Water Quality Planning Bureau

Field Procedures Manual
For
Water Quality Assessment Monitoring

Middle Thompson River
(Photo courtesy of Big Sky Fishing.Com)

Table of Contents

I. Goals and Objectives 5

II. Summary of Water Quality Assessment Monitoring Event 6

III. Field Supply List 7

IV. Determination of Reach Breaks and Sampling Sites 10

V. Recording Site Location 13

A. Initiate Site Visit Form 13

B. Using Magellan SportTrak MAP GPS unit 13

C. Document Latitude and Longitude 13

VI. Field Instrument Measurements 14

A. Field Instrument Maintenance, Calibration & Measurements 14

VII. Grab Sampling for Chemistry 15

A. Water Samples 15

B. Metal Sediment Samples 16

C. Recording the chemistry sampling event 16

VIII. Biological Sampling 18

A. Macroinvertebrates 18

Traveling Kick Method 18
Jab Method 19
Recording macroinvertebrate sampling event 20

B. Periphyton 21

Collecting a composite sample 21
Recording the periphyton sampling event 21

C. Chlorophyll a 21

Rock sampling method 22
Hoop Method 22
Core Method 23
Phytoplankton Method (chlorophyll a in water) 23
Recording the chlorophyll a sampling event 24

IX. Quality Control 26

A. Field Blanks 26

Preparation, Transport and Submittal 26

Quality Control Criteria 26

B. Field Replicate samples 26
Sample collection and submittal 26
Quality Control Criteria 27

C. Recording Quality Control Samples 27

X. Physical Characteristics and Habitat Assessments 28

XI. Site Scale Habitat Assessment 28

A. Site Habitat Information 28
Directions to Site, Landowner Information and Site Access Information 29
Site Characteristics 29
Human Influence 29
Fish Cover/Other 30
Site map 30
Recording a Site Scale Assessment 30

XII. Physical Characteristics 30

A. Total Discharge (flow) 30
Flow Meter Method (quantitative) 30
Float Method (semi-quantitative) 31
Estimated Flow 31
Recording flow (discharge) measurements 32

B. Channel Cross Sections (Laser level and Non-laser level) 33
Laser Level Cross-Section Method l 33
Non-Laser Cross-Section Method 33

C. Substrate Measurements 35
Wolman Pebble Count 35
Recording a Wolman Pebble Count 35

D. Optional Physical Characteristics 35

XIII. Reach Scale Habitat Assessment 37

A. Reach Information 37

B. NCRS Riparian Assessment Form 37

C. Photo locations 37

D. Optional Summary Form and discussion of reference condition 37

E. Recording a reach scale assessment 38

List of Attachments:

Attachment A – Checklist: Record Keeping for Water Quality Assessment Field Work
Attachment B – Entrenchment Ratio Using the Laser Method
Attachment C – Diagram of core plunger
Attachment D – Diagram of 10 meter transect for site information
Attachment E – Chain-of-Custody Instructions
Attachment F – STORET Definition Fields
Attachment G – Torrent Evidence Instructions

I. Goals and Objectives

The goal of water quality assessment monitoring is to collect sufficient information for each Assessment Database (ADB) defined segment to complete a Beneficial Use Support Determination (BUD). DEQ is using the summer/early fall seasons as the index period for data collection activities. An effort should be made to coordinate with Conservation Districts and landowners to gain private property access permission and to collect any additional data (including anecdotal information) that reflects historical and present water quality. The field data collected by DEQ will be considered along with all other readily available data obtained from federal, state and local agencies, other interested water quality organizations, and individuals to determine the current beneficial use support of the segment being studied.

The objective of this field procedures manual is to provide field personnel with reproducible methods for the collection of field samples and consistent documentation procedures to facilitate management of the information collected. The sampling methods included herein are designed for the *preliminary investigation* of waterbody segments to determine beneficial use support. Focused investigations designed to verify previously listed (303-d) causes of impairment, source assessments, collect data for use in models, loads, allocations, and TMDL effectiveness monitoring may require an altogether different sampling design than is presented herein.

This manual is incorporated by reference into the DEQ Quality Assurance Project Plan (QAPP) for Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005 (WQPBQAP-002).

II. Summary of Water Quality Assessment Monitoring Event

- ❑ "Ground Truth" preliminary stream reaches identified during pre-season planning.
- ❑ Determine representative sampling sites within each reach.
- ❑ Sample selected sites from downstream to upstream (to avoid contaminating later samples).
- ❑ Initiate all required Field Forms for each sampling event.
    - o Identify sampling site with GPS and record Lat./Long on Site Visit Form (Datum NAD83).

Sampling Sequence:

- ❑ Field Measurements and Chemical Sampling:
    - o **Calibrate Field Meter!**
    - o Measure pH, conductivity, temperature, and dissolved oxygen (DO). Record meter number and result values on site visit form.
    - o Collect grab samples for water chemistry (Commons, Nutrients, Metals, dissolved aluminum, TSS and/or TDS), Indicate sample identifiers and method of collection on site visit form
    - o Collect metal sediment samples and indicate sample identifiers and method of collection on site visit form (if mining sources are in the area).
- ❑ Biological Sampling:
    - o Identify representative riffle or pool. Collect macroinvertebrate sample using appropriate method.
    - o Perform Macroinvertebrate habitat assessment.
    - o Collect a periphyton sample from an undisturbed area of sampling site.
    - o Determine Chlorophyll *a* collection procedure, (i.e. rock, hoop, phytoplankton and/or core method) collect sample, and indicate sample identifiers and method of collection on site visit form.
- ❑ Physical/Habitat Measurements:
    - o Conduct site scale habitat assessment at sampling site
    - o Measure discharge (Marsh-McBirney meter) or estimate flow. Record results and method on Site Visit Form.
    - o Characterize streambed material (Wolman Pebble Count)
    - o Measure channel cross-section and record.
    - o Determine Rosgen stream classification **(Optional)**
    - o Complete Reach assessment. Since this a reach scale measurement, it may have to be completed after the last site in the reach has been completed so the entire reach will have been observed.

- ❑ Verify that all pertinent field forms are completed before leaving the site.
- ❑ Return to vehicle, record chemistry samples on chain-of-custody and site visit form. Place samples, including chlorophyll a, in cooler **on ice**. Be sure that bottles are tight closed, and that ziploc bags are sealed.
- ❑ Record biological samples on site visit form. Place samples in a cooler **without** ice.

III. Field Supply List

This checklist includes field supplies and numbers needed *per site sampled***.**

1) Physical Attributes

- ❑ 1 - Magellan SportTrak MAP GPS unit
- ❑ Maps (topographic, Forest Service, BLM)
- ❑ Digital camera with additional memory card(s)
- ❑ Horiba U-10 or YSI 556 meter (with calibration solutions, calibration log, and users manual)
- ❑ 1 - small squirt bottle of DI water to clean probes
- ❑ Marsh-McBirney flow meter
- ❑ 1 - top-setting wading rod for use with flow meter
- ❑ 2 - tapes (1, 100 ft., 1 300 ft.) for determining cross-sections
- ❑ 2 - chaining pins or bank stakes
- ❑ Rebar **(optional**)
- ❑ Roll of twine (**optional**)
- ❑ Hammer (**optional**)
- ❑ Leveling rod
- ❑ Laser level and tripod
- ❑ Rangefinder

2) Water Column Samples

- ❑ 1 - 250 ml (State lab) or 500 ml (Energy lab) plastic bottle for nutrients
- ❑ 1 vial of sulfuric acid for preserving nutrients
- ❑ 2 - 500 ml bottles, one for common ions/suspended solids (TSS) and one for metals
- ❑ 1 vial of nitric acid for preserving metals
- ❑ 1 - 50 ml centrifuge tube (green cap) for dissolved aluminum
- ❑ 1-60 cc syringe-to collect water sample for dissolved aluminum
- ❑ Disposable 0.45 uM filters for filtering water sample – dissolved aluminum
- ❑ 2 drops of nitric acid to preserve dissolved aluminum sample after filtration
- ❑ If **total dissolved solids (TDS)** will be collected, an extra bottle of 500 ml is required.

3) Metals Sediment Sample

- ❑ 1 - 2L wide mouth Nalgene bottle
- ❑ 1 - two-piece plastic Buchner funnel
- ❑ 2 - 12”x12” squares of 63 micron nylon mesh
- ❑ 1 - Plastic spoon to scoop stream bed sediment into funnel
- ❑ 1 - 1000 ml wash bottle with dilute nitric acid for washing equipment between sites
- ❑ 1 - 1000 ml bottle of dilute nitric acid

4) Chlorophyll *a* Sample(s)

a) Rock Method

- ❑ 2L wide-mouth jar (fixed station program)
- ❑ Large Ziploc bags
- ❑ Aluminum foil

b) Hoop Method

- ❑ Metal hoop (30 cm diameter, 710 cm^2)
- ❑ Scissors
- ❑ Large Ziploc bags
- ❑ Aluminum foil

c) Core Method

- ❑ Cut-off 60 ml syringes (5.7cm^2)
- ❑ 50 ml centrifuge tubes
- ❑ Aluminum foil
- ❑ Small Ziploc bags

d) Phytoplankton Method

- ❑ 50 ml centrifuge tubes
- ❑ 5 ml graduated cylinder cylinder
- ❑ 1 - hand pump vacuum with tubing
- ❑ Nalgene filtering unit
- ❑ GFF filters
- ❑ Tweezers
- ❑ Graduated cylinder (250-500 ml)

5) Periphyton

- ❑ 50 ml centrifuge tubes
- ❑ 1 - sharp knife or stiff toothbrush
- ❑ 1 – bulb pipette
- ❑ 2 ml of 10% formalin solution
- ❑ 1 - turkey baster
- ❑ Parafilm

6) Macroinvertebrates

- ❑ 1 - 1000 ml wide mouth jar
- ❑ 1 - D-frame kick net, mesh size 1200 uM
- ❑ 1 - Sieve (500 uM)
- ❑ Extra-D net
- ❑ 1 - sorting pan
- ❑ 80% ethanol solution
- ❑ Tweezers
- ❑ Parafilm
- ❑ Surber sampler or Hess sampler (if necessary)

7) Field Forms and Labels

- ❑ Copy of field forms on “Rite-in-the-Rain” paper **(See Attachment A)**
- ❑ Pre-made site visit labels to affix to forms
- ❑ Activity labels
- ❑ Laboratory Chain-of-Custody form
- ❑ Bottle labels and clear tape for covering labels

8) Other

- ❑ Field Procedures Manual
- ❑ Clipboard
- ❑ Compass
- ❑ Coolers
- ❑ Hip boots or waders (including repair kit)
- ❑ Fantastic spray
- ❑ Rain gear including tarp
- ❑ First Aid kit
- ❑ Extra batteries (laser level, flow meter, YSI or Horiba, camera, rangefinder and GPS unit)
- ❑ Latex gloves
- ❑ Bear spray, mosquito repellent, and sunscreen
- ❑ Tool set
- ❑ Trash bags
- ❑ Paper towels
- ❑ Duct tape
- ❑ Rulers
- ❑ Pencils
- ❑ Sharpies

IV. Determination of Reach Breaks and Sampling Sites

The selection of representative sampling sites is critical to an objective assessment of the segment and must consider how to overcome potential sampling design limitations from private property and inaccessible sites.

Spatial Hierarchy - DEQ uses a spatial hierarchy of segment, reach, and monitoring site to describe waterbodies at incrementally smaller scales.

a) Segment is the waterbody as defined in the assessment database (ADB). The segment is identified by a unique Segment ID (Example: MT41I006_200) and Segment Name [(Description: McClellan Creek from headwaters to the mouth (Prickly Pear Creek)]. This is the smallest unit for which an impairment determination is made.

b) Reach is a subdivision of a segment that represents a homogeneous portion of the segment based on geomorphology, or land use. Very short *segments* (<5.5 miles) may be homogenous throughout their entire length and could be considered to have only a *single reach*.

c) Monitoring Sites are locations selected within the reach for making shorter spatial scale measurements that will be compared to the same measurements taken at other monitoring sites within the reach (upstream – downstream) or to the same measurement in other reaches of the segment. Note: significant adits and tributaries may warrant that either another reach is considered or another sampling site. Consider time, resource and site access constraints before adding additional reach breaks.

Spatial and Temporal limits of Methods – The sampling methods presented herein are designed to provide multiple measures, on different scales, of a waterbody's beneficial use support.

Reach scale measurements

- The reach scale habitat assessment method that was adopted for the 2005 field season includes the NRCS Riparian Assessment form and selected forms from EMAP Western Pilot protocols. These forms are applied on a reach scale to document *long-term ecological* conditions for a reach (see "reach" definition above).

- The NRCS form includes provisions for assessment of waterbody "potential" to assess its condition. It is best to use either an internal or external reference site approach in addition to the scoring of "potential" to avoid an underestimate or overestimate of the condition.

Site scale measurements

- Site-scale habitat measurements – Site scale habitat assessment measures have been adopted from EMAP along with select supplemental questions of the NRCS Riparian Assessment. These observations only apply to the sampling site (standing in mid-channel at cross section transect, 5 m upstream and downstream)

- Geomorphology measurements such as DEQ channel cross section, Wolman pebble counts, Rosgen Stream Classification System (**optional**), and Percent fines **(optional**) measure *longer-*

term physical conditions at a site. Geomorphology measurements document variation within the reach, within the segment, and in comparison to regional reference sites.

- Measurement of biological assemblages (macroinvertebrates, periphyton, Chlorophyll *a*) indicates *recent* impact to aquatic life and fisheries beneficial uses.

- Macroinvertebrates and periphyton are a direct measure of aquatic life use support. They are important components of the aquatic ecosystem and are also used as an indirect measure of fisheries support.

- Chlorophyll *a* is a direct measure of primary contact recreation use support (nuisance algae discourages recreation), and an indicator of excess nutrients than may impact aquatic life use support and fisheries.

- Field and Laboratory Chemical measurements are single point in time measurements. Water samples have the shortest temporal and spatial coverage of all measurement taken by DEQ. They only relate to the sampling point (water column) at the instant the sample is taken. Metal sediment samples (grab) are used to determine the potential metals toxicity.

Site Selection

The **MINIMUM** number of sites based on the Waterbody segment length (as defined in ADB) should follow the criteria:

- **0-5 miles** - minimum of 1 reach with a minimum of 1 sample unless there is a change in ecoregion, land use, or a significant tributary or adit.
- **>5 mi. to 20 mi**. - minimum of 1 reach with 2 samples unless there are more frequent changes in ecoregion, land use, or a significant tributary or adit.
- **>20 mi. to 40 mi**. - minimum of 2 reaches with 3 samples unless there are more frequent changes in ecoregion, land use, or a significant tributary or adit.
- **>40 mi. to 60 mi**. - minimum of 3 reaches with 4 samples unless there are more frequent changes in ecoregion, land use, or a significant tributary or adit.
- **>60 mi. to 80 mi.** - minimum of 4 reaches with 5 samples unless there are more frequent changes in ecoregion, land use, or a significant tributary or adit.
- **>80 mi.** to 100 i. – Minimum of 5 reaches with 6 sampling sites unless there are more frequent changes in ecoregion, land use or a significant tributary or adit.
- **100+ miles** – Maximum reach length is 20 miles. Two samples per reach with samples at reach break points serving as a mid-point.

The waterbody segment is divided into reaches, and two or more sites represent the reach. Following are suggested guidelines on how to verify reaches and select sampling sites within criteria listed above.

Ground "truthing" a Reach – In pre-season planning, maps of the segment are used to determine preliminary reach breaks. The maps used should include a combination of Digital Ortho Quads available from the Montana State Library (NRIS) website. Topographic maps, and land use maps are vital for determining reach breaks. If available, aerial photography and LandSAT images provide a birds eye view of the segment.

At the site, reach breaks should be confirmed (if accessible) by visual observation of the transitioning of the waterbody through landforms, land uses, and through the influence of major

tributaries. Professional judgment will dictate if additional reaches must be broken out to adequately characterize the stream or if another sampling site is adequate to capture the particular change (within the reach).

Determining number and location of sampling sites – Site access may constrain the number and location of sampling sites along the reach. Because of this, general guidance is given on where sites could be located rather than strict criteria. Best Professional Judgment (BPJ) must be used to determine representative sites for sampling.

- Two (2) sites per reach – Unless a reach is extremely short (<5mi.), a reach should be monitored near the top and bottom to adequately represent the reach.
- Sample sites in the headwaters must consider the point where the majority of the small streams comprising the main channel converge and are well mixed.
- A two (2)-reach segment should have a minimum of 3 representative sampling sites with the middle site located near the reach-break point. Segments with three (3) or more reaches should have a sample from the headwaters area, at each reach break point and near the mouth.
- Monitoring sites near the mouth should be far enough from the mouth so as not to be influenced by the receiving body of water.

Monitoring point – Representative site

Similar to the ground truth of reach breaks, determining a representative sampling site requires professional judgment to determine what "representative" is for the reach. Generally, there are two major stream gradients that assessment methods are designed to characterize, high gradient and low gradient. High gradient streams are primarily riffles/runs and low gradient streams are primarily glides/pools.

- High gradient – The biological sampling methods for high gradient wadeable streams were developed for riffles. In a high gradient reach, a riffle should (generally) be selected as the representative sampling site.

- Low gradient – When the reach is primarily low gradient glides and pools may be the representative site. The glide/pool alternate sampling methods may have to be used to obtain a representative sample.

Safety – *Be aware of the environment that you are working in! Fast moving water and unstable banks present a hazard that could result in serious injury or death. Wildlife such as grizzly bears, rattlesnakes, mountain lions, muskrats, ants, and bees could be encountered in the field. Prepare for potential encounters with wildlife by including bear spray, snakebite kits, and bee sting kit (if you are sensitive to bees). All vehicles must have a First Aid Emergency Kit and a spare key.*

V. Recording Site Location

This is the first step taken upon arrival at the sampling site. All site locations must be documented using a GPS unit. In the event this is not possible, please note the reason on the Site Visit Form.

A. **Initiate Site Visit Form**

- ❑ Place the **Site Visit sticker** on the corresponding place on the Site Visit Form
- ❑ Record the **date** and **personnel** who sampled the site.
- ❑ Affix the label with HUC and Waterbody information to the upper right hand corner of the **Site Visit Form.** (If you do not have the appropriate label available, please fill out the following fields by hand: Trip ID, Project ID, HUC, and Waterbody Name.) **Always** fill out the Location, Visit # and County.

Note: If sites are unknown, and you do not have a unique STORET Station ID available, leave this field blank. Data Management Section will assign a STORET Station ID when the completed site visit form is received.

B. **Using Magellan SportTrak MAP GPS unit**

- ❑ Set map datum to NAD83:
  - o From any screen, press menu button => highlight "Setup" => enter => highlight "Map Datum" => enter => select "Primary" => enter=> select "NAD 83" => enter

- ❑ Setting the coordinate system to decimal degrees:
  - o From any screen, press menu button => highlight "Setup" => enter=> highlight "Coord System" => enter => select "Primary" => enter => select "Lat/Lon" => enter => "DEG.DDDDD" => enter

C. **Document Latitude and Longitude**

- ❑ Record the **latitude** and **longitude** on the Site Visit Form and note which GPS datum was used to take the reading (NAD 27, NAD83, or WGS84). **NAD83 is preferred.**

- ❑ If the Lat/Long was obtained by a method other than GPS, such as map interpolation, note this method in the space provided. Also note in the "Comments" field on the Site Visit Form the reason a GPS reading was unavailable. GPS Datum and method always apply to the measured or interpolated lat/long rather than the verification process.

VI. Field Instrument Measurements

The field instrument measurements include air and water temperature, pH, specific conductivity, dissolved oxygen, and turbidity. DEQ uses Horiba U-10 or YSI 556 field meters to measure temperature, specific conductivity, and dissolved oxygen. Turbidity may be taken on the Horiba U-10 field meter but is easily influenced by stray light. Alternatively, turbidity can be measured on a Hach Field Turbidimeter (SOP not included here) or estimated visually.

A. Field Instrument Maintenance, Calibration & Measurements

Field instruments must undergo annual inspection and maintenance prior to the field season according to the manufacturers specifications. This must occur within a time that allows for any needed parts to be ordered and installed before general use (plan ahead!).

Procedures for annual maintenance and daily calibrations are presented in each instrument's operations manual. Operations manuals must be remain with the instruments at all times for quick reference. Calibrations logs for recording annual and daily calibrations must remain with the instruments for recording calibrations and maintenance. Training for use of field instruments will be given prior to the beginning of the field season.

VII. Grab Sampling for Chemistry

DEQ uses two different grab sampling techniques for water and sediment samples. Water samples are generally taken at every site; whereas sediment samples are optional samples based on the potential for high metals concentrations from mining or other significant earth disturbance activities in the watershed.

A. Water Samples

Water samples are collected for common ions and TSS and/or TDS, nutrients, metals and dissolved aluminum. 3 bottles are provided (one for common ions, one for metals and one for nutrients). A 60 cm^3 syringe is used to sample for dissolved aluminum. IF **TDS** will be collected, an extra 500 ml bottle is required.

- ❑ Clean sample bottles and syringe are rinsed three times with the ambient water being sampled. After rinsing, fill the bottles with fresh water collected upstream from *any previous disturbances* to avoid contaminating the sample. The same applies for the syringe sample. Place the syringe in the water; fill it with 50 ml of fresh water.

- ❑ **Do not** allow your hands to come into contact with the sampling bottle opening or the syringe tip. Handling coins in your pocket could contaminate your hands and subsequently the sample if care is not taken to avoid touching the bottle opening.

- ❑ For the bottle samples, add the appropriate preservative to each sample type, affix the lid securely and mix the sample well by inverting 3-5 times.
  - o Nitric acid (HNO_3) for metals
  - o Sulfuric acid ($H2SO_4$) for nutrients
  - o **NO** preservative for TSS, TDS and common ions.

- ❑ For the dissolved aluminum sample, place a disposable filter on the syringe tip, and filter the 50 ml into a 50 ml centrifuge tube (**green cap**). If the water is very rich in sediment, it may be necessary to use another filter to collect 50 ml.
  - o Add 2-3 drops of Nitric acid (HNO_3) to the sample.
  - o Mix well by inverting the tube 3-5 times gently.

- ❑ Sample bottles and centrifuge tube should be identified with the following information
  - o Activity ID
  - o Collection Date
  - o Waterbody Name
  - o Collector's Name
  - o Sample Type

- ❑ Keep samples in a cooler with ice. Be sure lids are tight and that no leaking will occur. For the dissolved aluminum sample, cover the lid with **parafilm**.

B. **Metal Sediment Samples**

Sediment samples are collected to measure the potential for heavy metals to become suspended in the waterbody during high flows.

- ❑ Identify at least 5 wadeable deposition zones at the site being assessed that will best represent the stream reach. It is important to identify as many zones as necessary to accomplish this. These zones must be made up of VERY fine bed sediment.
- ❑ Place the Teflon 60-micron sieve between the two pieces of the Buchner funnel.
- ❑ Scoop sediment from the streambed with a non-metallic spoon or turkey baster and place it on the sieve in the funnel.
- ❑ Scoop enough sediment so the mesh filter is completely covered.
- ❑ Add ambient stream water over the sediment.
- ❑ Once enough water is added, stir the water and sediment with a non-metallic spoon, being very gentle not to damage the filter mesh.
- ❑ Fill the jar no more than 1/5 full. Use a minimum amount of water.
- ❑ Once the first zone is completed pour the excess sediment out of the sieve and move to the next zone, using the same sample bottle at each zone.
- ❑ Be sure to rinse the equipment with stream water at each site and then repeat steps 2 through 8.
- ❑ An alternative collection process includes collecting sediment from all representative stream zones and depositing it into a 1L wide mouth bottle. The sediment is mixed all together with a nonmetallic spoon and then wet sieved through the mesh filter all at once. Both methods are acceptable.
- ❑ Sample bottles should be identified with the following information
    - o Activity ID
    - o Collection Date
    - o Waterbody Name
    - o Collector's Name
    - o Sample Type.
- ❑ Store sample bottle in a cooler with ice.

C. **Recording the chemistry sampling event**

For water samples:

- ❑ On the Site Visit Form, check the box **"Water"** when water chemistry samples are collected. Checking the box **"Nut."** indicates a nutrient sample**, "Met."** a metals sample, **"Com.**" a commons sample, and **"Dis. Al"** a dissolved aluminum sample.
- ❑ Record a unique Sample ID (Activity ID w/medium code) on the Site Visit Form for all samples taken.

- ❑ Circle "**GRAB**" on the Site Visit Form under Sample Collection Procedure.
- ❑ Ensure that the sample date corresponds to the date in the upper left corner of the site visit form
- ❑ Complete Chain-of-Custody Form (**See Attachment E**).

For Metal sediment samples:

- ❑ On the Site Visit Form, check the box next to **"Sediment".**
- ❑ Note the Sample ID (Activity ID w/medium code) on the Site Visit Form for all samples taken.
- ❑ Circle "**SED-1**" on the Site Visit Form under Sample Collection Procedure.
- ❑ Complete Chain of Custody Form (**See Attachment E**)

VIII. Biological Sampling

Biological sampling includes collection of macroinvertebrates, periphyton, and chlorophyll *a*. These samples are used to determine the beneficial use support status of aquatic life, fisheries and primary contact recreation.

A. Macroinvertebrates

There are two primary methods (traveling kick and jab techniques) for collection of macroinvertebrate samples and a third, optional method (Hess Sampler). The Hess method is not included in this manual but can be found in the full text of DEQ SOP WQPBWQM-009.

Traveling Kick Method

This procedure is appropriate for sampling macroinvertebrates in riffle environments with gravel and cobble substrate.

- ❑ Equipment required shown on page 6.

- ❑ Position the D-frame net in the stream so that the "flat" side of the hoop is snug against the substrate, with the opening facing upstream. The net handle should be approximately perpendicular to the water's surface.

- ❑ Use one or both feet to loosen and churn the substrate upstream in front of the net opening. The churning and digging motions should be vigorous enough to disturb the several top inches of substrate and loosen any tightly clinging organisms. The path traveled should either run diagonally across the riffle (if the stream is small enough) or include three short runs in different depths and flows within the riffle.
    - o For a semi-quantitative sampling, the estimated area of substrate disruption and the total time of sampling must be recorded (by a member of the crew observing the sampler). The total area and time should be sufficient to collect a macroinvertebrate sample containing 300+ organisms.
    - o For qualitative sampling, the time and area of disturbance are not as important. The sample collection should be disturbed thoroughly so as many taxa as possible are collected.

- ❑ A fine sieve (500 um) may be used to clean the extra sediment, and/or to take out large sticks and coarse gravel from the sample. Rinse and clean the net thoroughly after each sample has been collected to prevent contamination of the next sample. The large rocks and sticks may be discarded after they have been thoroughly cleaned and examined.

- ❑ Transfer the sample to a 1 L bottle in small portions to minimize loss - until it is **HALF FULL**. Fill remaining space in bottle with ethanol until full (400-500 ml). **Extra bottles** may be required to collect the entire sample.

- ❑ The sample must be identified with an internal and external label with the following information:
    - o Outside label (stuck to the outside of the bottle).
        - ▪ Activity ID
        - ▪ Collection Date

        - Waterbody Name
        - Collector's Name
        - Sample Type
    - Internal label written in **pencil** and placed inside the sample bottle.
        - Activity ID
        - Collection Date
        - Waterbody Name

- ❑ After placing the inside label in the bottle, secure the bottle cap and cover it with **parafilm** to avoid leakage.

- ❑ Place the outside label and cover it with clear tape.

- ❑ Place samples in a cooler w/o ice. Be sure bottles **will not fall over**.

Jab Method

When riffles are rare or non-existent, as in low-gradient streams, the D-Frame net jab sampling method is used to collect multiple "jabs" throughout the sampling site. A single jab is meant to sample approximately 1 meter of length with the net; there should be 20 jabs per sample.

- ❑ Equipment required is the same as traveling kick (shown on page 7).

- ❑ Select the reach to be sampled: Select a reach of at least 1 meander length, or 20 bankfull channel widths. Examine and record the approximate proportion of productive macroinvertebrate habitat. Productive habitat types are: riffles, snags, aquatic vegetation, and bank margins.
  Determine how many jabs are required to accurately represent all habitat types. For example, if 50% of the available habitat is snags, 20% aquatic vegetation, and 30% riffle, select the number of jabs out of twenty proportional for each habitat type (i.e., snags: 10 jabs, aquatic vegetation: 4 jabs, riffle: 6 jabs).

- ❑ Collect the 20 jab sample: Sampling should be conducted moving in an upstream direction through the reach, proportionally allocating jabs among habitat types as determined above.
    - In runs or riffles that are primarily bedrock or boulder substrate, jab for a length of 1 meter in between boulders or where the bedrock contains some cobble. Jab net along substrate in an upstream direction, attempting to dislodge and catch invertebrates without retaining excessive debris.
    - If snags are present, sample roughly an equivalent of a meter sweep. Sweep through and around the snag in such a way as to dislodge and capture inhabitants. Inhabitants should be scrubbed off by hand into the net on coarser snags. In case of aquatic vegetation, sweep the net through the vegetation for about 1 meter trying to loosen inhabitants.

- ❑ Transfer the sample to the 1 L bottle in small portions to minimize loss until it is **HALF FULL**. Add ethanol (ETOH) **TO THE TOP (400-500 ml).** A fine sieve may be used to

clean the extra sediment, and/or to take out coarse gravel from the sample**. Extra bottles** may be required to collect the entire sample.

- The sample must be identified with an internal and external label with the following information:
  - Outside label (stuck to the outside of the bottle).
    - Activity ID
    - Collection Date
    - Waterbody Name
    - Collector's Name
    - Sample Type
  - Internal label written in **pencil** and placed inside the sample bottle.
    - Activity ID
    - Collection Date
    - Waterbody Name

- After placing the inside label, place the bottle cap, and cover it with **parafilm** to avoid leakage.

- Place the outside label and cover it with clear tape.

- Place samples in a cooler w/o ice. Be sure bottles **will not fall over**.

Recording macroinvertebrate sampling event

- On the Site Visit Form indicate a macroinvertebrate sample was taken by checking the appropriate box.

- Record the Sample ID (Activity ID w/medium code) on the Site Visit Form.

- Circle "**KICK**" or **"Jab"** on the Site Visit Form under Sample Collection Procedure.
  - For traveling kick net, record duration, kick length, number of sample jars and net mesh size.
  - For Jab technique, record number of jabs, number of sample jars and net mesh size.

- Complete the **<u>Macroinvertebrate Habitat Assessment Form</u>** for habitat type (riffle or pool).
  - Complete this form **ONLY** if you have taken a macroinvertebrate sample.
  - Use labels (if available) to fill out the upper portion of the form, otherwise, fill it out by hand.
  - Complete this form for the stream type of either "Riffle/Run" or "Glide/Pool", but not both.
  - For each of the habitat parameters, carefully read each of the options, and select a numeric score that best represents the conditions where the macroinvertebrate sample was collected.

B. **Periphyton**

This Periphyton sampling method is a qualitative procedure to determine algal abundance. The procedure is designed to yield a composite representative sample.

Collecting a composite sample

- Scraping the surface of rocks, lifting the algal film from near shore sediments and by scraping submerged branches or woody debris, collects a composite sample of microalgae. If these are dominated by moss, choose rocks that do not have moss.

- The scrapings are placed in a centrifuge tube in roughly the same proportion as the algae's occurrence throughout the sampling site habitat. Add ambient water to the **40 ml mark** in the centrifuge tube.

- Immediately add **1.5 ml** of the 10% formalin solution using a drop pipette.

- Close the centrifuge tube and cover the lid with **parafilm** to avoid leakage. Shake 3 times gently to distribute the preservative.

- Sample centrifuge tube should be identified with a label (external) with the following information:

    - Sample Type
    - Activity ID
    - Collection Date
    - Waterbody Name
    - Collector's Name

- After filling out the label, place it on the centrifuge tube, and cover it with clear tape.

- Place samples in the cooler *without* ice. Be sure tubes **will not fall over.**

Recording the periphyton sampling event

- On the Site Visit Form indicate which sample was taken by checking the appropriate box
- Note the Activity ID (Sample ID) on the Site Visit Form.
- Circle "**PERI-1**" on the Site Visit Form under Sample Collection Procedure.

C. **Chlorophyll *a***

These sampling methods are designed to quantitatively measure algae growth by measuring Chlorophyll *a*. This is used to determine if excessive algae growth is present, therefore discouraging primary contact recreation. Also, overly abundant algae indicate that excessive nutrients may be present in the waterbody. There are three sampling methods used to collect samples of chlorophyll-a attached to substrate (rock, hoop, and core). These are used individually or in combination to characterize a site's total chlorophyll *a* concentration.

Following the description of the three-substrate collection methods, a method for collecting a phytoplankton chlorophyll *a* sample from the water itself is presented. This method is primarily used for prairie streams that are pool-to-pool environments and have a green water color.

Rock sampling method

Method for transects with dominance of small boulders, gravel and cobble.

- Collect a minimum of six (submerged) rock samples to form a composite sample for the transect. The samples should be an even representation along the line. For intensive surveys more than one transect line may be required.
- The rocks should range from grapefruit to baseball size.
- Place the six rocks into a large Ziploc bag; place the label on the outside of the Ziploc bag (see label requirements below).
- Wrap the bag with aluminum foil leaving no space for light to enter. Place this wrapped bag into another large Ziploc bag and hand write the Activity ID w/medium code on the outer bag with a **BLACK INK SHARPIE.**
- Immediately store the sample on ice and away from light. The samples should be sent to the laboratory as soon as possible for chlorophyll *a* analysis (monochromatic, corrected for phaeophytin).

Hoop Method

Method for transects with dominance of filamentous algae.

- **Four** hoop samples (each hoop is 710 cm^2) are collected in a representative transect of the sampling site.
- A metal hoop is placed over a collection site (regardless of the substrate). All the algal material within the hoop is collected. Scissors can be used to detach the filamentous algae from their substrate.
- Manually separate the filamentous algae from the macrophytes. Retain filamentous algae.
- Place each hoop sampling of filamentous algae (cleaned of macrophytes) in a single large Ziploc bag; place a label on the outside of the Ziploc bag (see label requirements below). Wrap the bag with foil leaving no space for light to enter.
- Repeat procedure for the remaining three samples.
- Place each wrapped and foiled bag into another large Ziploc bag and hand write the Activity ID on the outer bag with a **BLACK INK SHARPIE.**
- Immediately store the sample on ice and away from light. Be sure bag is sealed so water from melting ice does not contaminate the sample.
- A single composite will be done at the laboratory.
- The sample should be sent to the laboratory as soon as possible for chlorophyll *a* analysis (monochromatic, corrected for phaeophytin)

.

Core Method

Method for transects dominated by pools or by silt-clay substrate

- Three core (5.7 cm^2) samples are collected in a representative transect of the sampling site and composited.

- A core sample of the stream bottom is collected using a cut-off 60 cc syringe. In deeper water, a broom handle can be duct-taped to the syringe to extend your reach
- After collecting several vertical centimeters of sediment within the syringe, the core is extruded so that the upper 1 cm of the core can be sliced off and placed in a 60 ml centrifuge tube. The remainder of the core sample is discarded.

- NOTE: Only the **upper 1 cm** of each core sample is placed in a centrifuge tube to form a 3 core composite. **(See Attachment C).**

- Sampling location is identified on the centrifuge tube on an external label with the following information:
  - Sample Type
  - Activity ID w/medium code
  - Collection Date
  - Waterbody Name
  - Collector's Name

- After filling out the outside label, place it on the centrifuge tube, and cover it with clear tape.

- Cover the centrifuge tube with aluminum foil, and place it in another small Ziploc bag. Hand write the Activity ID w/medium code on the outer bag with a **BLACK INK SHARPIE.**

- Place samples in the cooler with ice. Be sure bags are sealed so water from melting ice does not contaminate the sample. The samples should be sent to the laboratory as soon as possible for chlorophyll *a* analysis (monochromatic, corrected for phaeophytin).

*Phytoplankton Method (*chlorophyll *a* in water*)*

Method for transects dominated by pools with green color (light green to dark green). Usually collected when using the core method. This method uses a filtration apparatus to collect a sample. Since chlorophyll *a* breaks down readily in sunlight, the use of a dark Nalgene bottle is required to minimize the exposure of the sample to sunlight. The filter apparatus should be setup prior to sample collection to minimize the time between sampling and filtration.

Filter apparatus setup

- Equipment - hand pump vacuum with tubing, Nalgene filtering unit, GFF filters (0.45 um), tweezers or forceps, deionized water.

- Using clean forceps, place a glass fiber filter (0.45 um) on the filter holder. Use a small amount of deionized water from a wash bottle to help settle the filter properly.

- Rinse the sides of the filter funnel and the filter with a small volume of deionized water.

Sample collection and processing

- ❑ Rinse a clean 1L dark Nalgene bottle 3 times with stream water before collecting the sample.

- ❑ Grab a water sample using the 1L Nalgene bottle. Cap the bottle and thoroughly mix by inverting bottle 3 times.

- ❑ Rinse a 100 ml. graduated cylinder three times with deionized water. A smaller graduated cylinder may be necessary if the filter clogs with less than 20 ml. in the next two steps.

- ❑ Measure 20 ml or more of sample in the graduated cylinder and pour it into the filter funnel, place the cap on the filter funnel, and draw the sample through the filter using the vacuum hand pump. **Note: vacuum pressure from the pump should not exceed 7 psi to avoid rupture of fragile algal cells.**

- ❑ **Keep track of the volume of sample filtered!** The volume of sample filtered can vary from 5 ml to 1000 ml. When filtration begins to slow <u>and</u> the filter has developed a distinct green (or green-brown) color, sufficient sample has been filtered. Do not allow the filter to get clogged, you cannot discard excess sample (water) from the filtration apparatus without losing a portion of the sample from the filter media (this also makes it difficult to keep track of volume filtered.)

- ❑ After filtration is done, unplug the hand pump, remove the filter funnel from the filter holder, and remove the filter with clean forceps. Avoid touching the colored portion of the filter. Fold the filter in half, with the colored site folded in on itself. Place the folded filter paper in a 50 ml centrifuge tube.

- ❑ Sample centrifuge tube should be identified with the following information:
    - o Sample Type
    - o Activity ID
    - o Collection Date
    - o Waterbody Name
    - o Collector's Name
    - o Volume filtered

- ❑ Place the sample label on the centrifuge tube, and cover it with clear tape.
- ❑ Cover the centrifuge tube with aluminum foil, and place it in another small Ziploc bag. Hand write the Activity ID on the outer bag with a **BLACK INK SHARPIE.**

- ❑ Place samples in a cooler with ice. <u>Be sure bags are sealed so water from melting ice does not contaminate the sample.</u> The samples should be sent to the laboratory as soon as possible for chlorophyll *a* analysis (monochromatic, corrected for phaeophytin).

Recording the chlorophyll a sampling event

- ❑ On the Site Visit Form indicate a chlorophyll *a* sample was taken by checking the chlorophyll *a* box.

- ❑ Note the Activity ID w/medium code (Sample ID) on the Site Visit Form.

- Circle the sample collection procedure on the Site Visit Form.
  - For **Rock** collection method circle **CHLPHL-2.**
  - For **Hoop** collection method circle **HOOP**.
  - For **Core** collection method circle **CORE**.
  - For **phytoplankton** collection method circle **other** and write "**PHYTOPLANK"** next to it. Write phytoplankton: **volume filtered (ml**) on the comment section.

- Complete the Chain of Custody Form. Include the numbers or volume of samples submitted on the chain-of-custody (**See Attachment E**). For example:
  - For the **rock** method, include the number of rocks in the composite sample on the comment section (e.g., 6 rocks).
  - For the **hoop** method, include the number of hoops in the composite sample (e.g., 6 hoops)
  - For the **core** method, include the number of cores in the composite sample (e.g., 3 cores)
  - For the **phytoplankton** method, include the volume of water filtered (e.g., 250 ml. Filtered).

IX. Quality Control

The objective of sample collection for Water Quality Assessments is to arrive at a level of sufficient and credible data that supports a beneficial use support determination with a reasonable level of certainty that the decisions are correct. Further, these decisions must be made in the next two years for nearly 400 waters. As a result, the majority of DEQ's resources are devoted to collecting sample data. Quality controls for these data are limited to assessing precision, representativeness and contamination.

In 2005 DEQ *will not* submit blind samples to the analytical laboratories. Sufficient controls exist within the standardized methods published by EPA, USGS and APHA to adequately assess the precision and accuracy of laboratories.

A. Field Blanks

To assess the potential for false positive results due to site contamination, DEQ is collecting Field Blanks at the beginning, middle and end of the field season. The results of Field Blanks will verify that false positive results from site conditions or through cross-contamination during transport will not result in an erroneous beneficial use support determination.

Preparation, Transport and Submittal

- The analytical laboratory will provide reagent water in a large (4 liter or greater), sealed HDPE container. This bottle must be kept in a place in the vehicle where it does not become exposed to excessive dust, mud or come in contact with other equipment. A spare cooler is often the best place to store reagent water during transport.

- At the site, fill a set of the same bottles used for routine samples with the laboratory reagent water and preserve them using a preservative ampule.

- Bottles are sealed and labeled (e.g., Field Blank – "Basin" – mm/dd/yy). Record field blanks on a separate site visit form and apply a unique activity ID. Include field blanks on the chain of custody with collection date. Include with the shipment of samples to the laboratory.

Quality Control Criteria

- All field Blank results < MDL.

B. Field Replicate samples

To assess both precision and representativeness of the sampling technique, DEQ is collecting replicate samplings for all chemistry (except field parameters) and biological measurements. Replicate samplings will occur at the *beginning, middle and end* of the field season for each major basin. The results of replicate samples will verify that the various field crews are collecting samples consistently and that method and site variability is understood.

Sample collection and submittal

- Select a site that allows for two samples to be taken side-by-side. Samples are collected following the same guidelines for BOTH SAMPLES at the SAME SITE.

- When collecting replicate samples, all steps performed in collecting one sample (or set of samples) shall be repeated so that two samples (or sets of samples) have been collected.

- Replicate samples may be submitted to the laboratory labeled as "Field Replicate 0 and Field Replicate 1".

- Replicates must be handled identically (temperature, preservation, etc.). Include a remark in the comment section of the original samples site visit form, indicating that a replicate was collected at this site. Prepare a separate site form and a distinct Activity ID w/medium code to record the details of the replicate sample.

Quality Control Criteria

- Relative Percent Difference (RPD) of chemistry replicates (excluding chlorophyll-a) <25%.
- RPD of chlorophyll-a <50%
- Percent Taxonomic Difference (PTD) of macroinvertebrates and periphyton <10%.

C. **Recording Quality Control Samples**

- Currently, for all QC events, DEQ requires a separate site visit form for replicate samples.

- Always use a new I.D. number for the replicate, (preferably sequential) and use the same medium code as the original sample (i.e. “W” for water).

- Relevant information on the replicate site form includes the date, Station ID/site name and a brief statement that references the original site form/sample ID.

- Note on the original site form the replicate Sample ID.

X. Physical Characteristics and Habitat Assessments

For 2005, habitat assessments will be performed on two scales, site scale and reach scale. This should result in a better overall understanding of the condition of the waterbody's habitat characteristics and function.

The physical characteristics are measured at each site and include both required and optional methods. The required methods are the minimum information required to get a basic understanding of the geomorphology of the waterbody. The optional methods may be necessary for adequate characterization of suspected impairments observed at the site.

Site Scale Habitat Assessment (1 per sampling site)

- ❑ Site Information Forms
  - o Directions to site, Landowner Information, Site Access Information
  - o Site Characteristics
  - o Human Influence
  - o Fish Cover/Other
  - o Site Map

Physical Characteristics

- ○ Total Discharge
- ○ Cross-sections (Non-Laser or Laser)
- ○ Wolman pebble count
- ○ Percent fines ***(optional)***
- ○ Riffle Stability Index (RSI) *(**optional**)*
- ○ Rosgen stream classification *(**optional**)*

Reach Scale Habitat Assessment (1 per stream reach)

- ❑ Reach information
- ❑ NRCS Riparian Assessment
- ❑ Photos
- ❑ Summary *(**optional**)*
- ❑ Discussion of reference condition *(**optional**)*

XI. Site Scale Habitat Assessment

The purpose of this assessment is to provide more concise information on the sampling site itself. It should generally follow completion of the Macroinvertebrate Habitat Assessment with the scale of observations expanded for the site as described below for each form.

A. Site Habitat Information

This form includes Directions to the Monitoring Site, Landownership Information, Site Access Information, Site Characteristics, Weather Description, Human Influence, Instream Fish Cover/Other Information, and site map.

Directions to Site, Landowner Information and Site Access Information

- ❑ Describe briefly how to arrive at the monitoring site.
- ❑ Indicate if the land is public or private landownership. If public, please indicate the name.
- ❑ If you did not sample the stream, check one of the boxes ¾ of the way down the front of the form indicating why.

Site Characteristics

Individual site characteristics are based on a circle with a **200 m** radius around the sampling site.

- ❑ Waterbody Character: Assign a rating of 1 (highly disturbed) to 5 (pristine) based on your general impression of the intensity of impact from human disturbance. Place an "X" in the box next to the assigned rating on the Assessment Form. Assign a rating to the stream based on overall aesthetic quality, based on your opinion of how suitable the stream water is for recreation and aesthetic enjoyment today.

- ❑ Beaver: If you noticed any signs of beaver presence in the stream (chewed sticks, trees, dams, lodges) rate the beaver presence as either rare or common. If no beaver signs were present, mark the absent box. Also rate the amount of flow modification caused by any beaver activity as none, minor or major.

- ❑ Dominant Land Use: Make one estimate of the dominant land use in the circle around the x-site. Pick just one land use from among Forest, Agriculture, Range, Urban, Suburban/Town. If there are other major land uses, make note of them in the General Assessment section of the form. If forest is the dominant land use, make a guess as to the dominant age class of the forest (0-25, 25-75, or >75 years).

- ❑ Hydrologic Influence: Select the box that describes best the situation of the chosen monitoring site.

- ❑ Weather: Record a very brief description of the weather conditions during stream sampling (e.g. sunny, fair, partly cloudy, overcast, light rain, unseasonably warm, cold or hot, etc.). Any unusual weather right before sampling (e.g. heavy rain, 6 inches of snow) is also worth noting here.

- ❑ General Comments: If you want to elaborate on any of the above, use this section.

Human Influence

- ❑ Looking at both banks, describe if any human influences listed in the table can be found on either the right or left bank by circling the appropriate letter. The letters correspond to distances from the bank as follows:
  - o On the bank = B
  - o < 10 meters = C
  - o >10 meters = P
  - o Not present = 0

- ❑ Provide any comments you want to elaborate on in the comment section (See Attachment D)

Fish Cover/Other

For this observation, stand mid-channel at the selected transect and estimate a 5m distance upstream and downstream (**See Attachment D).**

- ❑ Examine the water and the banks within the 10m segment of stream for the following features and types of fish cover; filamentous algae, aquatic macrophytes, large woody debris, brush and small woody debris, in-channel live trees or roots, overhanging vegetation, undercut banks, boulders, artificial structures and moss.

- ❑ For each cover type, estimate the area cover. Record the appropriate cover class in the "FISH COVER/OTHER" section of the Site Information Form:
    - "0"=absent: zero cover
    - "1"=sparse: <10%
    - "2"=moderate: 10-40%
    - "3"=heavy: 40-75% or
    - "4"=very heavy: >75%

- ❑ For intensive surveys, repeat steps 1 and 2 at each transect, recording data from each on a separate field data form.

Site map

- ❑ Drawing of the site allow future assessments to return to the exact same place to review changes over time.

Recording a Site Scale Assessment

- ❑ On Site Visit Form, check the boxes next to "Habitat Assessment" and Scale "Site".

- ❑ Fill out the information at the top of Site Information form using the labels. If you don't have enough labels, please fill the information out by hand.

XII. Physical Characteristics

A. **Total Discharge (flow)**

Three methods are available for measuring flow. These are (in descending order of preference), flow meter, float method, and visual estimation. The practicality of using certain methods is largely dependent upon the flow condition of the stream. For instance, a flow meter is useless in a stream that doesn't have enough water to reliably use the instrument.

Flow Meter Method (quantitative)

Appropriate for narrow streams where 10-15 points can be measured in a cross section or wide streams where 25-30 ft. points can be obtained. Multiple readings are necessary for channels that are complex, and variable in their shape and flow patterns.

Note: It is acceptable for flow meter recordings and channel cross-sections to be performed simultaneously provided the nature of the site is amenable to this and there are two experienced field crew members available.

- Stretch a tape between end-points of your cross-section (often placed at bankfull or wider locations).

- Divide the distance from left water's edge to right waters edge by 25-30 to determine the number of stations; round to nearest ¼ foot for ease of accurately determining the width of the stations.

- Start at left water's edge and call out the location from the tape first. Stand downstream from the tape and meter, and at least 18" off to the side to avoid disrupting the flow measurement. Point the probe directly into the flow with the rod held vertically.

- Read the depth to the person recording the data.

- Take the reading at 0.6 depths by adjusting the top-setting rod. Allow the reading to settle to a fairly stable value and read the velocity.

- The person recording the data should fill out the header information on the total discharge form using the corresponding label, and the following fields: distance from initial point, depth and velocity.

Float Method (semi-quantitative)

The floating stick/ball method is a semi-quantitative method of determining flow. It is important to note this method tends to underestimate the flow due to slower velocity near the surface, but it is more accurate than a visual estimate.

- Find a reach of stream that is straight, as well as uniform in width and depth. This will assure that laminar flow is achieved to the greatest extent possible.

- Measure the length of the reach (in feet) and mark each end.

- Determine mean width (from the waters edge) by taking at least three transects within the reach.

- Determine mean depth by measuring depth at multiple points throughout the reach.

- Release a small stick or other floating object at the top of the reach and count the seconds to reach the lower point. Assure that the object stays in the main current. Repeat at least twice.

- Calculations:
    - Mean width x mean depth = cross-sectional area (ft^2)
    - Convert stick float time to ft/second (i.e., 26 ft/15 sec = 1.7 ft/sec)
    - Determine CFS (a x b)

Estimated Flow

Estimated flow is a simple observation. This should only be used for very small streams that will not support the use of flow meters or the float method. When estimating flow, please record a single estimated value rather than a range. If no flow is observed, but there is water present, indicate "no measurable flow" on the site visit form. If the streambed is dry,

indicate “dry bed”. Field crews are encouraged to include remarks about flow, particularly if it will not be measured.

Recording flow (discharge) measurements

- ❑ On the Site Visit Form, indicate the method used. For instance, if the float method was used, check the float box.

- ❑ If flow was estimated visually, record the estimated value on the Site Visit Form as cfs. Flows of zero cfs must have the appropriate comment box checked (e.g., Dry bed or No measurable flow).
- ❑ If the float method or flow meter is used, fill out the information at the top of Total Discharge form using preprinted labels. If you don’t have enough labels, please fill out the information by hand.

    - o For flow meters, record cross-sectional flow values according the method. Flow values can be calculated back at the office for flow meter measurements using an excel spreadsheet.

    - o For the float method, record the results of the three time distance measurements as a footnote to the discharge form.

B. **Channel Cross Sections (Laser level and Non-laser level)**

The cross section method contains elements of a Rosgen Level II measurements but should not be confused with the complete Rosgen Stream Classification, which is an ***optional*** physical measurement.

Laser Level Cross-Section Method I

- Setup the surveying instrument in a location where the entire cross section can be viewed. The instrument should be placed at an elevation higher than the highest feature required for the survey. Ideally, only one instrument setup will be required to survey the entire cross section; however, determining the width of the flood prone area may require multiple instruments setups due to dense foliage.

- Stretch the tape across the channel (zero on left bank) making sure the tape is perpendicular to the direction of the flow.

- Hammer Survey Stakes on each side past bankfull elevation. Attach the tape and adjust the tension until the tape is tight.

- Begin the cross section survey: Place the surveying rod at major breaks in bed elevation and key features such as left bankfull (LBF), left edge water (LEW), Thalweg (THL), right edge water (REW), right bankfull (RBF). See attached example.

- Record the distance point or station (ft), the corresponding Fore-Sight (ft), and the Height Depth or Elevation (ft). **See Attachment B**

- Measure the flood-prone area width (Width of the channel at an elevation that is 2 times the maximum bankfull depth).

- Calculate the bankfull cross sectional area and plot your cross section.

- Calculate mean depth, width/depth ratio and entrenchment ratio.

- Using the appropriate regional curves, check to make sure your cross sectional area, bankfull width and depth are reasonable. Make sure your bankfull velocity is reasonable (Velocity = Bankfull Discharge/Bankfull Area).

Non-Laser Cross-Section Method

- Identify a representative riffle cross-section in the stream reach, which typifies the form of the stream. Pick a fairly straight section where the channel is somewhat constricted, where you can avoid large boulders and big deadfalls, which alter the form and lateral extent of the channel.

- Install stakes at the bankfull elevation of each side of the channel and attach the tape first to the left bank stake, facing downstream. Pull the tape tight and attach it to the right bank stake. If the tape is so long that it tends to sag, install a nylon cord tightly at the same points on the stakes so you may have a more uniform horizontal plane to measure to. To achieve a near-level bankfull elevation, measure the Bankfull-to-Water Surface distance at the side with the most reliable bankfull indicator, and then adjust level of the tape at the other side of the channel to correspond with that measurement.

- Start measurements at the left bankfull point in the cross-section. At least 20 stations are recommended. Complete the measurements at the right bankfull location.

- Record each station value, as read from the tape, and then record the depth reading from the rod (measured from the channel bottom to the nylon cord).

- Notations must indicate left bankfull (Lbfk), right bankfull (Rbkf), left water edge (LWE), right water edge (RWE), and Thalweg (THWG).

Recording Cross-Section measurements

- On the Site Visit Form indicate that a Channel Cross-Section has been completed by checking the box next to "Channel X-Section." Indicate which method was used (laser/non-laser).

- Prepare for recording the measurements by selecting the "Stream Classification Form" and either the "Laser Level Cross Section" form or the "Channel Cross Section" form. Fill out site information at the top of the forms with a preprinted label or, alternately, by hand.

- Record readings on the appropriate cross section form and Stream Classification Form (these are the Rosgen Level II measurements noted earlier.) Note: It may be easiest to have one field crewmember read the measurements off and the other record the information.

C. **Substrate Measurements**

Substrate measurements are used to determine particle size distribution in the stream channel.

Wolman Pebble Count

The objective of the Wolman Pebble Count is to determine the particle size distribution.

- The sampling points are determined by paced transects across the channel from bankfull to bankfull – transects should include the top, middle, and bottom of the riffle. A minimum of 100 particle size observations will be done on the selected riffle for each Pebble Count.
- At each transect, start at bankfull width on one side and continue until the bankfull width is reached on the opposite side of the stream.
- Walk heel to toe and identify the first particle at the end of your boot touched by your finger. Measure the intermediate diameter of the particle.
- Tally the samples by the size categories outlined on the Substrate DEQ/MDM field form.
- For very large particles, count the same particle as many times as your toe encounters it.

Recording a Wolman Pebble Count

- Check the boxes next to "Substrate" and "Pbl. Count" on the Site Visit Form.
- Fill out the information at the top of Substrate DEQ/MDM form using the labels. If you don't have enough labels, please fill out the information by hand.
- Use the Dot/Slash system to record pebble counts. 10 =
- The cumulative percent total for each size class will be calculated electronically in the office.

D. **Optional Physical Characteristics**

Percent Fines

An optional substrate measurement is percent fines (see DEQ SOPs 1995-2004, Section 11.8.6, Percent Fines Calculation). This method is used to further refine the particle distribution measurement of substrate < 6mm.

Riffle Stability Index (RSI)

The RSI is an optional method for characterizing stream channels. The following abstract from the Journal of American Water Resources Association (Kappasser, August 2002) describes the principle behind the RSI. If RSI will be used, obtain the method from AWRA.

Abstract - Riffles in moderately entrenched stream reaches with gradients of 2 percent to 4 percent that have received excessive sediment from upstream have a distinctly different and higher proportion of smaller mobile particles than riffles in systems that are in dynamic equilibrium. The mobile fraction on the riffle can be estimated by comparing the relative abundance of various particle sizes present on the riffle with the dominant large particles on an

adjacent bar. Riffle particles smaller than the dominant large particles on the bar are interpreted as mobile. The mobile percentile of particles on the riffle is termed "Riffle Stability Index" (RSI) and provides a useful estimate of the degree of increased sediment supply to riffles in mountain streams. The RSI addresses situations in which increases in gravel bedload from headwaters activities is depositing material on riffles and filling pools, and it reflects qualitative differences between reference and managed watersheds. The RSI correlates well with other measures of stream channel physical condition, such as V and the results of fish habitat surveys. Thus, it can be used as an indicator of stream reach and watershed condition and also of aquatic habitat quality.*

Rosgen Stream Classification System

The Rosgen Stream Classification system is another optional method for characterizing stream channels. If Rosgen is used, please refer to DEQ SOPs 1995-2004 Section 13.1.1, Stream Classification.

XIII. Reach Scale Habitat Assessment

The reach scale assessment is addressed last because it covers a broader scale. This assessment may be *completed* after the last sampling site in the reach is sampled, however, consideration of the conditions for the entire reach begin at the first sampling site.

A. Reach Information

The purpose of this form is to document anthropogenic activities in the *reach*.

- ❑ Watershed Activities and Disturbances Observed: Rate each type of activity or disturbance listed on the form as either "Not observed", "Low", "Medium" or "High", and record the rating on the Assessment Form. Keep in mind that ratings will be somewhat subjective and that an extensive effort to quantify the presence and intensity of each type of stressor is not required. General categories or activities and types of disturbance are described below:
    - o Residential: The presence of any of the listed disturbances adjacent to or near the stream.
    - o Recreational: The presence of organized public or private parks, campgrounds, beaches or other recreation areas around the stream. If there are signs of informal areas of camping, swimming or boating around the stream (e.g. swimming hole), record them as "primitive" parks, camping.
    - o Agriculture: The presence of cropland, pasture, range, orchards, poultry, and/or livestock. Also note any evidence of water withdrawals for agriculture.
    - o Industrial: Any industrial activity (e.g. canning, chemical, pulp), commercial activity (stores, businesses) or logging/mining activities around the stream or in the catchment. Describe in more detail in the comments section.
    - o Management: Any evidence of water treatment, dredging or channelization, flow control structures, fish stocking, dams or other management activities.
- ❑ Any oddities, or further elaboration should be recorded in the Comments section.
- ❑ Torrent Evidence Form **(See attachment G)**
- ❑ Document if ice scour exists or If culverts are present and impacting fish by answering the 2 appropriate questions in the field forms.

B. NCRS Riparian Assessment Form

- ❑ Description of the NRCS Riparian Assessment form is provided in the Technical Notes accompanying the assessment.
- ❑ Training for the NRCS Riparian Assessment form is provided prior to the field season.

C. Photo locations

- ❑ Photo points are required where observations are made of significant conditions.

D. Optional Summary Form and discussion of reference condition

The Summary Form, Discussion of Reference Condition, Photograph Location, and Site Map are forms used to document additional information that will be used for the Water Quality Assessment. Information contained in these forms is extremely useful when a different DEQ staff member than those who collected the data completes the Water Quality Assessment. (e.g., a DEQ staff member performs the Assessment from data collected by EPA).

- For the summary and the discussion of reference condition, be as expressive as you can in describing the reach and the monitoring sites. These forms should be used in case there was not enough space under the comment section in previous forms.

- For photograph location, include a brief description of what is being photographed and why. Include the latitude and longitude of each photo.

- The site map is a sketch of major landscape characteristics of the reach or site, indicate which direction is North and the direction of the stream flow.

E. **Recording a reach scale assessment**

- On the Site Visit Form, check the boxes corresponding to the methods and forms completed.
    - For reach scale assessments, “Habitat Assessment” and Scale “Reach”.
    - For Photo locations, check the box labeled “Photographs”.

- Fill out the information at the top of each of the forms. If you don’t have enough labels, fill out the information by hand.

ATTACHMENT A

Checklist: Record-keeping for Reassessment Field Work

FORMS

- [ ] Site Scale Habitat Assessment Package*
- [ ] Reach Scale Habitat Assessment Package**
- [ ] Macroinvertebrate Habitat Form ***
- [ ] DEQ Chain of Custody Forms (for chemistry samples)

INSTRUCTIONS (one set per monitor)

- [ ] Field Procedures Manual
- [ ] Entrenchment Ratio using the Laser Level
- [ ] Instructions for the NRCS Riparian Assessment
- [ ] UPS Store / Bus Station Locations

LABELS (for sample containers and/or forms)

- [ ] Macroinvertebrate Sample (external)
- [ ] Macroinvertebrate Sample (internal)
- [ ] Periphyton Sample
- [ ] Chemistry Sample (water, sediment, chlorophyll *a* samples)
- [ ] Site Visit Code Stickers (color-coded)
- [ ] Pre-visit (address-style) labels (list Project ID, Trip ID, HUC, Waterbody, etc.)

MISCELLANEOUS

- [ ] Pencils
- [ ] Sharpies
- [ ] Clear tape
- [ ] Field Notebook (optional)

*Site Scale Habitat Assessment Package includes the following:

- [ ] Site Visit Form
- [ ] Site Habitat Information
- [ ] Total Discharge
- [ ] Channel Cross-Section (Non-Laser)
- [ ] Channel Cross-Section (Laser)
- [ ] Wohlman Pebble Count (
- [ ] Channel Cross-Section (Non-Laser)
- [ ] Site Map
- [ ] Rosgen Stream Classification (optional)
- [ ] Percent Fines (optional)
- [ ] RSI (optional)

**Stream Reach Habitat Assessment Package includes the following:

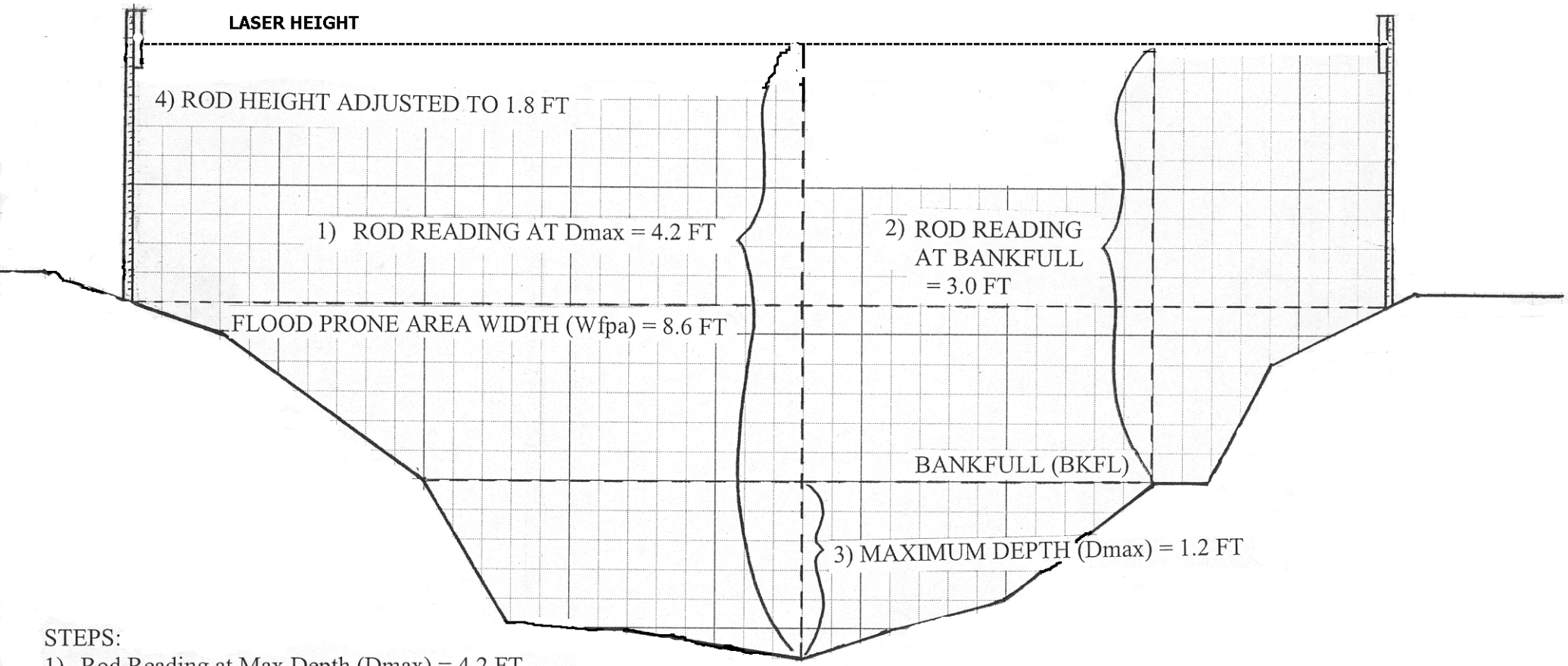
- [ ] Reach Information
- [ ] NRCS Riparian Assessment
- [ ] Photograph Locations and Descriptions
- [ ] Summary (optional)
- [ ] Reference Condition (optional)

*** Macroinvertebrate Habitat Forms

- [ ] Macroinvertebrate Habitat Assessment Form - Riffle/Run Prevalence
- [ ] Macroinvertebrate Habitat Assessment Form - Glide/Pool Prevalent Streams

FIELD PROCEDURES MANUAL - ATTACHMENT B

ENTRENCHMENT RATIO USING THE LASER METHOD

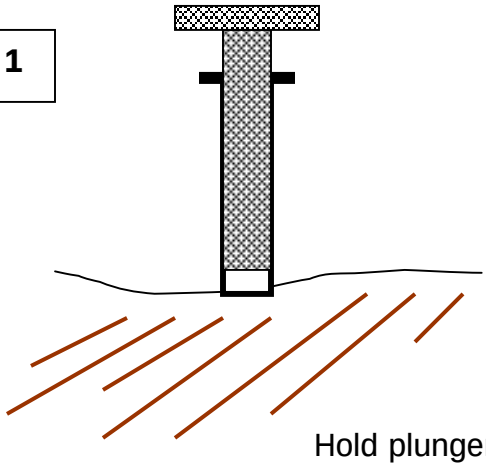


STEPS:

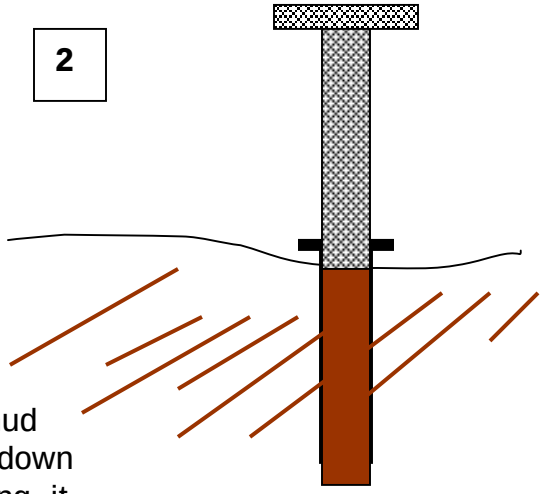
1) Rod Reading at Max Depth (Dmax) = 4.2 FT
2) Rod Reading at Bankfull = 3.0 FT
3) Subtract step # 2 from step # 1, = 4.2 FT – 3.0 FT = 1.2 FT = Dmax
4) Rod Reading at Dmax – 2 x Dmax = FPA elevation
   4.2 FT – 2.4 FT = 1.8 FT
   Set the rod at 1.8 FT. Move the rod up the bank slope,
   along the cross-section until the sensor intercepts the laser.
5) Mark the FPA locations on both banks.
6) Measure the straight-line distance between the two FPA locations.
   This is the width of the FPA (Wfpa) at 2 x Dmax.
7) Entrenchment Ratio = Wfpa/Wbkfl = 8.6 FT/ 5.0 FT = 1.72

Field Procedures Manual - Attachment C

1

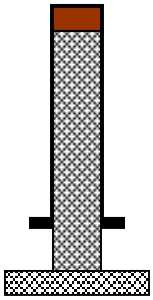


2



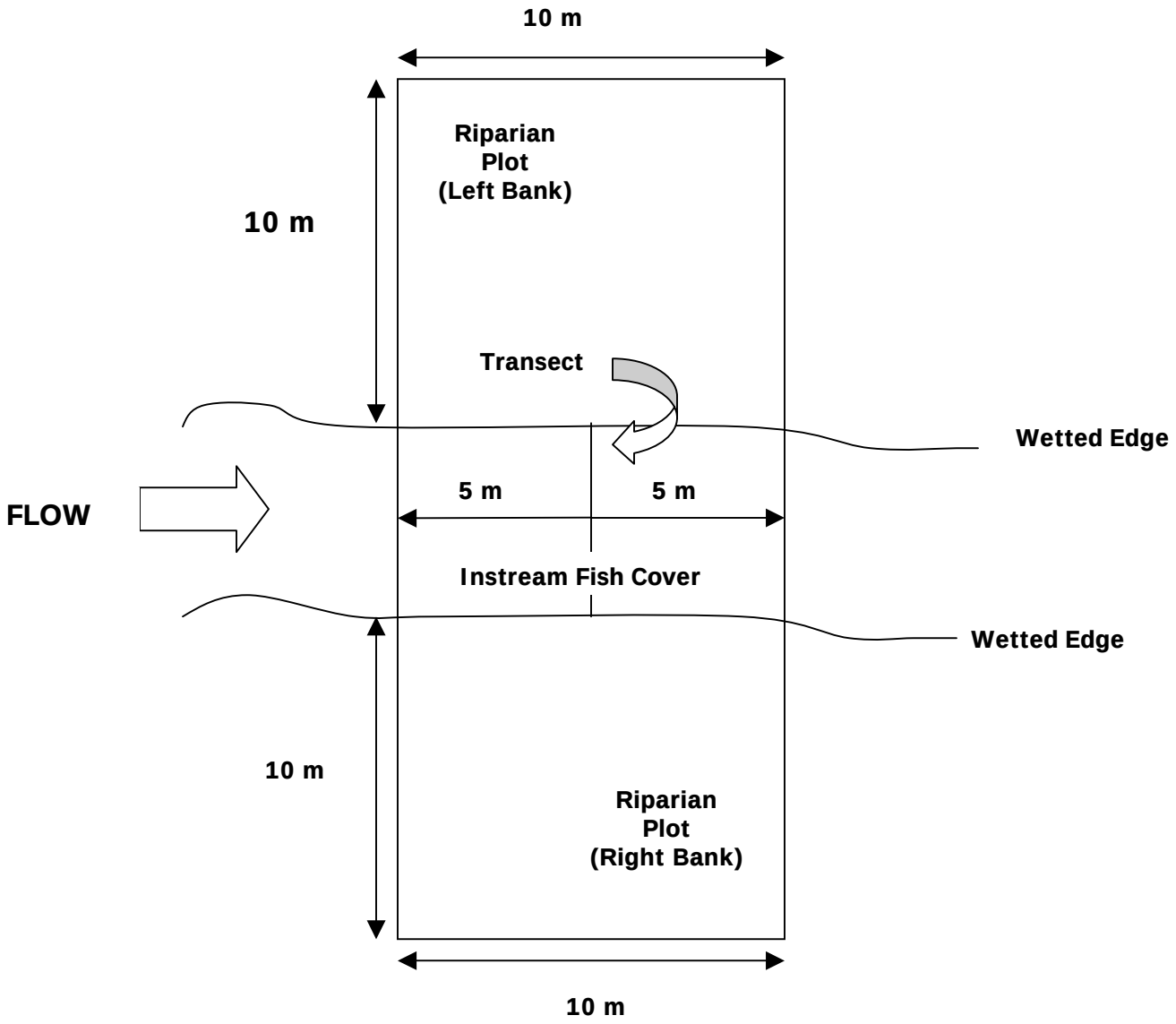
Hold plunger stationary at mud surface and push the barrel down into the mud. When removing, it is often helpful to put your fingers over the end of the syringe to prevent the core from falling out.

3



Extrude and discard all but **the upper 1 cm of core sample.** Extrude the remaining 1-cm thick sediment wafer into a sample container.

Field Procedures Manual - ATTACHMENT D



Field Procedures Manual - Attachment E

CHAIN OF CUSTODY RECORD (COC)
MT DEQ Chain of Custody Form Instructions

The Chain of Custody form should always be verified for completeness and checked for errors prior to submittal to the lab.

1. STORET **Project ID**: Use the Project ID from the Pre-Visit label with the waterbody information.

2. **Trip ID**: Enter the Trip ID from the Pre-Visit label with the waterbody information.

3. **Collected By**: Write the name of the person who collected the samples. (This field may not be present for data collectors outside of DEQ.)

4. **Account #**: Write the Lab account number the samples are to be billed to. (This field may not be present for data collectors outside of DEQ.)

5. **Lab Samples Submitted to**: Enter the name of the laboratory the samples are to be submitted to such as State Laboratory, or Energy Labs.

6. **Date submitted**: Enter the date the samples are turned over to the lab for analysis.

7. **Report Address**: Enter the address the paper report is to be delivered to. (This has been filled in for internal DEQ sampling.)

8. **Invoice Address and Phone**: For DEQ personnel this field has been entered for you. For personnel other than DEQ enter the name and the address of who is to be billed for the sample analysis. (This has been filled in for internal DEQ sampling.)

9. **Contact Name and Phone**: For DEQ personnel this field has been entered for you. For personnel other than DEQ enter the name and phone number of the person who collected the samples. Contractors should put their name and the company name in the contact name and phone and use the "invoice address" field to state the samples are to be delivered and billed to DEQ. (This has been filled in for internal DEQ sampling.)

10. **Project Name**: Leave this field blank. The lab will use the Project ID.

11. **Collection Date**: Enter the date the samples were collected. Do not use ditto ("") marks, arrows or lines to represent the same date.

12. **Collection Time**: Enter the time the samples were collected. Do not use ditto ("") marks, arrows or lines to represent the same time

13. **Sample Number**: Enter the Activity ID label number placed on the sample. Each sample type has a suffix that needs to be added on to the end of the number.

    W – Water

    C – Chlorophyll a (Note that Chlorophyll a is always quantitative, and a volume or area measure must be indicated in "Special Instructions" except for the entire rock collection method)

    SED – Sediment

    Different sample types must be listed on separate lines i.e. Line 1 Water, Line 2 Chlorophyll, Line 3 Sediment, etc.

14. **Number of Containers**: Enter the number of bottles the sample is contained in. Also note the Sample Type.

15. **Analysis Requested**: Write the analysis to be performed on each sample and check or make an "X" in the box for each sample you want to receive this analysis.

16. **Comments, Special Instructions, etc**.: This field is to make notes or comments to the laboratory. Area and number of composites for chlorophyll a samples should be noted here.

17. **Relinquished by**: The person who delivers the samples to the lab must enter his/her name in this field. This field must be filled out.

18. **Date/Time**: Enter the date and time the samples are delivered to the lab.

19. **Shipped by**: If the samples are "drop-shipped" from the field the person who ships the samples must enter their name in this field. If the samples are hand delivered to the DEQ water lab, cross-out "shipped", write in "dropped", and enter the name of the person who dropped off the samples at the secure location.

Notes:

Duplicate samples should be labeled with a different number string than other samples at a site, i.e. a new sheet of labels. Example: if the water sample is 03-A123-W the duplicate sample should be 03-A12**4**-W. The information that a duplicate of 03-123-W was taken and the duplicate sample id, 03-A124-W, should be noted on the Site Visit form.

At the time of sample delivery the laboratory must be notified that a SIM compatible **Electronic Data Deliverable (EDD)** is required. This has been done automatically on the form. However the laboratory needs to know who to deliver the EDD to. In the area next to "SIM compatible" designate which address the EDD is to be delivered to, either the "Report Address" or "Invoice Address".

These forms are carbons. Please do not write on a stack of forms. The writing will transfer to the next form in the stack.

Field Procedures Manual - Attachment F

STORET Field Definitions

Trip
A Trip is a project-year for a given data source. STORET meta-data at the trip level may include the name of the Trip Leader, and some detail about the sampling plan and parameters monitored if desired.

The Trip ID remains constant for a year. Contact data Management to establish a Trip ID or determine the correct Trip ID for monitoring activities.

Project
A STORET project is a way to group monitoring activities together long term (over time). The project for "TMDL" (SCD/BUD) is broken down into sub-major basins (8 digit HUC) due to the size of the project.

Monitors often define reach-specific or waterbody-specific projects to organize their workload. HUC-based STORET projects do not replace or supercede these projects defined at other levels for practical purposes.

Field Activity
Field activities are performed during a station visit to evaluate conditions in the environment. Field activities consist of sample collections, measurements, and observations made on-site.

- Sample Collection involves something extracted from its environmental setting using some type of equipment and/or a sample container.
- Measurements involve something measured in its environmental setting usually using some type of equipment or instrument.
- Observations involve something observed in its environmental setting usually without using any type of equipment. This category includes habitat assessments.

Station Visit
A discrete visit or period of time spent at a station during which measurements, observations, and/or sampling activities may take place. STORET accommodates Station Visits that last longer than a single day. The departure date is not required.

Data management associates a **Site Visit Code** (label number) with each Station Visit to group related activities together for internal tracking purposes.

Activity ID
An alphanumeric code that identifies a field activity. This ID is sometimes called a "sample ID". The Activity ID must be unique for each sample or activity. Add a **Sample Matrix Code** to the Site Visit Code to generate a unique ID for each physical sample.

Sample Collection Procedure
These are the procedures used in the field to generate samples, measurements, and/or observations. You must choose a sample collection procedure for any physical sample that is taken in the field.

Field Procedures Manual-Attachment G

Debris Torrents and Recent Major Floods

Major floods are those that substantially overtop the banks of streams and occur with an average frequency of less than once every 5 years. Major floods may scour away or damage riparian vegetation on banks and gravel bars that are not frequently inundated. They typically cause movement of large woody debris, transport of bedload sediment, and changes in the streambed and banks though scouring and deposition. While they may kill aquatic organisms and temporarily suppress their populations, floods are an important natural resetting mechanism that maintains habitat volume, clean substrates, and riparian productivity.

Debris torrents, or lahars, differ from "conventional" floods in that they are flood waves of higher magnitude and shorter duration, and their flow is comprised of a dense mixture of water and debris. Their high flows of dense material exert tremendous scouring forces on streambeds. For example, in the Pacific Northwest, debris torrent flood waves can exceed 5 meters deep in small streams normally 3 meters wide and 15 cm deep. These torrents move boulders in excess of 1m diameter and logs >1m diameter and >10m long. In temperate regions, debris torrents occur primarily in steep drainages and are relatively infrequent, occurring typically less than once in several centuries. They are usually set into motion by the sudden release of large volumes of water upon the breaching of a natural or human-constructed impoundment, a process often initiated by mass hillslope failures (landslides) during high intensity rainfall or snowmelt. Debris torrents course downstream until the slope of the stream channel can no longer keep their viscous sediment suspension in motion (typically <3% for small streams); at this point, they "set up", depositing large amounts of sediment, boulders, logs, and whatever else they were transporting. Upstream, the "torrent track" is severely scoured, often reduced in channel complexity and devoid of near-bank riparian vegetation. As with floods, the massive disruption of the stream channel and its biota are transient, and these intense, infrequent events will often lead to high-quality complex habitat within years or decades, as long as natural delivery of large wood and sediment from riparian and upland areas remains intact.

In arid areas with high runoff potential, debris torrents can occur in conjunction with flash flooding from extremely high intensity rainfall. They may be nearly annual events in some steep ephemeral channels where drainage area is sufficient to guarantee isolated thunderstorms somewhere within their boundaries, but small enough that the effect of such storms is not dampened out by the portion of the watershed not receiving rainfall during a given storm.

Because they may alter habitat and biota substantially, infrequent major floods and torrents can confuse the interpretation of measurements of stream biota and habitat in regional surveys and monitoring programs. Therefore, it is important to determine if a debris torrent or major flood has occurred within the recent past. After completing the Thalweg Profile and Channel/Riparian measurements and observations, examine the stream channel along the entire sample reach, including its substrate, banks, and riparian corridor, checking the presence of features described on the Torrent Evidence Assessment Form. It may be advantageous to look at the channel upstream and downstream of the actual sample reach to look for areas of torrent scour and massive deposition to answer some of the questions on the field form. For example, you may more clearly recognize the sample reach as a torrent deposition area if you find extensive channel scouring upstream. Conversely, you may more clearly recognize the sample reach as a torrent scour reach if you see massive deposits of sediment, logs, and other debris downstream.