Reach – a section or area of stream that has relatively similar habitat characteristics that is used to designate a survey area. A reach length can change when biotic or abiotic factors create a morphological change in the stream channel. For our purposes the reach is randomly selected therefore, habitat characteristics have no bearing on designating a reach length for sampling.

Riffle – a habitat of aquatic ecosystems that is characterized by "fast" moving water with increased turbulence and velocity. Typically, the stream channel gradient is greater in riffles and surface turbulence is caused by partially or completely submerged substrates. By definition, a riffle is an area of deposition from transported materials.

Riparian zone – the area between the stream and upland ecosystems

Side channel – a secondary channel connected to the main channel that water flows into from an upstream point and rejoins the main channel at a downstream point. The channel may be perennial or ephemeral and is separated by a stable or unstable island.

Sinuosity – the ratio of stream channel length to valley floor length. A meandering stream generally has a sinuosity greater than 1.5.

Terrace – an ancient area of the floodplain that at one time was the floodplain. They are elevated areas of past active floodplains formed from years of deposition.

Thalweg – a longitudinal line of maximum depth within a stream channel that demarcates the zone of constant flow in streams, particularly during low flow.

Transport – is the action of the flow of water carrying or suspending sediment and other material in the water column for deposition into downstream areas.

Valley width index (VWI) – ratio of the width of the valley floor to the width of the active stream channel (bankfull width; Moore et al. 1999).

Appendix 4. Packing list for field gear

Habitat Mapping
Laser Rangefinder
Compass
HP 48
Batteries (AA & AAA)
Tripod
Prism and pole
Measure tape (50(2)&100m)
Bank pins (6)
Flagging
Sharpies/pencils
Sandvik and cover
File
Durarite notebook

Substrate
Meter stick
Quadrants for fines
Data sheets
Clipboard
Pencils

Wood
Measuring tape
DBH tape
Data sheets
Clipboard
Pencil

Water chemistry
Acid-washed bottle (1 per watershed)
YSI meter
pH calibration packets (4.01 and 7.0)
Conductivity calibration packets
C-cell batteries
Waste bottle
Distilled water

Flow
Flow meter and rod
Measuring tape
Data sheets
Clipboard
Pencils
D batteries

Periphyton
PVC template
Toothbrush
Sample jars (1 per site)
Jar labels
Formalin
Syringe
Graduated cylinder
Vest

Macroinvertebrates
Kicknet
Sample jars (1 per site)
Brush
Jar labels
Jar label inserts
Ethanol

Fish / Amphibian
Backpack shockers
Battery connector cable
Probes
Dip nets
3-gallon bucket
Lineman's gloves
Extra battery
Conductivity meter
Thermometer ºC
Plastic bag
Measuring board
MS 222
Graduated cylinders
Leather gloves
Species codes
ID books
Data sheets
Clipboard
Pencils

Misc.
Field notebook
GPS unit
Maps
Atlas
Radio
Waders and boots
Backpacks
Hardhats
More batteries
Fishing line
Ziploc bags
Duct tape
Seam Seal

Camera
Nikon Coolpix 885 camera and case
Garmin GPS
USB cable
GPS cable
Extra battery and recharger.
Attachment for mounting the camera to the tripod (physical habitat crew only).
Memory Card- 128 MB.
White board and (at least 2) pens.

Appendix 5. Quick guide to field attribute calculations

Quick Guide to Field Attribute Calculations:

1. Wood measurements: minimum 3 m length and 30 cm dbh, within the active channel.
2. Minimum size for sampling: 1 meter wide (3 feet) active channel, by 0.1 meters depth (4 inches), in riffle habitats.
3. Transect layout (distance between transects or total reach length): Average bankfull (5 measurements in meters) x 20 / 10
4. Transect increments: divide bankfull width by 10; does not included thalweg, RB, LE etc.
5. Longitudinal increments: Reach length / 100; does not include PT, PM, and PH.
6. Pebble counts: taken at each of the 11 transects and 11 pebble samples are taken (Transect (bankfull) width / 10). (4 – 4096 mm)
7. Substrate Codes: BDRK, SAND, SILT AND WOOD (4 letters)
8. Fines: remember to take 3 measurements at the pool tail crest even if the width is too small to do so. (Range 0 – 50 intersections per placement)
9. Discharge: measure width from left wetted edge to right wetted edge, increments are equal to the: wetted width / 11. (Note: measure in the middle of cell)
10. Benthic Periphyton sampling: see Biological Stream Data Form for starting location
11. Macroinvertebrate sampling: see Biological Stream Data Form for starting location
12. Floodprone Transects: see Habitat Stream Data Form for the random transects
13. Fish and aquatic vertebrate measurements: see Habitat Stream Data Form for which transects that organism measurements will be taken on.
14. Water chemistry units of measure and range values: DO (6.5 – 12 mg/l), pH (5 – 8.5), Conductivity (0 – 140 μs/cm), and Temperature (4.0 – 25.0 °C).
15. Time of day (0000 – 2400)
16. **Electrofishing will cease if the water temperature reaches 18°C, this is a strict rule laid out in Section 10 and 4d Rules as set by NMFS.**
17. Remember left bank is always looking downstream.

Appendix 6. Downloads cheat sheet

Login to the Laptop:

User Name: fssetup (lower case)
Password: root (lower case)
Domain: Local Workstation

Electronic Downloading/Order of Operation:

1. GPS: GPL download icon on the desktop (GPS before camera at all times)
2. Camera: GPS_Photo link icon on the desktop
3. HP-48: Shortcut to Link 32 icon on the desktop
4. YSI: EcoWatch icon on the desktop

File Structure:
Desktop Folders:

1. Comments Folder: contains spreadsheet for electronic download problems and comments about operations. Also, place any information relevant to the data manager.
2. Protocol_Training Folder: contains the protocol, training manuals, and cheat sheets for referral.

C-Drive Folders:
Structure for GPS/Camera downloading:

1. My computer/Local disk (C)/crew #/stint #/GPS_Camera/
    - You should have a biological and physical folder for downloading.

Structure for TDS/HP-48 downloading:

1. My computer/Local disk (C)/crew #/stint#/TDS_Download
    - You will have all files in this folder.

Structure for YSI downloading:

1. My computer/Local disk (C)/crew #/stint#/YSI_Download
    - You will have a folder for each site for downloading.

Appendix 7. Common problems with survey link software

General

1. Points that appear out of order in the raw file should not be deleted or moved from the raw file. When coordinates are generated the points are placed in the proper order.
2. When a change is made in the raw file, new coordinate and ASCII files must be generated for the change to appear.
3. To edit within a raw data file line, click on the line and edit in the boxes that appear at the bottom of the screen.
4. Origin numbers should be corrected so they appear in numerical order (Be alert for two origins with the same number and skipped origin numbers), and traverse shots should be examined to be sure that occupy numbers and side shot numbers are correct.
5. To insert lines (used a lot to change rod and instrument heights) in the raw file click on the line above the one that needs editing. Click on edit then insert line(s). An editing box will appear at the bottom of the data file screen. Click on the desired tab and change the value(s). Once the values or items are changed click on the "Store" box and then click "Yes". Failure to click "Store" will result in the information entered being lost. Once finished making corrections click the "Done" box. (See B above for additional pertinent information.)
6. To delete a line, click on the line to be deleted then click "edit" then "delete line" and the line will automatically be deleted.
7. When two files are present for one site (e.g. WAHAM1001.rw5 and WAHAM1001b.rw5) the b file should be edited so that the first origin has the same azimuth, zenith, and etc. as the last origin in the previous file so long as the laser setup had not been moved. If the laser setup had been moved without traversing and a new file made (as in the case of a culvert or log jam obstructing the stream) the survey crew will have to re-shoot the entire site again. Therefore, *do not pick up and move the laser equipment, you must shoot another traverse and create a new origin.*

Labels

Pools

1. Pool head and tail errors can be remedied by finding the closest elevation (z-value) associated with the opposite label. If the pool head is missing, find pool tail elevation and the corresponding point on the opposite side of the pool will be pool head.
2. To find pool max depth, isolate and graph the elevation (z-value) of the longitudinal between pool tail and pool head. The deepest point will be pool max.

Transects

1. Transect ends can be fixed by finding the first or last shot taken on the Transect, or if points are out of order by graphing the northing (x) and easting (y) of the Transect. The first or last point on the Transect will usually be the end. (Note: Occasionally the transects will be reversed and points labeled as right will appear on the left and vise versa, label consistently with other notes and see later sections on how to correctly graph.)
2. Missing banks and wetted edges can be located by plotting the Transect elevation and finding the point on the other side of the Transect that corresponds to the appropriately labeled point.
3. Thalweg can be found by plotting the Transect elevation and using the lowest point on that Transect.
4. If both bankfull points are missing, the are usually the points directly between the ends and wetted edges, however if several points appear between end and wetted edges this process cannot be used.

Multiple Labels

1. Overwritten points will have the same side shot numbers, and may also have the same description/comments. The second point (i.e. higher line number in the raw file) is the point that is used in calculations; therefore the first point should be deleted.
2. If the points are not an overwrite but are two different points then the second and subsequent point labels should be erased as the surveyor most likely forgot to change the descriptor after shooting these points. An exception would be a gravel bar located in a Transect, or some other large object that would span greater than one point.

3. Origins that are labeled the same should be changed once it has been determined that they are not the same point. Determinations can be made by examining the northing, easting, and elevation to assure that the same numbers do not exist for both points.

Longitudinal

Northing vs. Easting errors:
Gaps in a longitudinal may occur for a number of reasons. Although most of the gaps cannot be fixed, it is important to try to identify the problem. Once identified a note should be made in the raw data file and other appropriate places as to the reason for the gap. Common gap causes are:

1. Log jams and debris. The gap may be single and long, or may have points in the middle but at odd intervals. Several origins may occur near each other or in a row in the data file signifying that the crew had to traverse around the object(s).
2. Pools. If the max depth was too deep or the pool too dangerous, points may have been skipped.
3. The stream went subsurface. This usually results in one large gap.
4. Culverts. These are usually long gaps with one or more fairly spaced out traverses. Care should be taken not to confuse a culvert gap with a logjam gap; a map may be useful in determining which is the cause of the gap. It is important to label this correctly.
5. Traverses. There may be several reasons for gaps caused by traverses. The cause will determine if the problem is fixable. Causes include:
    a. Faulty prism relocation. When the traverse was shot the prism person moved further upstream than they should have. This is not a fixable cause.
    b. Error when shooting the traverse. A leaf bounce or other circumstance may have occurred placing the traverse closer than it actually was. This is not fixable, but if known for sure should be noted.
    c. The traverse was shot twice. If two traverses appear (with the same origin number) a gap may occur. See the traverse section to determine how to correct this.
    d. The traverse was entered as a side shot rather than as a traverse. This is fixable and explained in the traverse section.

Elevation plot errors:
Over the course of a longitudinal, elevation will show several small drops and raises but an overall increase in elevation. The purpose of this section is to determine the cause of and correct instances where severe elevation losses or gains occur. However it should be noted that in certain cases the severe elevations could be a result of natural circumstances such as waterfalls or large pools. Other causes include:

1. Rod height (HR) change. To determine if this was the cause, check the raw data file for notes then look for HR changes immediately following the point(s) in question. If a HR change was made, try inserting a line above the erroneous point and changing the HR. Recalculate the files and see if the elevation looks correct. If not, try different common HRs to determine if HR was indeed the cause. If nothing works, return to the original data presentation and go on.
2. Rod height reset. Occasionally for no apparent reason the rod height in the HP will reset itself to 0.00. If no other change was made in this line, try deleting it. If deleting works, leave the line out, if it does not work reinsert it and try something else.
3. Instrument height (HI) change. If the decrease or increase follows a traverse, it is most likely due to an HI change. If subsequent traverses show a different HI value, change the HI of the questioned point to the new value and recalculate the files to determine if that was in fact the problem. Also check the raw data file for a traverse that was entered as a side shot, or a traverse that occurred twice. See the traverse section to determine how to fix this error.

Transects
Northing vs. Easting errors:

These errors become apparent when the xy-plot is made. Many of these errors are not fixable, but some are. In the case of fixable errors corrections should be made. In the case of the non-fixable errors the cause, if determined, should be noted in the raw data file.

1. Leaf and obstacle bounces. The points on the Transect in question seem out of line and are usually closer to the origin. These result from some obstruction between the laser and prism pole and cannot be fixed.
2. Traverse problems. If the problem points occur at or around a traverse this is most likely the cause. The possibility of fixing the error is dependent upon the traverse problem. See the traverse section for more detail.
3. In Excel points are switched from left to right. The left side as it was shot appears on the right side of the graph or vice versa. This is a software problem and is remedied by right clicking on the x-axis (usually the case) clicking the "Format Axis" option, then selecting the "Scale" tab, and checking the "Values in reverse order" box. Then click "OK" and check to see that the points are in correct order. If not, deselect the reverse order box for that axis and try the other axis. This problem mostly occurs where the x-axis needs to be reversed, but may happen where the y-axis needs to be reversed.

Elevation errors:
HI / HR changes. The laser operator forgot to change the instrument or rod height. See longitudinal elevation errors section for description of problems and solutions, as the elevation plot errors will appear the same on transects as they did on the longitudinal.

Traverse / Origin errors
Inserted Traverses:
These errors may occur for different reasons, but if they do not belong they should be edited. To edit, delete the three lines associated with the traverse, and every line after that needs to be changed so that the side shot indicates the correct occupied point (e.g. the 34 in "Sd shot: 34 – 79").

Traverses as Side Shots:
Occasionally the laser operator will shoot a traverse and enter it as a side shot. If this happens, an origin note will appear in the note section of the raw file but the origin will appear as a side shot, and will not have the other lines associated with an origin. To fix this use the following procedure:

1. Click the edit button in the tool bar and insert a line below the erroneous shot.
2. In the box that appears on the bottom of the screen click on the traverse tab.
3. In the "Occupy Point" box type in the number of the previous traverse shot (this will appear as the 27 in Sd Shot: 27-34). In the "Foresight Point" box type in the number of the point that was supposed to be the traverse (this will be the 34 in Sd Shot: 27-34).
4. In the "Angle" box press the down arrow and select "Azimuth". Enter the value given in the azimuth section of the side shot. To enter the degree, minute, seconds values, enter the degree value then a decimal point, then the remaining numbers (e.g. 280.1234 for the given value of 280° 12' 34"). The "Elevation" box should be default set at zenith, if it is not select that option and enter the zenith value given for the side shot.
5. Enter the slope distance in the appropriate box and type in the origin number in the "Note" box. Click on "Store" then "Yes".
6. Click on the "Occupy pt" tab. Enter the point number (34 in Sd Shot: 27-34).
7. To continue filling in the Northing, Easting, Elevation boxes a coordinate file will need to be accessed or generated. This can be done while the editing screen is present in the raw file. To access a previously generated coordinate file click on the open file button and navigate to the file and open it. To generate a new file click on the "Conversions" option in the tool bar then on the "Generate Coordinates" option. Click on the "OK" button and click "OK" again. Scroll down to the desired point and copy down the correct Northing, Easting, and Elevation numbers. Enter these in the appropriate boxes in the raw file and type in "ORIGIN" and the correct number in the note box.
8. Click "store" then "yes" then click on the "Backsight" tab in the editing box of the raw file.

9. Fill in the occupy point box (34 of Sd Shot 27-34) and the backsight point box (27 of Sd Shot 27-34). The backsight azimuth is the traverse azimuth ± 180 degrees. The backsight circle should be at and remain at 0.0000.
10. Click “Store” then “Yes” then “Done”.
11. Delete the side shot that should have been a traverse.
12. The lines that follow the new traverse must all be changed so that they show the new occupy point. To do this click on each line and change the “Occupy pt” to reflect the new origin (sd shot 34-35, sd shot 34-36, etc.). If necessary also change the “Foresight pt” so that points are not overwritten.
13. After all these steps are completed and you are sure the raw file is completely editing, you will need to delete the old coordinate file and create a new coordinate file (.asc), by following Step 7.

<u>Overwritten Traverses:</u>
These are easily identified by two traverses appearing in sequence with the same origin number noted. The problem lies in the fact that the traverse that appears second in the list has the same foresight and occupied point numbers (e.g. “Trav: 32-32” appears). To fix this, change the occupy point to the correct value (present as the first number in previous side shots) and delete the first set of lines associated with the traverse that was supposed to be overwritten.

<u>The Mysterious Reappearing Origin 1:</u>
As this section title implies, it is unknown how or why this happens, but Origin 1 will seemingly randomly reappear later on in the raw file. The points will also be changed so that 1 is recorded as the occupy point. To repair the damage, erase the inserted origin 1 and edit all of the remaining lines in which one appears as the occupied point. The replacement occupy point value should be the value of the previous traverse.

Appendix 8. Crew structure and tasks

Crew Structure & Tasks:

The following is an outline of the crew structure, tasks to be completed and order of events for each crew to follow upon arrival at their designated watershed and the necessary steps for beginning a survey.

Crew Structure
Person 1: Crew Leader
Person 2: Habitat/Biological
Person 3: Habitat/Biological
Person 4: Head Biological
Person 5: Habitat/Biological
(This person will have the site layout and bankfull task, after the first site)

Tasks

Habitat Crew	**Biological Crew**
Laser/Camera/GPS	Site layout/GPS (except first site)
Flow	Macroinvertebrate/periphyton sampling
Bankfull	Water Chemistry
Pebbles/Fines	Electrofishing
Wood	Amphibian search

Appendix 9. Order of events

Day 1 Site 1

Step 1

1. Two habitat personnel will begin by taking bankfull measurements and conducting site layout (Be careful not to disturb the site for the biological survey)
2. Two biological personnel will then follow by conducting macroinvertebrate and periphyton sampling. When they reach the end of the site, they will take water chemistry readings and leave the YSI running at the top of the reach (before leaving, write down the conductivity and temperature readings for electrofishing).
3. At the same time, the third habitat person will be setting up the laser, photographing the site and taking a GPS waypoint.

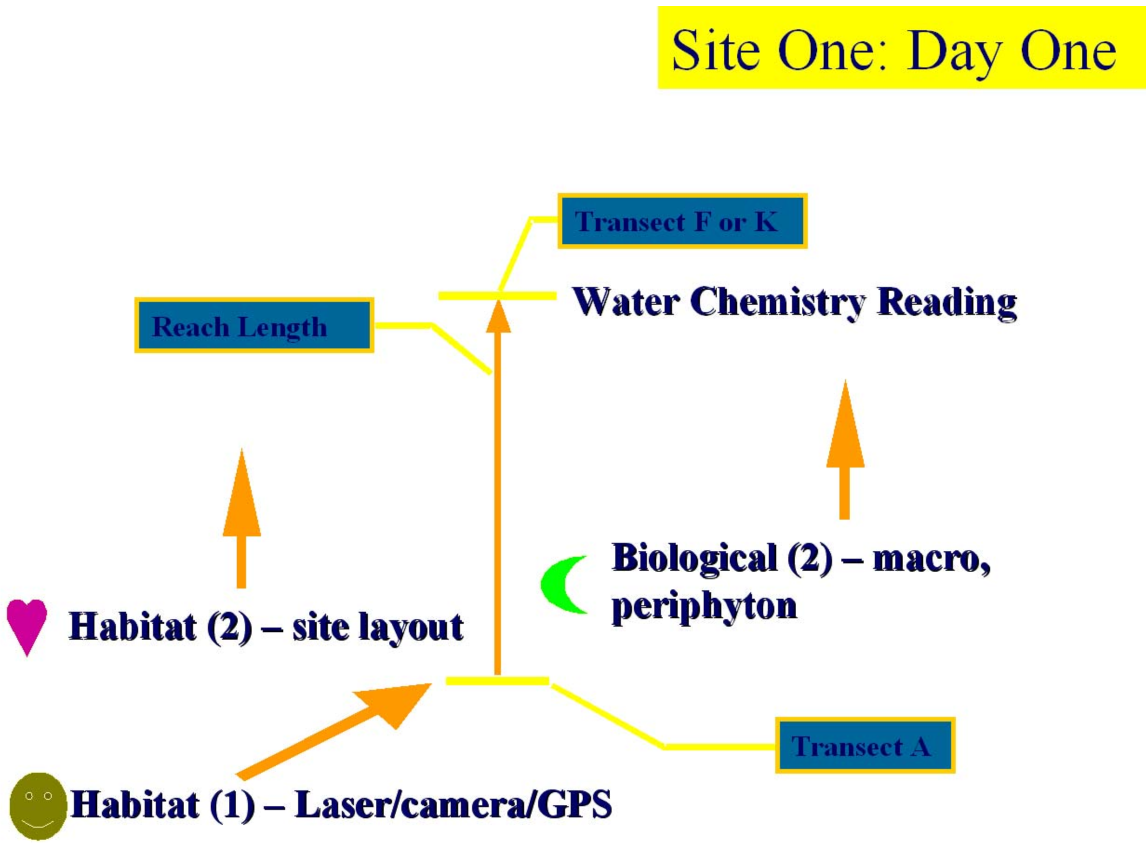

Figure 9. Order of events for the first "pass" through a site. The different symbols represent groupings of crew members.

Step 2.

1. After the habitat crew has completed site layout, they will work back downstream surveying for large wood (again, be careful not to disturb the site).
2. After the biological crew is finished collecting periphyton and macroinvertebrates, they should return to transect A and begin electrofishing.
3. After the habitat person is finished with the laser/camera operation, s/he should take flow measurements.

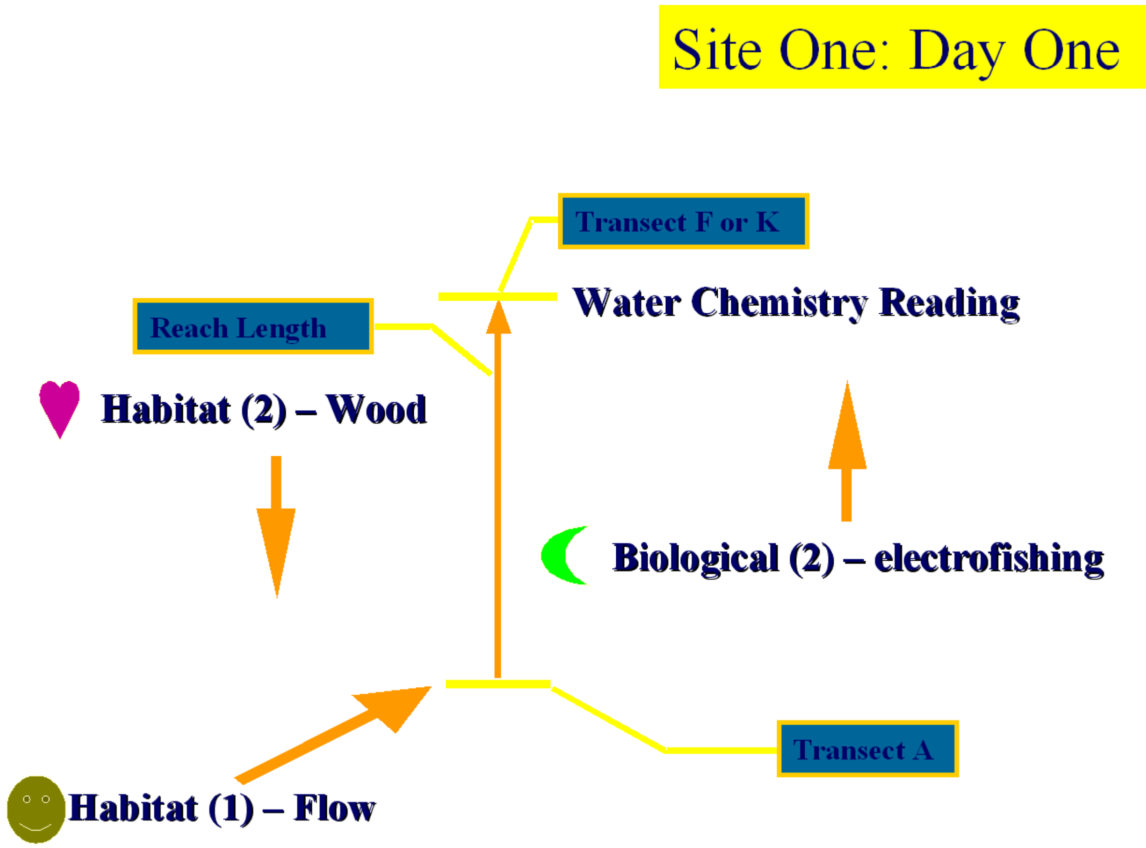

Figure 10. Order of events for the second "pass" through a site. The different symbols represent groupings of crewmembers.

Step 3.

1. When all habitat members are finished, they should immediately begin mapping the stream channel and finish the site.
2. When the biological crew is finished electrofishing, they should work back downstream and conduct amphibian searches, and then move to a new site.

Day 1 Site 2.
Following the diagrams shown above, complete the same steps at the second site and other sites during the field season.

Step 1.

1. The biological crew will first take a GPS waypoint, measure average bankfull and so the site layout. At the top of the site, perform water chemistry measurements.
2. One person conducts macroinvertebrate and periphyton sampling while the second person begins amphibian searches. When the macroinvertebrate and periphyton sampling is complete, that person should assist with amphibian searches.
3. Both people work upstream electrofishing.

Note: Collection of macroinvertebrates and periphyton can occur at the same time as site layout. It is important to note that the biological crew will be doing site layout from this point forward. The best-case

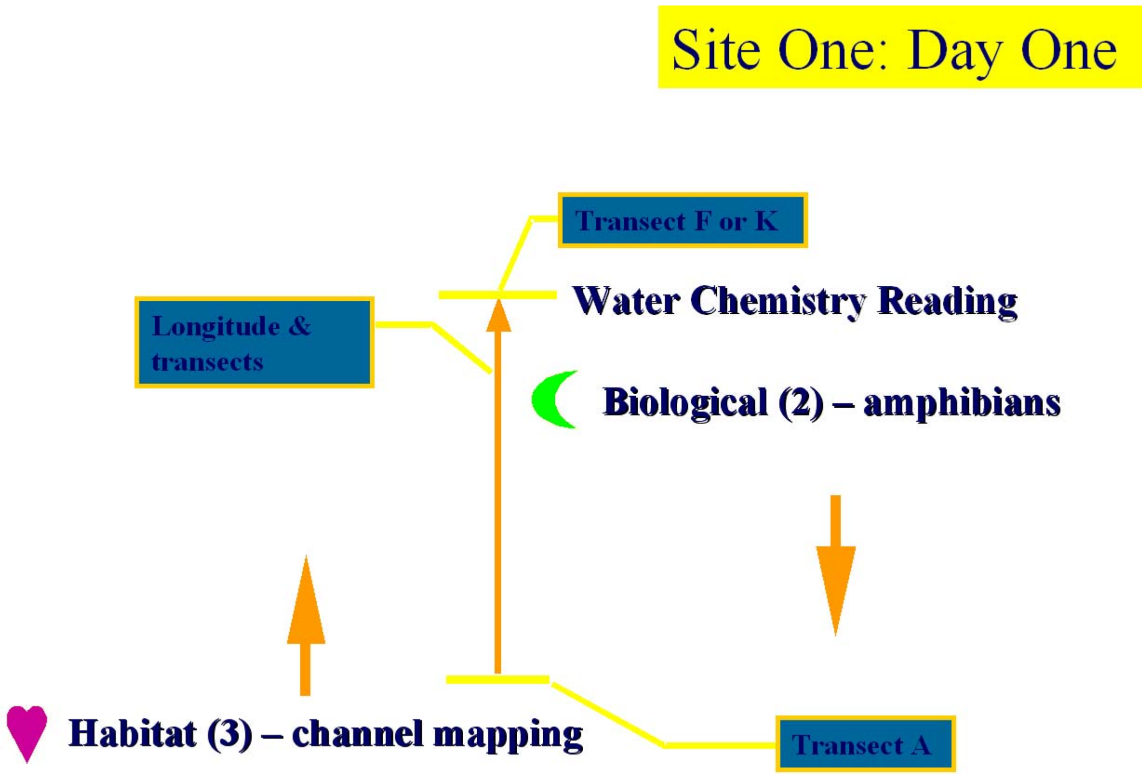

Figure 11. Order of events for the third "pass" through a site. The different symbols represent groupings of crewmembers.

scenario is that the biological crew will get 2 sites completed in a day and the habitat crew will complete 1½ sites per day.

Things to remember:

- The most important day of the sampling week is the first day. It is expected that all crew leaders and members follow the procedure as outlined in the three steps of Step 1 Day 1.
- The biological person who did site #2 layout on day #1 (and subsequent days) should do the site two bankfull and pebble measurements during day #2 (and subsequent days) on the habitat crew.
- However, the same person **does not** have to perform the site layout and bankfull measurement for every site. It is only important that the person who did a site layout the day before is performing the bankfull measurement for that site, during a habitat survey.
- The head biological person can recommend to the crew leader that he/she can be a part of the rotation in the habitat crew, as long as, the species composition is not complex and the rest of the crew is confident in species identification in the particular watershed.
- It is suggested that the crew leader design a rotating system that will afford everyone the opportunity to participate in different sampling tasks. A sampling strategy is discussed in Table 8 & 9, but they may not always be appropriate for each stint. It will be important to plan each day the evening before so that only one site needs to be completed, during the last sampling day.
- Another concern is the time frame allowed during the sampling period. There will be occasions when the biological crew can do 2 sites/day and the habitat crew can finish a 1-½ sites/day (best-case scenario). But, in certain watersheds both crews may only get one site finished during a sampling day (worst-case scenario). It is the crew leader's responsibility to plan accordingly, so that by the last sampling day everyone is completing the last site of the week.

- Finally, if a crew is finished early and the other crew does not need any help to complete a site or catch up on the sampling rotation that crew is finished early for the day. However, in most cases it will be important for the early crew to help finish sampling, e.g., flow, data recorder, etc.

Table 8. Suggested sampling strategy for crew leaders to follow when appropriate. This scenario assumes that the head biological person is part of the habitat rotation.

Day	Site	#1 Crew Leader	#2 Habitat	#3 Habitat	#4 Head Biological	#5 Biological	Type of Survey
1	1	1	2	3	4	5	All Survey
1	2				4	5	Bio
2	2	1	2			5	Habitat
2	3			3	4		Bio
2	4			3	4		Bio
3	3	1	2	3			Habitat
3	4	1	2	3			Habitat
3	5				4	5	Bio
4	5	1	2		4		Habitat
4	6			3		5	Bio
5	7		2		4		Bio
5	6	1		3		5	Habitat
5	7		2	3	4		Habitat
6	8	1	2	3	4	5	All Survey

Table 9. Suggested sampling strategy for crew leaders to follow when appropriate. This scenario assumes that the head biological person is not part of the habitat rotation.

Day	Site	#1 Crew Leader	#2 Habitat	#3 Habitat	#4 Head Biological	#5 Biological	Type of Survey
1	1	1	2	3	4	5	All Survey
1	2				4	5	Bio
2	2	1	2			5	Habitat
2	3			3	4		Bio
2	4			3	4		Bio
3	3	1		3		5	Habitat
3	4	1		3		5	Habitat
3	5		2		4		Bio
4	5	1	2	3			Habitat
4	6				4	5	Bio
5	6	1		3		5	Habitat
5	7	1	2	3			Habitat
5	7		2		4		Bio
6	8	1	2	3	4	5	All Survey

Appendix 10. Frequently asked questions about photographs

Q) How do we link GPS points with photos?
A) The GPS unit automatically collects what is called a 'track log'. A track log is basically an electronic breadcrumb trail of your travels. The unit records a position based on predefined criteria such as minimum distance between points or *time elapsed*- we will use the latter. The GPS/Photo Link software looks at the time a photo was taken (it's automatically embedded into the photo) and the time of the points collected in the track log and links the two. It's important to have the time set correctly on the digital camera so that it reflects the time on the GPS unit.

Q) If I'm taking a photo of a waterfall or a logjam, should I hold onto the GPS unit or put it near the feature?
A) Put it near the feature and then step back to take the picture.

Q) There are A LOT of logjams. Do I need to take a photo of each one?
A) No, just a "representative sample" of what is out there.

Q) Should I use the zoom on the camera?
A) Normally you will want to take pictures at the "wide angle," setting (with whiteboard in the lower right or left corner of the picture). Stand about?? feet from the white board to take the picture. Since you are taking digital pictures, it's easy to later crop the pictures if necessary. Use the zoom (or macro) for "critter pictures."

Q) I took a photo and I really need to explain something about it. What goes on that comment sheet?
A) On the comment sheet, enter the date, the time the photo was taken, who took the photo, time, and whatever you would like to describe it.

Q) How and when should I charge the camera batteries?
A) Charge the batteries while driving (use the AC converter that plugs into the lighter) so that you always take fully charged batteries with you to a sampling site.

Q) The track log is full so what should I do?
A) You need to get to your laptop and use the GPS/Photo Link software to download the track log. DO NOT SAVE THE TRACK LOG ON THE GPS UNIT. If you do, it will erase the time attribute. If you can't get to your laptop to download the software, take a waypoint at each photo location and name it so that it indicates the site number and photo number on the comment sheet. Example: P0316- this would indicate photo 16 at site 3.

Q) Should I use the viewfinder or LCD display to frame the picture?
A) Use the viewfinder for landscape shots and the LCD screen for close ups.