FIELD METHODOLOGY FOR THE ASSESSMENT OF TMDL SEDIMENT AND HABITAT IMPAIRMENTS

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Document Revision History			
Revision #	**Revision Date**	**Revised By**	**Revision Description**
01	3/13/2010	Jim Bond	Edits and restructuring of field forms to provide more intuitive flow of data entry; inclusion of field forms as appendix B to methodology; inclusion of figures and photos illustrating morphological features and "pugging and hummocking"; some editing and/or expansion to existing methods to provide further detail and clarity of direction; and basic grammatical and formating edits.

1.0 INTRODUCTION

This document describes the methodology employed by the Montana Department of Environmental Quality to collect sediment and habitat related data on stream segments listed as impaired due to sediment and/or habitat alterations on the 303(d) List. In addition, this process is also employed for the evaluation of potential reference sites as well as other non-listed waterbodies. The stream survey site assessment techniques described within this document will be implemented following the development of an aerial assessment database and the creation of a Sampling and Analysis Plan (SAP). Stream segments will be divided into reaches and sub-reaches during the development of the aerial assessment database through the use of GIS data layers and aerial imagery, while the specific locations at which stream surveys should be performed will be described in the SAP. The SAP will include hydrologically relevant data, such as an estimate of the expected bankfull width, mean bankfull depth and cross-sectional area based on regional reference data. The SAP will also include a review of the past 5-10 years of streamflow data for the area using USGS gaging station data along with SNOTEL data and other climatic data. This information will be recorded in the **Sediment and Habitat Assessment Site Information Form** prior to going into the field.

1.1 Field Reconnaissance and Site Selection

Once the aerial assessment database is compiled, a preliminary SAP will be prepared and the field reconnaissance will be performed to select stream survey sites that are representative of the overall reach/sub-reach conditions. During field reconnaissance, any potential issues with the site, such as a lack of access or the presence of beaver dams, will be resolved. The survey site assessment length will also be determined during field reconnaissance based on the estimated bankfull channel width of the stream. Following field reconnaissance, the SAP will be refined based on observed "on-the-ground" conditions.

1.2 Survey Site and Survey Cell Lengths

During field reconnaissance, the bankfull channel width of the stream will be estimated. This estimate will be used to determine the appropriate stream survey site length based on the bankfull channel width criteria described in **Table 1-1**. Each survey site will be divided into five cells, which will be numbered from downstream to upstream. If the bankfull width is near a cutoff, it will be the responsibility of the field leader to determine if 500, 1000, 1500 or 2000 feet of stream should be assessed. As general guidance, survey site length should be increased to 1000 feet for streams with bankfull widths of approximately > 10 feet, while the 1000-foot survey length should be retained for streams with bankfull widths of approximately 50 feet. Some discretion on survey length may be used by the field leader for bankfull widths > 50 feet. The increased survey length is intended to capture the diversity in morphological character; as streams increase in size, the morphological features often tend to increase in size as well, and the frequency of occurrence often displays some proportionality to the size of the stream. Therefore, as streams get larger, longer survey lengths are necessary to fully represent the reach conditions. As survey site lengths increase however, the time involved to conduct the survey also increases and so judgment can be made based on the reach conditions encountered and whether a 1500 foot reach or a 2000 foot reach will suffice to adequately represent the survey site. General guidance calls for a 1500-foot survey site length for bankfull widths between 50-60 feet, and 2000 feet for bankfull widths >60. However, under many circumstances bankfull widths much larger that 60 feet will cease to be wadeable, and render this methodology inappropriate for that site. It will be the responsibility of the field leader to determine if the length of the survey site should be modified. The field crew leader will document on the site visit form and/or the site visit notes the criteria used to make such modifications to the reach site length.

Table 1-1. Survey Site and Survey Cell Lengths.

Bankfull Channel Width (Feet)	Survey Site Length (Feet)	Length of Survey Cell (Feet)				
		Cell 1	Cell 2	Cell 3	Cell 4	Cell 5
< 10	500	0-100	100-200	200-300	300-400	400-500
> 10 to < 50	1000	0-200	200-400	400-600	600-800	800-1000
> 50 to < 60	1500*	0-300	300-600	600-900	900-1200	1200-1500
>60	2000*	0-400	400-800	800-1200	1200-1600	1600-2000

* The selection of either a 1500 or 2000 foot survey site length at bankfull channel widths of > 50 will be determined on an individual basis.

1.3 Field Crews and Division of Labor

Field crews will be established and tasks will be assigned by the field leader. Tasks are designed to be completed by 1, 2, or 3-person crews. Each crew should include at least one member that is experienced in the assessment techniques. A general division of labor and recommended crew numbers is provided in **Table 1-2** for 4, 5 and 6-person field crews, respectively.

Table 1-2. Recommended Division of Labor, 4, 5 and 6-Person Field Crew.

Task Name	Task	Division of Labor		
		4-Person Crew	5-Person Crew	6-Person Crew
Long-pro / BEHI	Site Delineation, Examine Bankfull Indicators, Pools, LWD, BEHI and Add Bank	1	2	2
Cross-Section	Cross-Section, Riffle Pebble Counts, Riffle Grid Tosses and RSI	2	2	3
Greenline	String tape and Greenline	1	1	1

Since field tasks will likely take varying amounts of time depending on site complexity, crews may not be working in the same cell at the same time. However, it is important that crews communicate when measurement sites overlap (i.e. riffle cross-sections and riffle pebble counts), since some measurements may affect other measurements. Specifically, the field crew should be aware of the following, especially in situations where the streambanks cannot be easily walked due to dense riparian vegetation:

1. The field crew should avoid disturbing the streambed in riffles where pebble counts and grid tosses will be performed.
2. The field crew should avoid disturbing the streambed in pool tail-outs or potential spawning areas, since grid tosses will be performed at these locations.

1.4 Common Abbreviations

When recording field notes, several shorthand notations should be applied:

RR = river right
RL = river left
bkf = bankfull
RBF = right bankfull
LBF = left bankfull
d/s = downstream
u/s = upstream
xs = cross-section
BEHI = Bank Erosion Hazard Index
NBS = Near Bank Stress

Note that river right and river left are always described based on a downstream orientation.

1.5 Field Photos

Field photos are specified at several places in this assessment, including the upstream and downstream ends of the survey site, at each cross-section and at each eroding streambank. In general, field photos will be the responsibility of the field leader. If two cameras are used at a site, photo information should be entered on separate **Photo Logs**. When entering the field photo number, be sure to enter the number that appears on the camera's screen. Examples of appropriate photo descriptions to be entered in the **Photo Log** include:

"u/s view at d/s end"
"d/s view at xs1"
"view from RR at xs1"
"d/s view at BEHI 1"
"view toward bank at BEHI 1"

Photo documentation should also be made when extensive pugging and hummocking (**Figure 1-1**) is observed, when there are crossings or access points that have lead to channel over-widening, to document the level of browse of woody vegetation, to note any obvious signs of human caused disturbance, and to provide a general overview of site conditions. The goal of these additional photos is to provide supporting information regarding human caused sediment sources observed at the survey site.

Figure 1-1. Examples of pugging and hummocking

2.0 METHODS

In this section, a detailed methodology is presented for assessing sediment and habitat impairments to Montana streams. Additional information regarding assessment methodologies can be found in the sources of information used to develop this methodology. Field forms associated with this methodology are provided in accompanying spreadsheets. An equipment checklist is presented in **Attachment A**.

2.1 Survey Site Delineation

The stream survey site will be delineated beginning at a riffle crest and extending upstream the pre-determined length. When no riffles are present, the field leader will be responsible for selecting an appropriate starting point. To delineate the survey site, perform the following steps:

1. When first arriving at a site, it is the responsibility of the field leader to establish the downstream end of the survey site at a riffle crest.
2. At this time, the field leader should review the information on the **Sediment and Habitat Assessment Site Information Form** with the entire field crew so that the crew is aware of the expected bankfull width and cross-sectional area.
3. From the riffle crest at the downstream end of the survey site, string a tape measure along the river right streambank at approximately the bankfull elevation along the entire length of the survey site. For a 500’ survey site, string a 200’ tape and a 300’ tape, starting with the 200’ tape. For a 1000’ survey site, string five 200’ tapes. For a 1500’ survey site, string five 300’ tapes. For a 2000’ survey site, string five 300’ tapes and one 200’ tape. For the 1000’, 1500’ and 2000’ survey sites the field crew member stringing the tapes will tie a piece of flagging denoting the progressive stationing at each new cell boundary for the entire length of the survey site.
4. While the tape measure is being strung, the field leader will record the GPS location of the downstream stationing of the survey site on the **Sediment and Habitat Assessment Site Information Form**. Once the field leader reaches the upstream end of the sample reach, typically at the end of the assessment, he/she will record the GPS location of the

upstream stationing of the survey site on the **Sediment and Habitat Assessment Site Information Form**. Standard methods for recording GPS measurements can be found in *Field Procedures Manual for Water Quality Assessment Monitoring* (MDEQ 2005).

5. Digital photos will be taken looking in both the upstream and downstream directions at both the upstream and downstream ends of the survey site. Photo numbers and a brief description (e.g. "u/s view at d/s end") will be recorded in the **Photo Log**. In the GPS column of the **Photo Log**, indicate that photos are taken at sites that correspond to GPS points using the following notation:

    d/s end = photos taken at the downstream end of the survey site
    u/s end = photos taken at the upstream end of the survey site

6. As the tape is being strung, the field leader will proceed upstream measuring, and if needed marking with a pin flag potential bankfull indicators. At this time, the field leader will measure the height ("elevation") of potential bankfull indicators and record the bankfull elevation on the **Bankfull Elevation Field Form** (see Section 2.2). The field leader will also mark the appropriate riffles where cross-sections and pebble counts will be performed using green flagging. The other members of the field crew should also be examining potential bankfull indicators as they begin on their respective tasks.
7. During this phase of the assessment, the field leader should also note any tributary inputs and irrigation diversions or return flows on the **Bankfull Elevation Field Form**.

2.2 Field Determination of Bankfull Elevation above Water Surface

Determination of the bankfull elevation is one of the most important aspects of field data collection, since an accurate bankfull elevation is necessary for many of the measurements. The ***bankfull elevation*** in this assessment will be measured as the height of the most well defined and representative selected bankfull indicators (e.g. top of bar) above the surface water level. In the field, this will be measured by placing the base of the measuring rod at the surface water "elevation", which will be zero, and measuring the height of the bankfull "elevation" at the selected bankfull indicators. When making this measurement, it can be helpful to place a flat object and a bubble level at the selected bankfull indicator. For longer horizontal distances between the bankfull indicator and the water surface, a taught string and/or a measuring rod can be placed at the bankfull indicator and extended out to the location of the surface water elevation parallel to the ground. In this case a bubble or line level must be utilized. The bankfull elevation will remain fairly constant throughout a survey site, unless a disturbance, such as water diversions and/or tributaries or other flow altering impacts have lead to unexpected variability in the overall channel form. Also it appears that there is consistency in bankfull elevations within watersheds of similar hydro-physiographic regions. Therefore elevations at one site can be used as a preliminary indicator, or gauge of accuracy, at another site with the same characteristics.

Lead by the field leader, all members of the team will work together to identify appropriate locations to measure bankfull elevations. On the **Bankfull Elevation Field Form,** record the bankfull elevation measurements to the nearest tenth of a foot and note the type of feature that the measurement is made on. Also note which side of the channel the bankfull measurement is made on and which type of feature was identified as a bankfull indicator. The field leader should keep in mind that channel cross-sectional measurements will be performed in riffles and, thus, should be looking to see if there are any riffles with clear bankfull indicators. At least **5** (and up to 15) separate bankfull elevation measurements should be recorded on the **Bankfull Elevation & Slope Assessment Field Form**. These measurements will then be reviewed and a bankfull elevation above water surface for the site will be established. The final bankfull determination will be made by the person with the most experience, which will generally be the field leader, though the entire field crew will be expected to provide input. The determined bankfull elevation above water surface will then be used as a guide for the field crew to look for as they record measurements throughout the survey reach. Potential bankfull indicators include (Leopold 1994, Rosgen 1996):

> The elevation of the highest depositional feature, such as the **top of a point bar** or other relatively flat surface**.**
>
> A **change in vegetation type**, such as from a gravel bar to perennial vegetation, or from herbaceous vegetation to woody vegetation. Note that during times of drought vegetation may colonize the active channel. Willows frequently occur below the bankfull level, while alders frequently grow above the bankfull level.
>
> A **change in slope (slope break),** such as a change from a sloping depositional bar to a vertical bank or from a vertical bank to a more level surface at the floodplain elevation.
>
> A distinct **change in the particle size distribution** on the surface of streambanks.
>
> Evidence of an **inundation feature**, such as a small bench along an otherwise entrenched channel.
>
> **Staining of rocks** may be used in some circumstances.
>
> **Exposed root hairs** may be used in some circumstances.
>
> Other channel features, such as the **top of the bank,** the **bottom of an undercut**, and **debris in the riparian vegetation** are also useful measures to examine when assessing the bankfull elevation, though these features do not necessarily correspond with the bankfull elevation.

2.3 Channel Cross-sections

Channel cross-section measurements will be performed at a riffle in each cell using a line level and a measuring rod. Data collected during the Channel Cross-section assessment should be entered in the **Channel Cross-section Field Form**. The steps to performing channel cross-section measurements go as follows:

1. Review the **Bankfull Elevation & Water Surface Slope Field Form** to determine the expected bankfull elevation.
2. Select the first riffle encountered in the cell progressing in the upstream direction. If no riffle is encountered in a cell, follow these criteria:

If there is a riffle in 4 out of 5 cells, then 4 riffle cross-sections will be performed.

If there is a riffle in 3 out of 5 cells, then 3 riffle cross-sections will be performed.

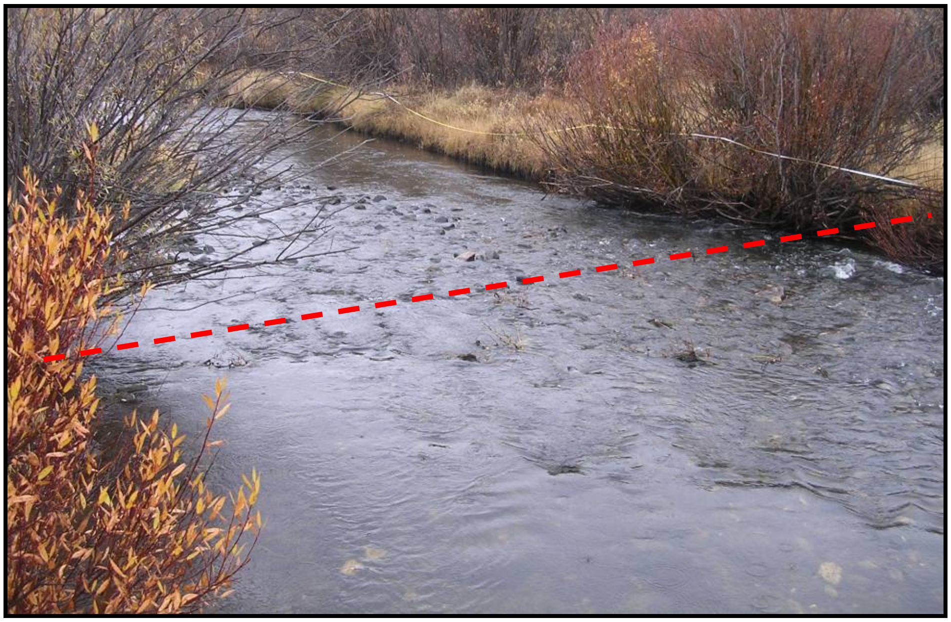
If there are only 2 cells with riffles, then 1 cross-section measurement will be performed at the first riffle encountered in each cell progressing in an upstream direction. If there are additional riffles in either of these cells, then a “second pass” will be made starting at the downstream cell, where the next riffle upstream will be assessed. Thus, there will be a total of 3 riffle cross-sections from three distinct riffles ensuring that no riffle is measured twice.

If there are only 1 or 2 riffles in the entire assessment reach, then only 1 or 2 cross-sections will be performed.

If there are no riffles in the survey site, perform one cross-section measurement in the shallowest run. Note on the **Sediment and Habitat Assessment Site Information Form** that this measurement was made in a run.

3. Examine the streambanks along the riffle for potential bankfull indicators and make additional measurements to confirm the bankfull elevation. Bankfull indicators both upstream and downstream of the riffle can also be reviewed at this time. Record additional measurements on the **Bankfull Elevation & Water Surface Slope Field Form** (if space remains), or in the *calculations and notes* box for the individual cross-section.
4. String a 200-foot tape (“line level”) from the bankfull elevation on the river left streambank (looking downstream) to the bankfull elevation on the river right streambank at the most “well-defined” portion of the riffle and perpendicular to the bankfull channel. One crew member should hold the tape measure in place on the left bank, while the second crew member secures the tape to the right bank. Be sure that the tape is strung tightly, since a sagging tape will lead to inaccurate measurements.
5. If the riffle is situated at an angle to the overall bankfull channel direction, perform the cross-section measurement where the riffle comprises the greatest portion of the stream channel or the area where the riffle is most clearly defined, as depicted in **Figure 2-1**.

Figure 2-1. Example of a Riffle Situated at an Angle to the Bankfull Channel.



6. If there is a mid-channel bar at the along the riffle, move the line level cross-section to a portion of the riffle lacking this feature. If the mid-channel bar extends the length of the riffle, then include it in the bankfull channel measurement if the top elevation is below the bankfull elevation.
7. If the top of the mid-channel bar is above the bankfull elevation, or there is a side channel along the riffle (see 7.a.), within the same cell progress to the next riffle upstream or to a portion of the riffle that is relatively un-impacted by these features. If these features extend the length of the cell, and therefore must be measured, then divide the channel into two cross-sections extending from bankfull to bankfull and perform depth measurements at the appropriate interval based on the overall bankfull width of both channels. Use the cross-section table at the end of the **Channel Cross-section Field Form** to enter this information.
    a. If there is a side channel along the riffle, include it in the bankfull channel measurement if it is flowing. If it is not flowing, include it in the bankfull channel measurement if the thalweg elevation is below the bankfull elevation (Heitke et al. 2006) and divide the channel into two cross-sections extending from bankfull to bankfull and perform depth measurements at the appropriate interval based on the overall bankfull width of both channels. Use the cross-section table at the end of the **Channel Cross-section Field Form** to enter this information. If the side channel is not flowing and the thalweg depth is above the bankfull elevation or the side channel is discontinuous, exclude it from the bankfull channel assessment (Heitke et al. 2006).
8. Do not perform cross-section measurements at sites used for human or animal crossings (Kershner et al. 2004). If this situation is encountered at the first riffle in the cell, progress to the next riffle upstream or to a portion of the riffle that is relatively un-impacted by the crossing. In the *calculations and notes* box of the field form, record the type adjustment made.

9. If no riffles are identified within the entire stream survey site, perform the cross-section measurement in a run. The selected run should represent the longest section of the channel that has the shallowest bed elevation. Record that the measurement was performed in a run on the **Sediment and Habitat Assessment Site Information Form**. Note that there is often a "good" (i.e. easily discernable) bankfull indicator on only one side of the channel. The other side of the channel can be "set" at this elevation, based on the measured distance between the surface water elevation and the bankfull elevation that was established during the bankfull elevation assessment. When the line level is strung tightly, the distance from the water surface to the tape ("line level") should be the same on both sides of the channel. In dry channels and in longer cross sections where tape sag occurs, a level must be used to ensure a good tape setting. Also in longer cross sections it is recommended that a thin piece of rip-cord be strung in addition to the tape. The cord helps to minimize tape sag over longer distances.
10. Record the station location of the cross-section.
11. Record the latitude and longitude at the center of the cross-section on the **Cross Section Field Form**.
12. Take a picture of the cross-section, preferably facing downstream. Record the photo number on the **Cross-section Field Form** and in the **Photo Log**. Record whether the photo was taken facing downstream or upstream in the **Photo Log** (i.e. "d/s view at xs1"). Take a second photograph of the cross-section looking across the channel and record which side of the channel the cross-section is taken from (i.e. "view from RR at xs1"). Take an optional third photograph of the streambank with the "best" bankfull indicator, including the line level and the measuring rod, and record which streambank this was taken on. The measuring rod should be placed with the base ("zero") at the surface water elevation. In the GPS column of the **Photo Log**, indicate that the photo was taken at a cross-section using the following notations:

    xs1 = Photo taken at cross-section 1
    xs2 = Photo taken at cross-section 2
    xs3 = Photo taken at cross-section 3
    xs4 = Photo taken at cross-section 4
    xs5 = Photo taken at cross-section 5

13. Measure the bankfull width to the tenth of a foot.
14. Calculate the interval at which depth measurements will be performed based on the following criteria and record this interval:

    For streams <10 feet wide (500' survey reaches), collect depth measurements at equally spaced intervals at 20% of the bankfull channel width (divide bankfull channel width by 5).

    For streams >10 but <50 feet wide (1000' survey reaches), collect depth measurements at 10% intervals (divide bankfull channel width by 10).

    For streams between 50-60' feet wide, collect measurements at ~7% intervals (divide bankfull channel width by 15).

For streams between >60’ feet wide, collect measurements at 5% intervals (divide bankfull channel width by 20).

15. Once the interval at which depth measurements will be performed is determined, one crew member will make the measurements across the channel progressing from river left to river right (facing downstream), while the second crew member records the data. Measurements should be recorded to the tenth of a foot as the distance from the channel bed to the line level.
16. Record the thalweg depth, which is found at the deepest part of the channel. If the thalweg depth is not captured during the equally spaced depth measurements, be sure to measure this depth and record it for use in the floodprone width calculation (note that this measurement will not be included when determining the mean bankfull depth).
17. From the cross-section measurements, calculate the mean depth and then calculate the cross-sectional area and the width/depth ratio (optional) using the following equations (note that calculations performed in the field should only be used as a field check. Post-field data processing may utilize different methodologies and/or equations):

    Mean depth = sum of depth measurements / number of depth measurements (exclude the RBF and LBF measurements, unless they are greater than zero, such as when there is a vertical bank)

    Cross-sectional area = bankfull width x mean bankfull depth

    Width/depth ratio = bankfull width / mean bankfull depth

18. Compare the measured cross-sectional area to the expected cross-sectional area based on regional reference data as cited on the **Sediment and Habitat Assessment Site Information Form**. If the measured cross-sectional area is not within the expected range based on regional reference data as cited on the form, review the bankfull elevation. If it appears that the bankfull elevation was in error, re-perform the measurements. Otherwise, note the reasoning behind the discrepancy in the *calculations and notes* box of the field form. As discussed in Section 2.2, the cross-sectional area should remain relatively constant among the five riffle cross-sections. If they are not, then the bankfull elevation should be reviewed.
19. Leave the line level in place while performing the floodprone width measurements.

2.4 Floodprone Width Measurements

The floodprone width measurement is made at the same location as the channel cross-section measurement and the data should be recorded on the **Channel Cross-section Field Form**. The floodprone elevation is defined as twice the maximum (thalweg) depth (Rosgen 1996). The floodprone width is measured perpendicular to the valley, which may or may not be the same as being perpendicular to the bankfull channel at a given cross-section (Heitke et al. 2006). The steps to performing floodprone width measurements go as follows:

1. The floodprone elevation is calculated based on the maximum depth, which is determined during the cross-section assessment, using the following equation:

   Floodprone elevation = 2 x maximum depth

2. Starting at the left streambank, place the measuring rod on top of the tape ("line level") at the bankfull channel margin so that "zero" on the rod is at the bankfull elevation.
3. Identify the height of the previously measured maximum bankfull depth on the measuring rod. This is the height of the floodprone elevation.
4. Place the clinometer at the height of the floodprone elevation on the measuring rod and look "through" the clinometer towards the floodplain.
5. Level the clinometer using the "zero" percent slope reading.
6. The second member of the crew will measure the floodprone width using a 200-foot tape and starting at the bankfull channel margin.
7. The crew member with the clinometer will guide the crew member with the tape to the point where the "zero" percent slope reading on the clinometer meets the ground elevation. This is the edge of the floodprone area and corresponds with the floodprone elevation at "2 x maximum depth".
8. Measure the floodprone distance out as far as possible, or to 200 feet, whichever is encountered first. If the floodplain distance is >200 feet, circle ">200 feet" on the field form.
9. Be sure to measure a total floodprone width of at least 300 feet when applicable (i.e. the stream is 60-feet wide), including the bankfull channel width and the floodprone distances on both sides. A total distance of 300 feet is recommended when the stream is 60-feet wide, since this would lead to an entrenchment ratio of 5, which indicates the stream is not entrenched. On smaller streams, field personnel can use Best Professional Judgment to determine an adequate distance to measure along the floodplain to assess whether a stream is entrenched or not. When the entrenchment ratio is >5, circle this on the field form.
10. When a clear "line-of-site" is precluded by dense riparian vegetation, the edge of the floodprone area should be estimated using Best Professional Judgment. When this is done, circle the "estimated" box on the field form. Dense vegetation can also preclude the use of the tape measure. In this situation, it is acceptable to "pace" the floodprone distance or to provide a visual estimate of the floodprone width. When this is done, be sure to mark the "estimated" box on the field form.

    Note that field members responsible for estimating distances by pacing should measure their "stride" prior to making field measurements. This can be accomplished by laying out 100 feet of tape, and then counting how many paces it takes to go 100 feet. Divide 100 by the number of paces to determine the distance traveled in one "stride". The field member can the count their paces when making distance estimates and multiply this by the length of the "stride".

11. If a "localized" high point of the floodplain is encountered along this transect, such as a mound associated with riparian vegetation, continue past this point until the actual terrace is reached. A high point should generally be considered "localized" if there are areas of

the floodplain below the floodprone elevation upstream or downstream of the high point, as well as farther back on the floodplain from the high point. When in doubt, try to visualize where the water will be when it leaves the bankfull channel.

12. Repeat this measurement on the river right side of the channel.
13. Calculate entrenchment ratio and record on the **Channel Cross-section Field Form.**
14. In situations where there are side channels separated by large distances and/or elevations that are higher than the identified floodprone elevation, additional analysis of the floodprone area may be necessary using GIS and aerial imagery.

2.5 Identification of Channel Bed Morphology

The length of the survey site occupied by pools and riffles will be identified during this assessment. The data should be recorded on the **Pools, Riffles and Large Woody Debris Field Form.** This assessment will be performed concurrently with the pool habitat quality, percent surface fine sediment in pool tail-outs, and large woody debris assessments. The steps to identifying the bed morphology go as follows:

1. Starting at the downstream end of the cell, record the downstream and upstream station of the following bed morphology features: riffles and pools. A riffle feature will be considered significant when it occupies >50 percent of the bankfull channel (Heitke et al. 2006). All qualifying pools, defined below and in section 2.6.4, will be counted.

    Riffles are sections of the channel bed with the steepest bed slopes, causing the surface water to flow swiftly and turbulently over submerged or partially submerged particle materials. The substrate of a riffle is generally comprised of gravels or cobbles (Overton et al. 1997). The "riffle crest" at the upstream end of this feature distinctly marks the start of a riffle and can be identified as the area where the surface water flow changes from smooth to turbulent. Riffles tend to have an indistinct thalweg and are considered a ***"fast, shallow"*** habitat unit. Illustration provided in **Figure 2-2**.

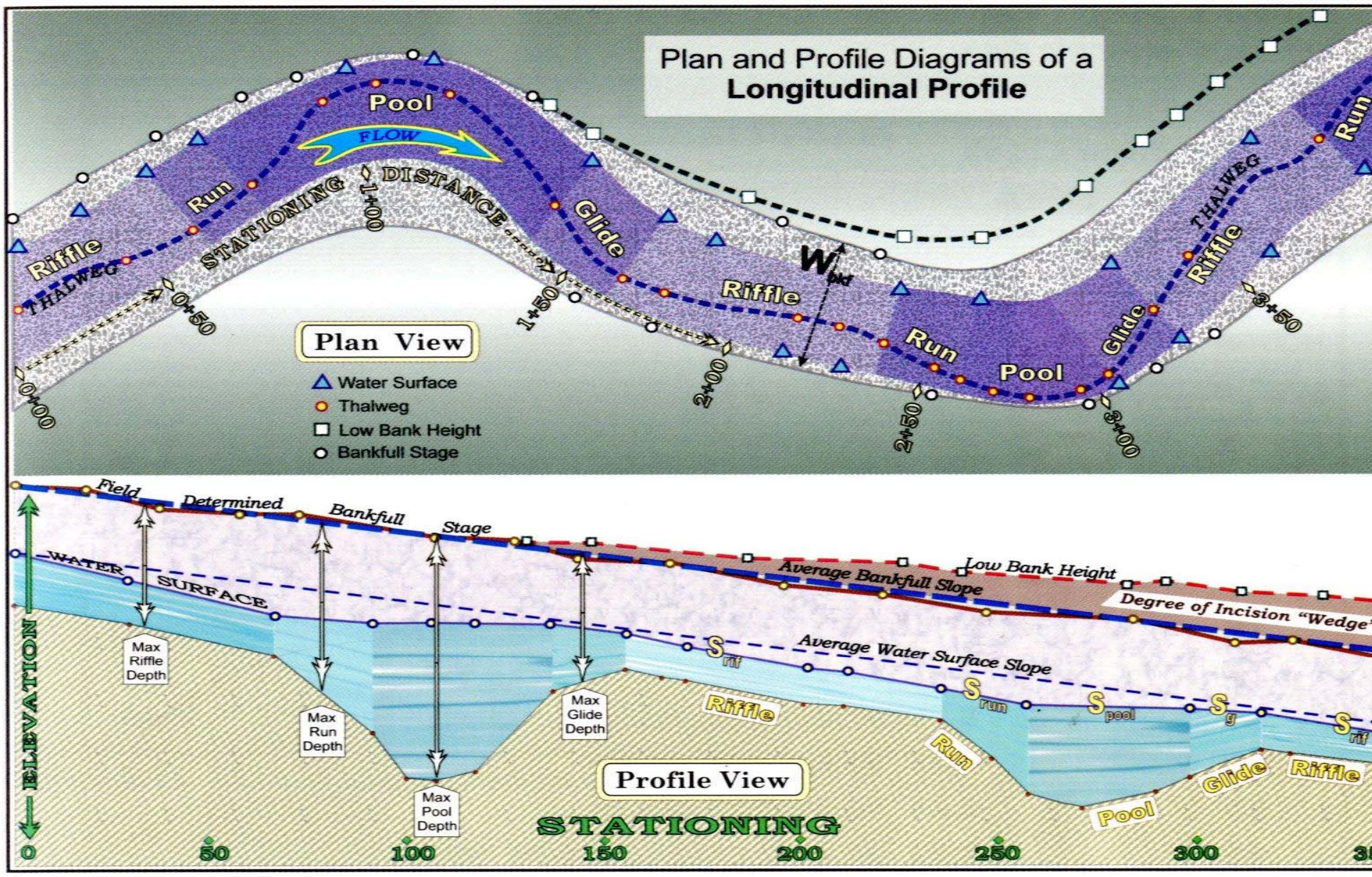
    Pools are depressions in the streambed that are concave in profile and bounded by a "head crest" at the upstream end and "tail crest" at the downstream end (see additional description in the Residual Pool Depth section). Pools can be formed by scour or damming. Pools are considered a "***slow, deep"*** habitat unit. Pool length should be measured along the thalweg from the head crest to the tail crest (Kershner et al. 2004). Illustration provided in **Figure 2-2**.

2. Besides riffles and pools, streams are comprised of two other dominant channel bed morphology features: glides and runs. Definition for glides are provided, though the stationing of these features will not be recorded on the field forms. Illustrations provided in **Figure 2-2**.

    Runs differ from riffles in that depth of flow is typically greater and the slope of the channel bed is less than that of riffles. The surface water in a run has little or no turbulence, though the flow is still relatively swift. Runs will often have a well defined thalweg and are considered a ***"fast, deep"*** habitat unit.

Glides occur at the transition from the pool to the crest of a riffle. The slope of the channel bed through a glide is negative (upward bed slope in the downstream direction), while the slope of the water surface is positive. Glides have a uniform U-shaped channel bottom with no defined thalweg (Overton et al. 1997). The head of the glide can be identified by examining the location of increased flow velocity coming out of the pool and/or the location of a break in slope in the channel bed as it raises out of the pool and decreases to a lesser gradient. Note that this feature is often absent/indistinguishable in the transition from a pool to a riffle. Glides are considered a ***"slow, shallow"*** habitat unit.

Figure 2-2. **Channel Bed Morphology (from Rosgen 2008)**



2.6 Residual Pool Depth

The residual pool depth measurements will be performed at all pools encountered. Data collected during this portion of the assessment should be recorded on the **Pools, Riffles and Large Woody Debris Field Form**. This assessment will be performed concurrently with the pool habitat quality, percent surface fine sediment in pool tail-outs, and large woody debris assessments. The steps to performing the residual pool depth assessment go as follows:

1. Starting at the downstream end of the cell, approach each pool from the downstream end.
2. Record the pool number, starting at “1” and progressing upward through the survey site.
3. Record the upstream and downstream station of the pool, with the downstream end being located at the same point that the residual pool-tail depth measurement is made.
4. For this assessment, a ***pool*** is defined as a depression in the streambed that is concave in profile, is bounded by a “head crest” at the upstream end and “tail crest” at the downstream end, and that typically has a maximum depth that is 1.5 times the pool-tail depth (Kershner et al. 2004). Dammed pools will also be assessed, though backwater pools will not. When in doubt, measure the pool, since the measurement can be removed from the dataset during post-field data processing if it is determined to be inappropriate.
5. Note that “dammed” pools will not have a tail crest and no depth measurement is necessary. When a “dammed” pool is encountered, write “N/A” in the *Pool Tail Crest Depth* column of the field form.
6. For this assessment, the ***residual pool*** is defined as the portion of the pool that is deeper than the riffle crest forming the downstream end of the pool (Hilton and Lisle 1993). To identify the “residual” pool, visualize the shape of the pool and evaluate where “standing” water would remain if all the “flowing” water were drained from a stream. The pool tail crest tail is located at the most downstream end of this “residual” or “remaining” pool.
7. To determine the residual pool depth, identify and measure the depth of the pool tail crest to the tenth of a foot. The pool tail crest depth should be measured at the deepest point along the tail crest where there is a slope break as the pool transitions into another channel bed feature (Overton et al. 1997, Heitke et al. 2006). This area generally coincides with the thalweg. Note that the depth of the pool tail crest tends to remain relatively constant along a stream reach at a given streamflow.
8. Measure the maximum depth of the pool to the tenth of a foot. It often takes several measurements while “probing” the pool to determine which point is the deepest. Once the maximum depth of the pool is identified, record this value on the field form.
9. When working within a dry channel, measure the depths of the pool and hydraulic control from the channel bed surface to the bankfull height.

2.7 Pool Habitat Quality

An assessment of pool habitat quality will be performed at all pools encountered. Data collected during this portion of the assessment should be recorded on the **Pools, Riffles and Large Woody Debris Field Form**. This assessment will be performed concurrently with the residual pool depth, percent surface fine sediment in pool tail-outs and large woody debris assessments. The steps to performing the pool habitat quality assessment go as follows:

1. Determine the pool type as (Overton et al. 1997):

S = Scour, when formed by the scouring action of water flowing over/around an obstruction or at a meander bend
D = Dammed, when formed by downstream damming action

2. The pool formative feature will be described for each pool as (cite primary type) (Overton et al. 1997):

    LS = Lateral scour, when formed by scour at a meander bend
    P = Plunge, when formed by scour from vertically falling water
    B = Boulder, when formed by a boulder
    W = Woody Debris, when formed by overhanging vegetation or woody debris

3. Pool size will be determined based on the proportion of the bankfull channel width occupied by the pool. Describe each pools as:

    S = Small, when <1/3 of the bankfull channel
    M = Medium, when >1/3 and <2/3 of the bankfull channel or is >10 feet wide
    L = Large when >2/3 of the bankfull channel wide or is >20 feet wide

4. The pool cover type will be described for each pool as (cite primary type):

    V = Overhanging Vegetation
    D = Depth
    U = Undercut
    B = Boulder
    W = Woody Debris
    N = No apparent cover

5. Although the "U" cover type should only be used if an undercut provides a substantial amount of cover for the pool, if an undercut bank is present at a pool, it should be measured. The depth of the undercut streambank will be measured, if present, using the measuring rod. This measurement should be made by inserting the measuring rod horizontally into the undercut streambank. The "depth" of the undercut will be the distance from the back of the undercut to the edge of the overhanging streambank. It may take several measurements to determine the maximum depth of the undercut. The maximum depth of the undercut should be recorded on the field form to the tenth of a foot.

2.8 Fine Sediment in Depositional Spawning Areas

An assessment of the percent of fine sediment in depositional spawning areas using the grid toss method will be conducted at all scour pools encountered within each cell where appropriate sized spawning gravels have been identified and the potential for spawning exists. **Always perform the grid toss when spawning gravels are observed or when observed conditions, parent geology, and/or stream type suggests that spawning gravels would be present under natural**

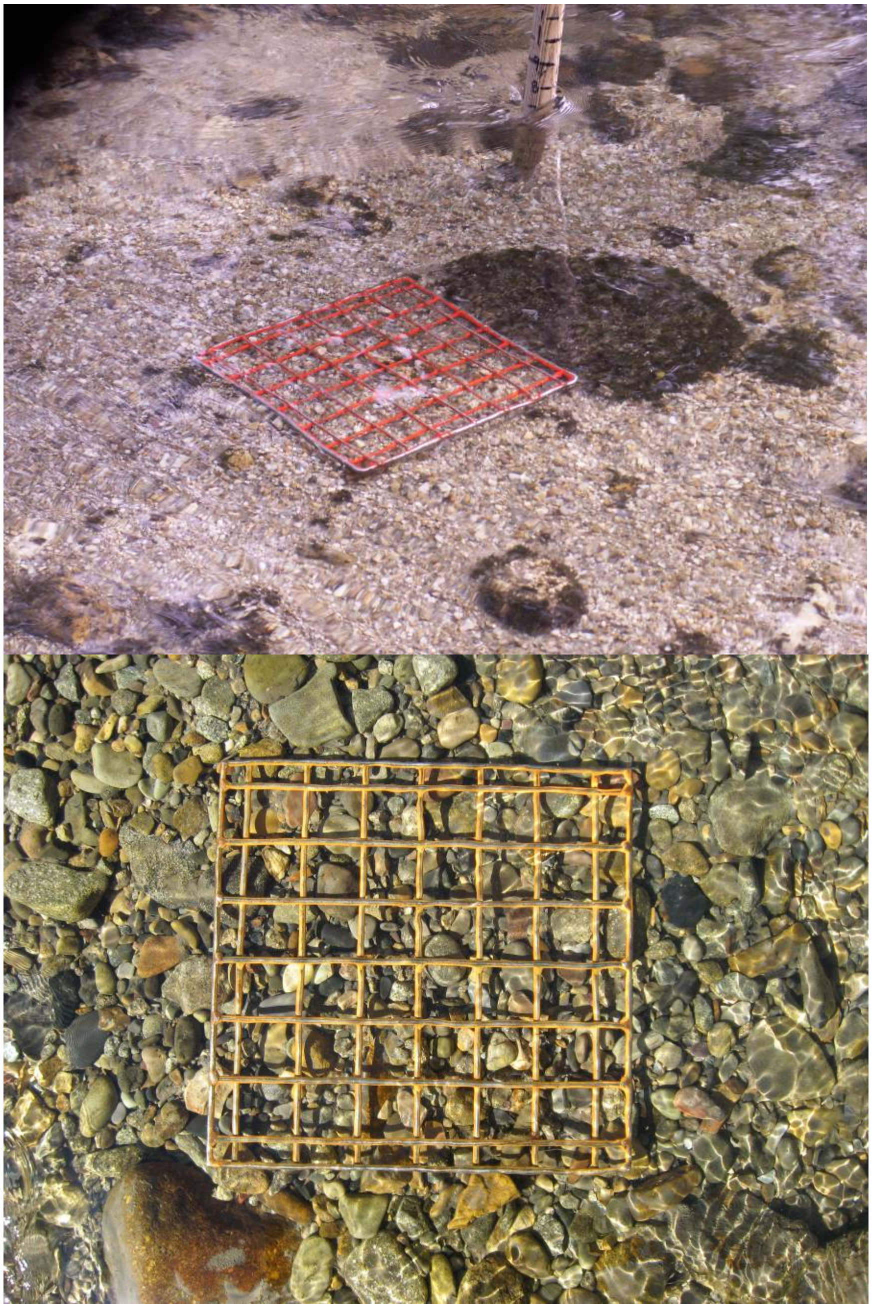
conditions. Data collected during this portion of the assessment should be recorded on the **Pools, Riffles and Large Woody Debris Field Form**. This assessment will be performed concurrently with the residual pool depth, pool habitat quality and large woody debris assessments.

> **Note that it is often expedient to perform this measurement prior to the residual pool depth measurements and the pool habitat quality assessment since clear water is required for this procedure.**

The steps to performing the percent fine sediment assessment in depositional spawning areas using the grid toss go as follows:

1. Approach the first ***scour*** pool encountered in the cell from the downstream end so as to not disturb fine sediment on the streambed since this can impede visibility.
2. Since part of the salmonid spawning cycle occurs during baseflow conditions in the spring and the fall, it is up to the observer to determine which portion of the pool could potentially support spawning.
    a. Identify the depositional spawning area, which is typically located just upstream of the pool tail crest. At times the depositional spawning area will be identifiable as an “arc” at the downstream end of the pool. In situations where the pool transitions to a glide, the pool tail-out will extend to the riffle crest of the downstream riffle (see definitions in Section 2.5). In some instances the identified depositional spawning area will only be on one side of the pool-tail or the pool itself. In these instances the grid measures are to focus only in these areas and it is very important that only the most qualified personnel identify and sample such areas.
    b. The appropriate size of spawning gravels varies based on stream size and the expected fish species, since larger fish are capable of moving larger substrate particles. In general, fish can spawn in gravels with a median diameter up to about 10% of their body length (Kondolf 2000). Therefore, as fish length increases from 6 to 30 inches, the median particle size (D50) of spawning gravel increases from 0.6 to 3.0 inches. An example of appropriate sized spawning gravels for fish approximately 5 and 15 inches is presented in **Figure 2-3** (Note each “square” of the grid is equal to approximately 1.5 inches).

Figure 2-3. Example of Appropriate Sized Spawning Gravels.



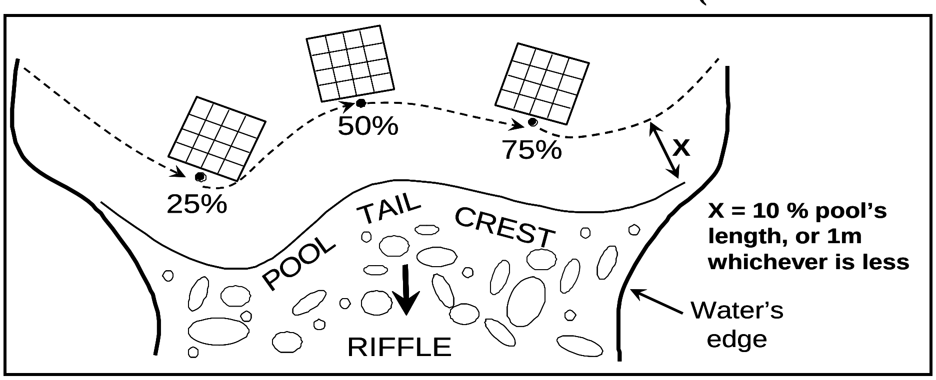
3. The observer should record the potential for spawning as:

   Y = Pool feature has the appropriate sized gravels for spawning
   N = Pool feature lacks appropriate spawning gravels
   ? = It is unclear if the pool feature would support spawning

4. The observer should record the location of the depositional spawning area and provide a estimate of the D50 of the material deemed appropriate for spawning:
    a. In the Location column of the field form the observer will define the general location of the area sampled. The two options available include either **PT** (Pool-Tail) or **NT** (Non-Typical) with comments clarifying the location.
    b. The visual estimate of the D50 of the bed material within the identified potential spawning area will be made within the range of categories available for the pebble count. These include < 2mm, 2-4mm, 4-6.35mm, 6.35-8mm, 8-11.3mm, 11.3-16mm, 16-22.6mm, 22.6-32mm, 32-45mm, 45-64mm, 64-90mm. Note size classes approaching 90mm approximately equates to a 35 inch fish.

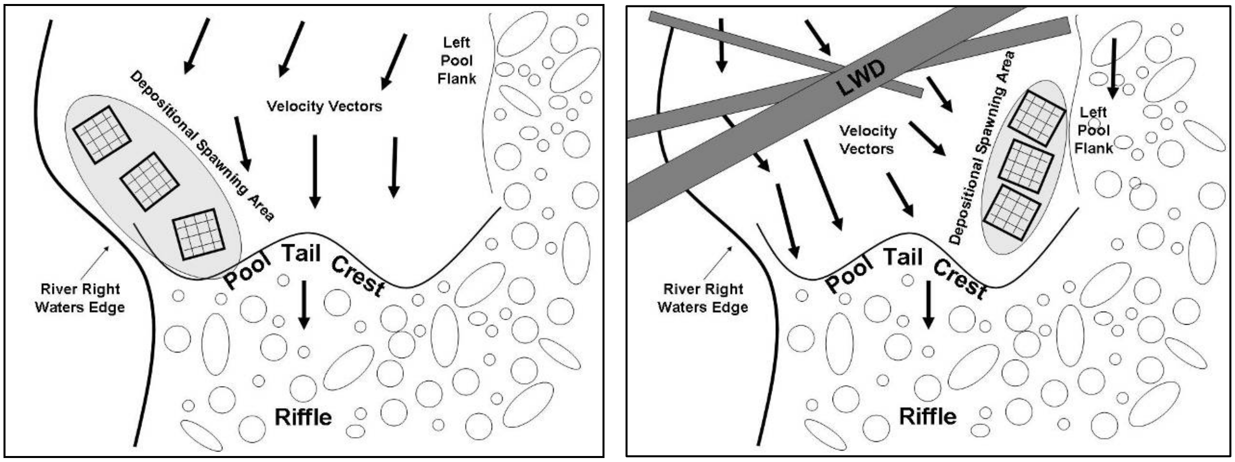
5. Typical vs non-typical spawning areas:
    a. Sampling depositional spawning areas within "typical" pool tail features:
        i. The grid toss measurement should be performed in the "arc" just upstream of the pool tail crest in situations where the pool flows directly into a riffle. Approximately 10% of the pools length upstream of the tail crest can be include as the pool tail-out, or approximately 1 meter, whichever is less (Heitke et al. 2006). Note that the grid toss measurement is not to be made in the scoured portion of the pool itself or in the thalweg.
        ii. Perform the grid toss at approximately the 25%, 50% and 75% of the wetted channel width within the arc of the area of material of spawning size or smaller (Kershner et al. 2004) (**Figure 2-4**).

Figure 2-4. Location of Pool Tail-out Grid-toss Measurements (from Heitke et al. 2006).



    b. Sampling depositional spawning areas within "non-typical" pool features:
        i. The grid toss measurement should be performed in the area identified as having the potential for spawning. More often then not these areas are located at the flanks of the pool or the pool tail itself where the appropriate habitat, including adequate velocity, is present to support spawning.
        ii. Perform the grid toss at approximately the 25%, 50% and 75% of the length of the area of material of spawning size or smaller (**Figure 2-5**).

Figure 2-5. Sampling Depositional Spawning Areas within "Non-Typical" Pool Features.



6. To perform the grid toss, randomly "toss" the grid in each zone sequentially.
   a. The grid can break if it lands on an edge, so the "toss" should be made gently and grid should land on the channel bed relatively flat.
7. Use a Plexiglas viewer to improve visibility by placing it on the waters surface with the upstream edge out of the water.
8. To assess the percent of fine sediment <6.35mm, count how many intersections "cover" (or intersect with) particles <6.35mm. Note that the standard size of the grid is 12"x12" and the intersection size is approximately 6mm. There are 49 "internal" intersections. Do not count intersections along the edge of the grid. It may help reduce observer bias to use a bank flagging pin to locate the particle to be assessed near each grid intersection.
9. Record the number of intersections covering particles <6.35mm on the field form.
10. If a portion of the grid lands on a large cobble or boulder, pick up the grid and re-perform the toss. If large cobbles and boulders cannot be avoided, do not assess grid intersections that fall on the large cobble or boulder. Large cobble or boulders will be considered as a single stone covered by 4 or more intersections. On the field form, record the number of particles <6mm out of the number assessed (e.g. 6/35).
11. In small streams, the grid tosses may overlap. When this occurs, place an "X" in the appropriate column of the field form to indicate that the measurements overlap.
12. If algae or organic debris on the streambed hinders identification of the particle under the grid intersections, try and gently clear away the obstruction without disturbing the streambed. In some instances, the observer can "probe" the grid intersection to "feel" if there is fine sediment underneath it. When the particle size cannot be determined under one or more intersections, record the number of particles <6mm out of the number assessed (e.g. 6/35). If the pool tail-out is large enough, the observer can choose to re-toss the grid in an area lacking obstructions.
13. Repeat this measurement in all scour pools encountered in the cell. If there are no scour pools in the cell, progress to the next cell.

2.9 Fine Sediment in Riffles

An assessment of the percent of fine sediment in riffles using the grid toss method will be performed at same location in which pebble counts are performed. The grid toss measurements should be performed before the pebble count measurements are performed. Data collected during this portion of the assessment should be recorded on the **Riffle Pebble Count Field Form**. The steps to performing the percent fine sediment assessment in riffles using the grid toss go as follows:

1. The riffle grid toss measurement will be performed in the same riffle as the riffle pebble count as described in Section 2.11.
2. Perform this measurement mid-way down the riffle at distances 25%, 50% and 75% progressing from the bankfull channel margin on river left.
3. Count the number of intersections on the 49-point grid with particles <6.35mm as described in Section 2.8.

2.10 Woody Debris Quantification

The amount of large woody debris (LWD) will be assessed along the entire assessment reach. This assessment will be performed concurrently with the residual depth, pool habitat quality and percent surface fine sediment in pool tail-outs assessments. Data collected during this portion of the assessment should be recorded on the **Pools, Riffles and Large Woody Debris Field Form**. The steps to performing the large woody debris assessment go as follows:

1. Large pieces of woody debris located within the bankfull channel that are stationary and appear to influence channel form at bankfull flows will be counted based on the following categories:

    A **single** piece of large woody debris should be counted if it is greater than 9 feet long or two-thirds of the wetted stream width, and 4 inches in diameter at the small end (Overton et al. 1997). On the field form this will be recorded as "1" if there is one single piece. If several single pieces are located near each other, but are not functioning as an aggregate (i.e. not collectively influencing channel bed morphology), then the actual number of single pieces should be recorded.

    An **aggregate** of large woody debris is comprised of two or more single pieces that are in contact with one another and are collectively influencing channel bed morphology. An estimate of the number of pieces that meet the definition of a single piece should be made. This number of individual pieces will be recorded on the field form as the number of single pieces per one aggregate.

    A **willow bunch** will be denoted on the field form with an "X" when a dead willow or decadent branches of a live willow are influencing channel bed morphology. The term "willow bunch" is used in this assessment to apply to all riparian shrub species that may be encountered (i.e. alders, red osier dogwood, etc.).

Only one “type” of LWD should be noted at a station. The “willow bunch” type should generally be recorded as “1”. While there is a minimum size requirement for LWD, it is important to consider the potential of a piece to influence channel morphology, as specified in #1 of the method. If a piece is borderline in size and does not meet the morphology criteria, then it should not be counted. A willow bunch should only be counted when it is a dead set of branches leaning over or into the channel and influencing channel morphology. This will typically be the case on meadow streams with finer substrate, while systems with larger substrate will not likely be influenced.

2.11 Riffle Pebble Count

One Wolman (1954) pebble count will be performed in the first riffle encountered in Cells 1, 3 and 5 progressing in an upstream direction for a total of 300 particles within the assessment reach. Data collected during this assessment will be recorded on the **Riffle Pebble Count Field Form**. The steps to performing the riffle pebble count go as follows:

1. The riffle pebble count will be performed in the first riffle encountered within Cells 1, 3 and 5. This will be the same riffle that the channel cross-section measurements will be performed in. If one or more cells lacks a riffle, use the following criteria to select an appropriate riffle to sample:

    If Cell 1 lacks a riffle, perform the pebble count in Cell 2 in the same riffle in which the cross-section measurement is performed.

    If Cell 3 lacks a riffle, perform the pebble count in Cell 4 in the same riffle in which the cross-section measurement is performed.

    If Cell 5 lacks a riffle, perform the pebble count in Cell 2. If Cell 2 was assessed, perform the pebble count in Cell 4.

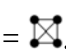
    If a total of three pebble counts are not obtaining using these criteria, begin again in Cell 1 and collect samples at the second riffle until a total of three riffle pebbles counts are obtained.

    If there are only 1 or 2 riffles in the entire assessment reach, then only 1 or 2 pebble counts will be performed.

    If there are no riffles in the survey site, collect one pebble count from the shallowest run. Note on the **Sediment and Habitat Assessment Site Information Form** that this measurement was made in a run.

2. Particles will be collected using the “heel-to-toe method” where the assessor progresses across the channel perpendicular to the bankfull channel flow while placing one foot in

front of the other and collecting the first particle encountered by the tip of their finger at the toe of their leading foot. If a particle is encountered more than once (i.e. large boulder or bedrock), the feature is counted as many times as it is encountered.

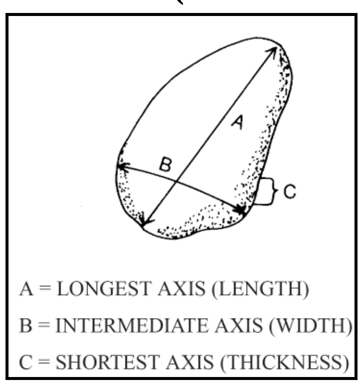
3. The pebble count will be performed for particles fluvially deposited on the streambed within the bankfull channel margin and for particles deposited by streambank erosion. Particles will not be collected from streambanks below the bankfull elevation that were not deposited by fluvial processes or streambank erosion.
4. The assessor should begin the pebble count on the channel bed at the left side of the bankfull channel at the mid-point of the riffle when the streambank angle is >90º.
5. When the streambank angle is <90º, particles will be collected from the streambank within the bankfull channel margin if the particle was deposited by fluvial or streambank erosion processes.
6. The first "pass" will be conducted across the riffle progressing from left to right. Once the assessor reaches the right bank, the process is repeated just upstream of the "line" where particles were just collected.
7. At least 100 particles must be assessed in each riffle pebble count and each "pass" must be completed from bankfull to bankfull. If 100 particles are not collected in the first two passes, the assessor should move to the lower third of the riffle for the third and forth passes and then to the upper third of the riffle for the fifth and sixth pass, if necessary.
8. Particles will be collected using a template (also called a gravelometer), since this technique provides higher accuracy than measurements with rulers and reduces variability between different operators (Bunte and Abt 2001).
9. A template is used to reduce errors in defining the *b*-axis, which is the intermediate length axis of the particle (see **Figure 2-6** in Section 2.11). However, when using the template, it is possible to insert particles that have a comparatively small *c*-axis (i.e. flat rocks) "diagonally" into a template hole that is actually smaller than their *b*-axis. Thus, it is important when using the template to assess particle size based its ability to pass through the vertical or horizontal sides of the template hole, which correspond to the actual size classes used to determine the particle size distribution.
10. When using the template, measure and record particles by the smallest diameter template hole that they will pass through. Start with the template hole whose diameter appears larger than the sample particle and move to progressively smaller template holes. The smallest template hole that the particle passes through is the upper end of the size class. When the sampler calls out "16" for the recorder, this means that the particle is "***less than 16mm"*** and passed through the 16mm template hole, but not the 11.3mm template hole. Therefore, the particle is within the 11.3mm to 16mm size class and the recorder will enter the data accordingly.
11. Particle size data will be recorded using the "dot/slash" system, where, 10 = . The four dots should be filled in first, followed by the outside lines of the box, and, finally, the diagonal lines.
12. There are spaces on the field form to tally the results for each size class if there is additional time in the field. Otherwise, this can be performed during post-field data processing.
13. Note that templates with square holes will be modified so that the <2mm and <6.35mm categories have round holes.

2.12 Riffle Stability Index

The riffle stability index (Kappesser 2002) will be assessed in each cell for streams that have developed point bars. Data collected during this assessment will be recorded on the **Riffle Pebble Count Field Form**. The steps to performing the riffle stability index go as follows:

1) Within each survey cell, locate the gravel bar closest to the riffle in which the pebble count and channel cross-section measurements were made. If the associated cross-sections station is near a cell boundary, and there is no gravel bar in the cell, measurements can be made at the closest bar in the next or former cell.
2) Identify the dominant large particle size that has been recently deposited on the gravel bar. Dominant large particles are defined here as the largest particles that occur on the depositional bar at an estimated frequency of 10% or greater. Recently deposited particles can be identified as having a brighter color, a lack of attached algae, a lack of staining, and are not embedded.
3) Measure the *b*-axis for 15 freshly moved dominant large particles and record measured value on the field form. The *b*-axis is the intermediate size axis as depicted in **Figure 2-6**.
4) The riffle stability index is calculated as the geometric mean of the dominant large particle size on the bar compared to the cumulative particle size distribution collected during the riffle pebble count.

Figure 2-6. Intermediate Axis Measurement (from Harrelson et al. 1994).



2.13 Riparian Greenline Assessment

A greenline assessment of riparian vegetation quantifies the ground cover, understory and overstory along the assessment site by general community type as a percent at approximately bankfull. Data collected during the riparian greenline assessment should be recorded on the **Riparian Greenline Field Form**. The steps to performing the riparian greenline assessment go as follows:

1. Starting at the downstream end of the cell, perform measurements at 10-foot intervals progressing upstream along the ***greenline***, which is located at approximately the bankfull channel margin (Windward 2000).
2. Every 10-feet, the ground cover (<1.5 feet tall), understory (1.5 to 15 feet tall) and overstory (>15 feet tall) riparian vegetation will be assessed (USEPA 2004).
3. The ground cover (<1.5 foot tall) vegetation will be described in the following categories:

    W = Wetland vegetation, such as sedges and rushes
    G = Grasses or forbs, rose, snowberry (vegetation lacking binding root structure)
    B = Disturbed/bare ground
    R = Rock, when a large cobble or boulder is encountered
    RR = Riprap

4. When the 10-foot interval falls at the base of a shrub or tree, place a dash (-) on the field form.
5. When pugging and hummocking due to the mechanical hoof action of grazing ungulates is observed, add "/H" to the field form (i.e. "G/H" indicates grass or forb ground cover with evidence of pugging and hummocking). See **Figure 1-1** for an example of pugging and hummocking.
6. When Bare/Disturbed ground is observed, if the location appears to have the potential to support an herbaceous or woody vegetative community under "natural" circumstances, add "/D" to the field form.
7. If moss is encountered, simply choose the category that best describes the feature that the moss is associated with.
8. The understory vegetation (1.5 to 15 feet tall) and overstory vegetation (>15 feet tall) will be described in the following categories:

    C = Coniferous
    D = Deciduous, riparian shrubs and trees with sufficient rooting mass and depth to provide protection to the streambanks
    M = mixed coniferous and deciduous

9. When assessing understory and overstory vegetation along the greenline, envision an imaginary column about 5 feet or so in diameter extending up from the 10-foot interval at the bankfull margin. If this column intersects the canopy a shrub or tree, then record the data in the appropriate category.
10. If no shrub or tree is encountered, place a dash (-) in the column on the field form.

11. When the bankfull channel margin is comprised of exposed sand or gravel due to streambank erosion, the greenline measurement should be made at the top of the bank.
12. When the channel margin is along a gravel bar, the greenline measurement should be made at the estimated bankfull elevation. When this is the case, place an "X" on the field form to denote the measurement was made along the bankfull channel margin at a gravel bar.
13. At 50-foot intervals, the field crew will estimate the vegetated buffer width along both sides of the stream. This can be accomplished with a tape measure in areas where the riparian zone is small or the vegetation is not dense. The buffer width can also be estimated by pacing, visual estimate or with the use of a range finder. This distance should generally correspond with the floodprone area and, in many instances, will be bound by terraces or other distinct topographic features.
    a. The goal is to estimate the width of vegetation that is buffering the stream from adjacent land use. It is not defined as the actual width of the band of riparian vegetation. This is because both riparian and non-riparian vegetation can act in a buffering capacity.
14. When performing the greenline assessment on larger streams, 2 crew members should progress along opposite sides of the channel simultaneously. In this case, crew members will be responsible for performing the greenline assessment on their respective sides of the channel, though only one crew member will be responsible for recording the data. The crew member assessing the river left side of the channel that lacks the tape should estimate the location of each 10-foot interval based on the guidance of the crew member progressing along the tape measure.
15. Following the completion of greenline measurements, the total number of times each canopy type was observed is tallied in the box at the bottom of the field form.
16. Note that the greenline assessment is specifically designed for areas in which streambank erosion is influenced by riparian shrub coverage. This measurement is optional in situations were riparian shrubs do not play an important role in streambank stability, such as steep mountain streams in coniferous forests.

2.14 Streambank Erosion Assessment

An assessment of all actively/visually eroding and slowly eroding/undercut/vegetated streambanks along the assessment reach will be conducted. This assessment involves delineating the eroding streambanks by "type", performing Bank Erosion Hazard Index measurements, estimating or measuring Near Bank Stress, evaluating the sources of streambank erosion and if appropriate performing an "add bank" assessment.

Data collected during the streambank erosion assessment should be recorded on the **Streambank Erosion Field Form.** Data collected during the "add bank" assessment should be recorded on the **Additional Streambank Erosion Measurements Form**.

The steps to performing the streambank erosion assessment are outlined in the following sections.

2.14.1 Eroding Streambank "Type" Delineation

1. The field crew member tasked with performing the eroding stream bank assessment will assess the various "types" of eroding streambanks as he/she moves through the assessment reach.
    a. For this assessment eroding streambanks will be delineated by "type" based on the BEHI and NBS characteristics, with each unique bank being described as an individual "type".
    b. When a bank is encountered that is similar to a bank already assessed, it is considered an "add bank" and it is assigned the "type" of the earlier bank.
2. Identify the upstream and downstream end of each unique eroding streambank, and record its type and stationing on the **Streambank Erosion Field Form** field form.
    a. If the eroding streambank is an "add bank" this data is recorded on the **Additional Streambank Erosion Measurements Form.**
3. Assess streambank erosion in one cell at a time, numbering streambanks in ascending order.
    a. Each individual eroding streambank regardless of "type" will be given a number per #3 above. If the eroding bank is an "add bank" in addition to the bank number, this eroding bank will be assigned the number of the similar bank "type", and this will be recorded on the **Additional Streambank Erosion Measurements Form.**
4. If a cell lacks an eroding streambank, no streambanks will be assessed in that cell.
5. If an eroding streambank extends between two cells, include it in the downstream cell, which will be the first cell assessed in the upstream progression.
6. If an eroding streambank extends beyond the boundaries of the delineated stream survey site, do not include the portion of the streambank outside of the site.

2.14.2 Bank Erosion Hazard Index and Near Bank Stress

This assessment will be performed on one bank for each bank "type". The data is recorded on the **Streambank Erosion Field Form**. "Add bank" assessments are defined in section 2.12.4.

1. Identify the most representative portion of the streambank and perform the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) estimates and/or measurements at this spot based on methods developed by Rosgen (1996, 2001, 2006) and adopted by the USEPA (2006).
2. Estimate the mean height of the eroding streambank from the toe of the bank to the top of the bank by making several measurements along the eroding streambank. The ***toe*** of the streambank is defined as the point where the streambank meets the channel bed. Note that the toe of the streambank will not necessarily be in the water during baseflow conditions.
3. The BEHI score is a metric derived from the following measurements which will be performed in the field: bank height, bankfull height, root depth, bank angle, and surface protection (**Figure 2-6**). For each bank, the BEHI score is then adjusted for bank materials and stratification.

Bank height is measured from the toe of the bank to the top of the bank (note that this is labeled "study bank height" in **Figure 2-7**).

Bankfull height is measured from the toe of the bank to the bankfull elevation. Unless the toe of the bank is at or above the surface water elevation, this height will be greater than the bankfull elevation identified along the survey site.

Root depth is measured as the depth that the predominant roots extend into the soil from the top of the bank.

Root density is estimated as a percent of the area assessed for root depth that is comprised of plant roots. Record estimates to the nearest 10%.

Bank angle is measured from a horizontal plane in degrees from the toe of the bank to the top of the bank, with 90º being a vertical bank and >90º being an undercut bank. The angle of an undercut bank is determined by inserting the measuring rod into the deepest portion of the undercut and gently "prying" it back as close as it will go to vertical. Record measurements to the nearest 5º.

Surface protection is measured as the percent of the streambank that is exposed to erosion. Surface protection can be provided by sod mats (i.e. vegetated slumps), large woody debris or boulders. Record measurements to the nearest 10%.

The **bank material adjustment** is applied as follows:

Subtract 10 points if the bank is comprised of cobbles.

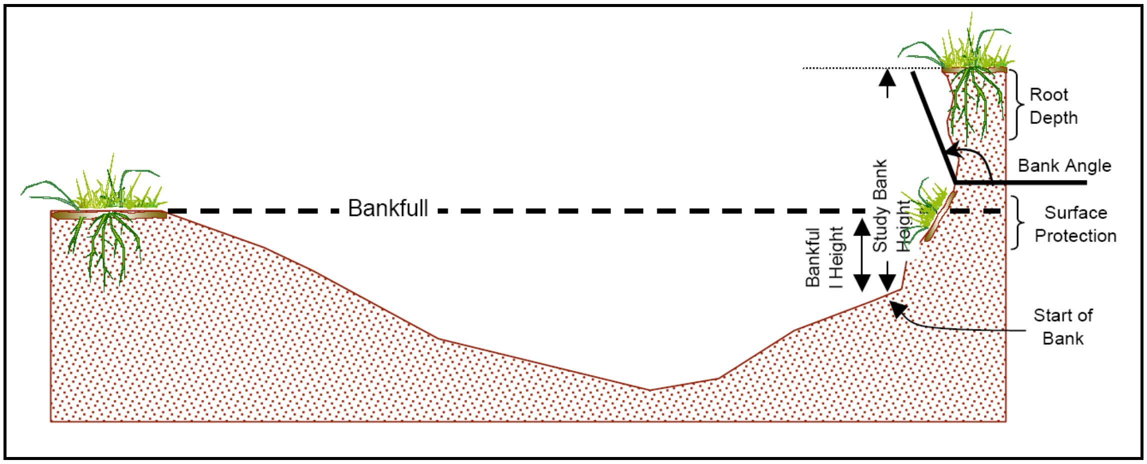
Add 5-10 points if the bank is comprised of gravel and sand, depending on the amount of sand.

Add 10 points if the bank is comprised of sand.

No adjustment is necessary for clay banks.

The **stratification adjustment** is applied depending on the position of the layers in relation to the bankfull stage. A streambank should be considered stratified when a more erosive layer is situated or "sandwiched" between two less erosive layers within the bankfull zone.

Figure 2-7. BEHI Measurement Variables (from EPA 2006).



4. Perform the NBS assessment and/or record estimate.
    a. To perform the NBS assessment, perform approximately 5 bankfull depth measurements at roughly equal spacing across the bankfull width of the stream channel. Record these measurements in the *Bankfull mean depth calculations* box on the field form and calculate the mean bankfull depth.
    b. Measure the *near bank maximum depth*, which is the deepest bankfull channel depth (measured from the channel bed to the bankfull elevation) within the 1/3 of the channel closest to the eroding bank along the cross-section. Record this depth on the field form.
    c. Calculate the ratio of near-bank maximum depth to bankfull mean depth (d_{nb}/d_{bkf}) and record this value and the subsequent NBS ratings (**Table 2-1**)
    d. NBS estimates are supported by describing the rational as based on one of the following categories: channel pattern, radius of curvature, or near bank max depth. The NBS estimate can also be supported by performing the "near bank max depth" measurement at the bank of interest and then utilizing the mean bankfull depth from the cross-section measurements.

Table 2-1. Conversion Table of d_{nb}/d_{bkf} Values to NBS Ratings.

NBS ratings based on d_{nb}/d_{bkf}	
d_{nb}/d_{bkf} ratio	**NBS rating**
< 1.00	**Very Low**
1.00 – 1.50	**Low**
1.51 – 1.80	**Moderate**
1.81 – 2.50	**High**
2.51 – 3.00	**Very High**
> 3.00	**Extreme**

5. Once the BEHI and NBS estimates and/or measurements have been made take one photo looking downstream at the eroding streambank and second photo facing the streambank at the site where the BEHI and NBS assessment was performed (**Figure 2-7**). Include the measuring rod and the line level in the photo for reference, with the base of the rod placed at the toe of the streambank. Provide a brief description in the **Photo Log** (i.e. "d/s view at BEHI 1", "view toward bank at BEHI 1").
6. If the eroding streambank is "complex" and appears to have more than one BEHI value and/or more than one NBS value, then the streambank may need to be broken into two or more eroding streambank "types". If only the NBS changes along the streambank, then two separate NBS measurements can be performed for one eroding bank so long as the length of eroding bank associated with each NBS measurement is recorded.

Figure 2-7. Example of Appropriate Photos of Eroding Streambanks.

2.14.3 Streambank Composition and Erosion Source Assessment

1. For each bank that undergoes the BEHI assessment, visually estimate the streambank material composition and identify the sources of streambank erosion.
2. When assessing the streambank composition, first estimate the percent comprised of coarse gravel, cobbles and boulders (>6mm). Next, evaluate and the percent comprised of sands and clays (<2mm). Finally, assessed the amount of streambank comprised of fine gravels (2mm-6mm). Assess each category to the nearest 10%.
3. Indicate if hoof shear is observed by circling either "present" or "absent" on the field form. If hoof shear is observed, document it with a photograph and provide a brief description in the **Photo Log**.

4. For all eroding stream banks regardless of "type", identify sources of streambank instability and estimate a percent in the following categories:

   Transportation
   Riparian Grazing

Cropland
Mining
Silviculture
Irrigation-shifts in stream energy
Historic (provide a description of the source)
Natural Sources
Other (provide a description of the source)

5. If a source of streambank erosion is not observed, do not record a value. The exception is for natural sources, which must always be estimated, even if that value is 0%. Eroding streambanks at the outside of meander bends, for example, are likely due at least partially to natural sources, though human sources may be leading to increased instability and erosion.

2.15 Water Surface Slope Estimation

The water surface slope will be estimated and recorded on the **Bankfull Elevation & Water Surface Slope Field Form**. It is important to note that this procedure is for a very rough estimate only, and is conducted simply to compare with the information gathered during aerial assessment and reach stratification. For more accurate measurements of stream slope, laser levels or hand levels with zoom scopes, in conjunction with survey rods are recommended. The steps to assessing the water surface slope go as follows:

1. This assessment will be performed in all cells that have a portion of their length with a clear “line-of-site” between two riffles.
2. This measurement is performed at the surface water elevation from the top of one riffle (riffle crest) to the top of the next riffle in a relatively straight section of the channel. Other channel bed features (i.e. “pool-to-pool”) may be utilized as long as distinct points can be identified in both features. Record the feature that was used on the field form.
3. To perform the slope assessment, two crew members will stand at the surface water elevation on the same side of the channel, with one crew member in each riffle. In situations where standing at the surface water precludes a direct “line-of-site”, crew members can stand in the channel. When this is done, be sure to stand at the same elevation (i.e. 0.4 feet deep) in the same type of feature (i.e. riffle crest). The depth can be measured using the measuring rod and relayed between the two crew members.
4. Slope will be measured with a clinometer in percent, which is on the right hand side of the clinometer.
5. To measure slope, the crew member with the clinometer must first establish where their “eye-level” meets on the other crew member (i.e. the top of their head, their sunglasses, their shoulders, etc.). This “eye-level” point will be used as a pseudo stadia rod. If this spot is above the persons head, then the crew members should switch roles.
6. Measure the slope in percent from upstream to downstream and record this value on the field form.
7. If there are less than two riffles in a cell, or if there is not a clear “line-of-site” between two riffles (or other identified feature) due to dense riparian vegetation, then do not

perform this measurement. In this case, slope measurements at the reach scale as assessed from aerial photos will be used.

2.16 Field Notes

Field notes will be taken once the stream survey site assessment is complete and recorded on the **Site Visit Notes Field Form**. Field notes should be recorded by the field leader, but will include the inputs of the entire field crew. Field notes should be taken in the following four categories:

1. Description of human impacts and their severity
2. Description of stream channel conditions
3. Description of streambank erosion conditions
4. Description of riparian vegetation conditions
5. Estimation of Existing and Potential Rosgen Stream Type
6. Before leaving the site, Field Leader will also review all datasheets to ensure all expected data has been collected and recorded properly.

3.0 LITERATURE CITED

Bunte, K., and S.R. Abt. 2001. Sampling surface and subsurface particle-size distributions in wadeable gravel- and cobble-bed streams for analysis in sediment transport, hydraulics, and streambed monitoring. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-74.

Harrelson, C.C., C.L. Rawlings, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. United States Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245.

Heitke, J.D., E.J. Archer, D. D. Dugaw, B.A. Bouwes, E.A. Archer, R.C. Henderson, J.L. Kershner. 2006. Effectiveness monitoring for streams and riparian areas: sampling protocol for stream channel attributes. Available on the internet at: http://www.fs.fed.us/biology/resources/pubs/feu/pibo/pibo_2006_stream_sampling_protocol.doc

Hilton, S., and T.E. Lisle. 1993. Measuring the fraction of pool volume filled with fine sediment. United States Department of Agriculture, Forest Service, Pacific Southwest Research Station. Research Note PSW-RN-414-WEB.

Kappesser, G.B. 2002. A riffle stability index to evaluate sediment loading to streams. *Journal of the American Water Resources Association* 38(4): 1069-1081.

Kershner, J.L., E.K. Archer, M. Coles-Rithchie, E.R. Cowley, R.C. Henderson, K. Kratz, C.M. Quimby, D.L. Turner, L.C. Ulmer, and M.R. Vinson. 2004. Guide to effective monitoring of aquatic and riparian resources. Gen. Tech. Rep. RMRS-GTR-121. U.S. Department of Agriculture, Rocky Mountain Research Station, Fort Collins, Colorado. 57p.

Kondolf, G.M. 2000. Assessing Salmonid Spawning Gravel Quality. *Transactions of the American Fisheries Society*, 129: 262-281.

Leopold, L. 1994. A View of River. Harvard University Press, Cambridge, Massachusetts, and London, England.

MDEQ. 2005. Field Procedures Manual for Water Quality Assessment Monitoring. Water Quality Planning Bureau, Helena, Montana.

Overton, C. K., S. P. Wollrab, B. C Roberts, and M. A. Radko. 1997. R1/R4 (Northern/ Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. General Technical Report INT-GTR-346. Ogden, UT: USDA Forest Service, Intermountain Research Station. 73 p.

Pick, T., P. Husby, W. Kellogg, B. Leinard, and R. Apfelbeck. 2004. Riparian Assessment: Using the NRCS Riparian Assessment Method. U.S. Departement of Agriculture, Natural Resources Conservation Service.

Rosgen, D. 1996 Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Rosgen, D. 2001. *A practical method of computing streambank erosion rate.* Proceedings of the Seventh Federal Interagency Sedimentation Conference, Vol. 2, pp. II - 9-15, March 25-29, 2001, Reno, NV. Available at: http://www.wildlandhydrology.com/assets/Streambank_erosion_paper.pdf.

Rosgen, D. 2006. Watershed Assessment of River Stability and Sediment Supply. Wildland Hydrology, Fort Collins, Colorado.

Rosgen, D. 2008. River Stability Field Guide. Wildland Hydrology, Fort Collins, Colorado.

U.S. Environmental Protection Agency. 2004. Wadeable Stream Assessment: Field Operations Manual. EPA841-B-04-004. Washington, D.C. Available on the internet at: http://www.epa.gov/owow/monitoring/wsa/wsa_fulldocument.pdf.

U.S. Environmental Protection Agency. 2006. Watershed Assessment of River Stability and Sediment Supply (WARSSS). Version 1.0. Available on the Internet at: http://www.epa.gov/warsss/index.htm.

Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-47.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. *Transactions of the American Geophysical Union*, 35:951-956.

Attachment A

EQUIPMENT CHECKLIST

Equipment Checklist	
	Field Procedures and Site Information Forms
	Waders
	Field forms for 500, 1000, and 2000 foot reaches
	Folders or a system for organizing completed field forms
	Pencils
	2 calculators
	1 role green flagging
	1 role pink/orange flagging
	Pin flagging
	Sharpie for marking flagging
	6 300-foot tape measures
	2 100-foot tape measures
	5 200-foot tape measure
	4 stakes/pins for cross-sections
	2 "clips" for cross-sections (if not using stakes with clamps)
	Minimum 3 measuring rods (1 BEHI, 1 x-sec, 1 long pro)
	2 line levels for bank full determinations
	2 metal grids for pool tail-out grid toss and riffle grid toss
	2 plastic shields for grids
	2 gravelometers
	1 clinometer
	2 rulers for RSI (must be in mm)
	Resource grade GPS unit
	1 range finder
	2 cameras (1 for site pics, x-sec pics; 1 for BEHI)
	1 flashlight
	Extra batteries for GPS, range finder, camera, other
	Sunscreen, bug repellent
	Sunglasses
	First aid kit
	Bear spray (when warranted)

Attachment B

FIELD FORMS

Channel Cross-section Field Form - Page 1	BFW >10 and <30	Measured distance between surface water and bankfull = ___________

Reach ID / Date: **Field Personnel:**

Cell 1	Station		Photo		Latitude		Longitude						
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**RBF**
Interval (BFW / 10) =	ft	**Width**											
Bankfull mean d =	ft	**Depth**											
Cross sectional area =	sq ft	Width/Depth =			notes:								
Thalweg (dmax) =	ft	Slope (%) =											
Left flood prone width **(LFP) =**	ft	>200' estimate	Right flood prone width **(RFP) =**	ft	>200' estimate								
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW											

Cell 2	Station		Photo		Latitude		Longitude						
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**RBF**
Interval (BFW / 10) =	ft	**Width**											
Bankfull mean d =	ft	**Depth**											
Cross sectional area =	sq ft	Width/Depth =			notes:								
Thalweg (dmax) =	ft	Slope (%) =											
Left flood prone width **(LFP) =**	ft	>200' estimate	Right flood prone width **(RFP) =**	ft	>200' estimate								
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW											

Cell 3	Station		Photo		Latitude		Longitude						
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**RBF**
Interval (BFW / 10) =	ft	**Width**											
Bankfull mean d =	ft	**Depth**											
Cross sectional area =	sq ft	Width/Depth =			notes:								
Thalweg (dmax) =	ft	Slope (%) =											
Left flood prone width **(LFP) =**	ft	>200' estimate	Right flood prone width **(RFP) =**	ft	>200' estimate								
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW											

Channel Cross-section Field Form - Page 2	BFW >10 and <30	

Reach ID / Date: **Field Personnel:**

Cell 4	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**RBF**
Interval (BFW / 10) =	ft	**Width**											
Bankfull mean d =	ft	**Depth**											

Cross sectional area =	sq ft	Width/Depth =				notes:
Thalweg (dmax) =	ft	Slope (%) =				
Left flood prone width **(LFP) =**	ft	>200' estimate	Right flood prone width **(RFP) =**	ft	>200' estimate	
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW				

Cell 5	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**RBF**
Interval (BFW / 10) =	ft	**Width**											
Bankfull mean d =	ft	**Depth**											

Cross sectional area =	sq ft	Width/Depth =				notes:
Thalweg (dmax) =	ft	Slope (%) =				
Left flood prone width **(LFP) =**	ft	>200' estimate	Right flood prone width **(RFP) =**	ft	>200' estimate	
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW				

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:__________

measurement	**LBF**												**RBF**
width													
depth													

Indicate **measurement number**, **LBF** and **RBF** for both channels. There will be a total of 9 depth measurements and 4 measurements at the bankfull channel margins. Blacken one column of boxes where the island/bar is located.

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:__________

measurement	**LBF**												**RBF**
width													
depth													

Equipment Checklist	
	Field Procedures and Site Information Forms
	Waders
	Field forms for 500, 1000, and 2000 foot reaches
	Folders or a system for organizing completed field forms
	Pencils
	2 calculators
	1 role green flagging
	1 role pink/orange flagging
	Pin flagging
	Sharpie for marking flagging
	6 300-foot tape measures
	2 100-foot tape measures
	5 200-foot tape measure
	4 stakes/pins for cross-sections
	2 "clips" for cross-sections (if not using stakes with clamps)
	Minimum 3 measuring rods (1 BEHI, 1 x-sec, 1 long pro)
	2 line levels for bank full determinations
	2 metal grids for pool tail-out grid toss and riffle grid toss
	2 plastic shields for grids
	2 gravelometers
	1 clinometer
	2 rulers for RSI (must be in mm)
	Resource grade GPS unit
	1 range finder
	2 cameras (1 for site pics, x-sec pics; 1 for BEHI)
	1 flashlight
	Extra batteries for GPS, range finder, camera, other
	Sunscreen, bug repellent
	Sunglasses
	First aid kit
	Bear spray (when warranted)

Sediment and Habitat Assessment Site Information Form

TPA:	**Date:**
Stream:	**Reach/Sub-reach ID:**

Field Delineated Geographic Coordinates

	Latitude	Longitude
Downstream End		
Upstream End		

Firm/Personnel:

Expected Survey Site Length: 500 feet 1000 feet 1500 feet 2000 feet other:_________

Landowner Contact Information / Notes

Directions to Site

Aerial Assessment Information

Level 4 Ecoregion:	**Stream Order:**
Confinement:	**Gradient:**

Regional Reference Data

Watershed Area at Mouth (sq.mi.):	**Watershed Area above Site (sq.mi.):**
Expected Cross-sectional Area (sq.ft.):	**Expected Bankfull Width (ft):**

General Comments

Task Checklist

____Photos	____Woody Debris	Note whether cross-section and pebble count measurements were made in riffles or runs:
____Bankfull Indicators	____Riffle Pebble Counts	
____Cross-sections & Floodprone Widths	____Riffle Stability Index	
____Pool Measurements	____Riparian Greenline	
____Fine Sediment in Pool Tail-outs	____Bank Erosion	
____Riffle Lengths	____Slope	**riffle / run**
____Fine Sediment in Riffles	____Field Notes	

Photo Log

Reach ID / Date: **Field Personnel:**

GPS	Photo #	Description

GPS notations: **d/s** = downstream end, **u/s** = upstream end, **xs1** = cross-section (for 1-5), otherwise leave blank

Bankfull Elevation Field Form

Reach ID / Date:

Bankfull Elevation Above Water Surface

Station	Channel Margin	Bankfull Height (ft)	Bankfull Indictor (assign number)	Bankfull Indictor Pick List (pick one or more)
	RR / RL			**1** = top of point bar or other relatively flat surface
	RR / RL			**2** = change in vegetation type
	RR / RL			**3** = break in slope
	RR / RL			**4** = change in particle size distribution
	RR / RL			**5** = inundation feature
	RR / RL			**6** = staining of rocks
	RR / RL			**7** = exposed root hairs
	RR / RL			**8** = top of bank
	RR / RL			**9** = bottom of undercut
	RR / RL			**10** = debris in riparian vegetation
	RR / RL			
	RR / RL			
	RR / RL			
	RR / RL			
	RR / RL			
Field Determined Bankfull Elevation				

Note: **RR** = river right streambank, **RL** = river left streambank, determined facing downstream

notes on bankfull indicator selection:

Tributary input at station:	**RR / RL**	Irrigation diversion or return flow at station:	**RR / RL**
Tributary input at station:	**RR / RL**	Irrigation diversion or return flow at station:	**RR / RL**
Tributary input at station:	**RR / RL**	Irrigation diversion or return flow at station:	**RR / RL**
Tributary input at station:	**RR / RL**	Irrigation diversion or return flow at station:	**RR / RL**

Channel Cross-section Field Form - Page 1	BFW <10
Reach ID / Date:	**Field Personnel:**

Measured distance between surface water and bankfull (ft) = ___________

Cell 1	Station		Photo		Latitude			Longitude	
Bankfull width (**BFW**) =		ft		**LBF**	**1**	**2**	**3**	**4**	**RBF**
Interval (BFW / 5) =		ft	**Width**						
Bankfull mean d =		ft	**Depth**						
Cross sectional area =		sq ft	Width/Depth =				notes:		
Thalweg (dmax) =		ft	Slope (%) =						
Left flood prone width (**LFP**) =	ft	>200' estimate	Right flood prone width (**RFP**) =		ft	>200' estimate			
Entrenchment ratio =			Entrenchment Ratio = (LFP+BFW+RFP)/BFW						

Cell 2	Station		Photo:		Latitude			Longitude	
Bankfull width (**BFW**) =		ft		**LBF**	**1**	**2**	**3**	**4**	**RBF**
Interval (BFW / 5) =		ft	**Width**						
Bankfull mean d =		ft	**Depth**						
Cross sectional area =		sq ft	Width/Depth =				notes:		
Thalweg (dmax) =		ft	Slope (%) =						
Left flood prone width (**LFP**) =	ft	>200' estimate	Right flood prone width (**RFP**) =		ft	>200' estimate			
Entrenchment ratio =			Entrenchment Ratio = (LFP+BFW+RFP)/BFW						

Cell 3	Station		Photo:		Latitude			Longitude	
Bankfull width (**BFW**) =		ft		**LBF**	**1**	**2**	**3**	**4**	**RBF**
Interval (BFW / 5) =		ft	**Width**						
Bankfull mean d =		ft	**Depth**						
Cross sectional area =		sq ft	Width/Depth =				notes:		
Thalweg (dmax) =		ft	Slope (%) =						
Left flood prone width (**LFP**) =	ft	>200' estimate	Right flood prone width (**RFP**) =		ft	>200' estimate			
Entrenchment ratio =			Entrenchment Ratio = (LFP+BFW+RFP)/BFW						

Channel Cross-section Field Form - Page 2							**BFW <10**		
Reach ID / Date:						**Field Personnel:**			
Cell 4 Station			Photo:		Latitude			Longitude	
Bankfull width (**BFW**) =		ft		**LBF**	**1**	**2**	**3**	**4**	**RBF**
Interval (BFW / 5) =		ft	**Width**						
Bankfull mean d =		ft	**Depth**						
Cross sectional area =		sq ft	Width/Depth =				notes:		
Thalweg (dmax) =		ft	Slope (%) =						
Left flood prone width (**LFP**) =	ft	>200' estimate	Right flood prone width (**RFP**) =		ft	>200' estimate			
Entrenchment ratio =			Entrenchment Ratio = (LFP+BFW+RFP)/BFW						

Cell 5 Station			Photo:		Latitude			Longitude	
Bankfull width (**BFW**) =		ft		**LBF**	**1**	**2**	**3**	**4**	**RBF**
Interval (BFW / 5) =		ft	**Width**						
Bankfull mean d =		ft	**Depth**						
Cross sectional area =		sq ft	Width/Depth =				notes:		
Thalweg (dmax) =		ft	Slope (%) =						
Left flood prone width (**LFP**) =	ft	>200' estimate	Right flood prone width (**RFP**) =		ft	>200' estimate			
Entrenchment ratio =			Entrenchment Ratio = (LFP+BFW+RFP)/BFW						

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:______

Measurement	**LBF**								**RBF**
Width									
Depth									

Indicate measurement number, LBF and RBF for both channels. There will be a total of 4 depth measurements and 4 measurements at the bankfull channel margins. Blacken one column of boxes where the island/bar is located.

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:______

Measurement	**LBF**								**RBF**
Width									
Depth									

Channel Cross-section Field Form - Page 1	BFW >30 and <45	Measured distance between surface water and bankfull = __________

Reach ID / Date: **Field Personnel:**

Cell 1	Station		Photo		Latitude			Longitude				
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interval (BFW / 15) =	ft	**Width**										
Bankfull mean d =	ft	**Depth**										
Cross Sectional area =	sq ft		**10**	**11**	**12**	**13**	**14**	**RBF**	notes:			
Thalweg (dmax) =	ft	**Width**										
Left flood prone (**LFP**) =	ft >200' estimate	**Depth**										
Right flood prone (**RFP**) =	ft >200' estimate	Width/Depth =			Slope (%) =							
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW										

Cell 2	Station		Photo		Latitude			Longitude				
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interval (BFW / 15) =	ft	**Width**										
Bankfull mean d =	ft	**Depth**										
Cross Sectional area =	sq ft		**10**	**11**	**12**	**13**	**14**	**RBF**	notes:			
Thalweg (dmax) =	ft	**Width**										
Left flood prone (**LFP**) =	ft >200' estimate	**Depth**										
Right flood prone (**RFP**) =	ft >200' estimate	Width/Depth =			Slope (%) =							
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW										

Cell 3	Station		Photo		Latitude			Longitude				
Bankfull width (**BFW**) =	ft		**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interval (BFW / 15) =	ft	**Width**										
Bankfull mean d =	ft	**Depth**										
Cross Sectional area =	sq ft		**10**	**11**	**12**	**13**	**14**	**RBF**	notes:			
Thalweg (dmax) =	ft	**Width**										
Left flood prone (**LFP**) =	ft >200' estimate	**Depth**										
Right flood prone (**RFP**) =	ft >200' estimate	Width/Depth =			Slope (%) =							
Entrenchment ratio =		Entrenchment Ratio = (LFP+BFW+RFP)/BFW										

Channel Cross-section Field Form - Page 2	BFW >30 and <45	

Reach ID / Date: **Field Personnel:**

Cell 4	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft				**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interval (BFW / 15) =	ft			**Width**										
Bankfull mean d =	ft			**Depth**										
Cross Sectional area =	sq ft				**10**	**11**	**12**	**13**	**14**	**RBF**	notes:			
Thalweg (dmax) =	ft			**Width**										
Left flood prone (**LFP**) =	ft	>200'	estimate	**Depth**										
Right flood prone (**RFP**) =	ft	>200'	estimate	Width/Depth =			Slope (%) =							
Entrenchment ratio =				Entrenchment Ratio = (LFP+BFW+RFP)/BFW										

Cell 5	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft				**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interval (BFW / 15) =	ft			**Width**										
Bankfull mean d =	ft			**Depth**										
Cross Sectional area =	sq ft				**10**	**11**	**12**	**13**	**14**	**RBF**	notes:			
Thalweg (dmax) =	ft			**Width**										
Left flood prone (**LFP**) =	ft	>200'	estimate	**Depth**										
Right flood prone (**RFP**) =	ft	>200'	estimate	Width/Depth =			Slope (%) =							
Entrenchment ratio =				Entrenchment Ratio = (LFP+BFW+RFP)/BFW										

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:__________

measurement														
width														
depth														
measurement														
width														
depth														

Indicate measurement number, LBF and RBF for both channels. There will be a total of 19 depth measurements and 4 measurements at the bankfull channel margins. Blacken one column of boxes where the island/bar is located.

Channel Cross-section Field Form - Page 1	BFW >45	Measured distance between surface water and bankfull = __________

Reach ID / Date: **Field Personnel:**

Cell 1	Station		Photo			Latitude					Longitude		
Bankfull width (**BFW**) =	ft			**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Interval (BFW / 20) =	ft		**width**											
Bankfull mean d =	ft		**depth**											
Cross sectional area =	sq ft			**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**RBF**	
Thalweg (dmax) =	ft		**width**											
Left flood prone (**LFP**) =	ft	>200'	est.	**depth**										
Right flood prone (**RFP**) =	ft	>200'	est.		Width/Depth =		notes:							
Entrenchment ratio =		Ent. Ratio = (LFP+BFW+RFP)/BFW			Slope (%) =									

Cell 2	Station		Photo			Latitude					Longitude		
Bankfull width (**BFW**) =	ft			**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Interval (BFW / 20) =	ft		**width**											
Bankfull mean d =	ft		**depth**											
Cross sectional area =	sq ft			**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**RBF**	
Thalweg (dmax) =	ft		**width**											
Left flood prone (**LFP**) =	ft	>200'	est.	**depth**										
Right flood prone (**RFP**) =	ft	>200'	est.		Width/Depth =		notes:							
Entrenchment ratio =		Ent. Ratio = (LFP+BFW+RFP)/BFW			Slope (%) =									

Cell 3	Station		Photo			Latitude					Longitude		
Bankfull width (**BFW**) =	ft			**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Interval (BFW / 20) =	ft		**width**											
Bankfull mean d =	ft		**depth**											
Cross sectional area =	sq ft			**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**RBF**	
Thalweg (dmax) =	ft		**width**											
Left flood prone (**LFP**) =	ft	>200'	est.	**depth**										
Right flood prone (**RFP**) =	ft	>200'	est.		Width/Depth =		notes:							
Entrenchment ratio =		Ent. Ratio = (LFP+BFW+RFP)/BFW			Slope (%) =									

Channel Cross-section Field Form - Page 2	BFW >45	

Reach ID / Date: **Field Personnel:**

Cell 4	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft				**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Interval (BFW / 20) =	ft			**width**											
Bankfull mean d =	ft			**depth**											
Cross sectional area =	sq ft				**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**RBF**	
Thalweg (dmax) =	ft			**width**											
Left flood prone (**LFP**) =	ft	>200'	est.	**depth**											
Right flood prone (**RFP**) =	ft	>200'	est.		Width/Depth =		notes:								
Entrenchment ratio =			Ent. Ratio = (LFP+BFW+RFP)/BFW		Slope (%) =										

Cell 5	Station		Photo		Latitude		Longitude	

Bankfull width (**BFW**) =	ft				**LBF**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Interval (BFW / 20) =	ft			**width**											
Bankfull mean d =	ft			**depth**											
Cross sectional area =	sq ft				**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**RBF**	
Thalweg (dmax) =	ft			**width**											
Left flood prone (**LFP**) =	ft	>200'	est.	**depth**											
Right flood prone (**RFP**) =	ft	>200'	est.		Width/Depth =		notes:								
Entrenchment ratio =			Ent. Ratio = (LFP+BFW+RFP)/BFW		Slope (%) =										

Channel Cross-section Measurements for Riffles with Mid-channel Bars and Side Channels - Cell:__________

measurement														
width														
depth														
measurement														
width														
depth														

Indicate measurement number, LBF and RBF for both channels. There will be a total of 19 depth measurements and 4 measurements at the bankfull channel margins. Blacken one column of boxes where the island/bar is located.

Pools, Riffles and Large Woody Debris Field Form

Reach ID / Date: **Field Personnel:**

Cell 1	**Pools**								
Pool #	D/S Station	U/S Station	Max Pool Depth (ft)	Pool Tail Crest Depth (ft)	Pool Type	Pool Size	Pool Formative Feature	Pool Cover Type	Undercut Depth (ft)

Depositional Spawning Area Grid Toss								
Pool #	Spawning Gravels Observed	Location (PT, NT)	Estimate D50	Grid Toss # 1	Grid Toss # 2	Grid Toss # 3	Place **X** if Tosses Overlap	Comments
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						

Riffles	
Downstream Station	Upstream Station

Large Woody Debris			
Station	# of Individual Pieces	# of Individual Pieces / Aggregate	Willow Bunch

Pool Type: **S** = Scour, **D** = Dammed (for dammed pools, write "N/A" in the Pool Tail Crest Depth column)

Pool Size: **S** = Small (<1/3 of bankfull width), **M** = Medium (1/3-2/3 of bankfull width), **L** = Large (>2/3 bankfull width)

Pool Formative Feature: **LS** = Lateral Scour, **P** = Plunge, **B** = Boulder, **W** = Woody Debris (cite primary type if > than 1)

Pool Cover Type: **V** = Overhanging Vegetation, **D** = Depth, **U** = Undercut, **B** = Boulder, **W** = Woody Debris, **N** = No apparent cover (cite primary type if > than one). **Note:** if undercut present, it is the primary cover type.

Pools, Riffles and Large Woody Debris Field Form

Reach ID / Date: **Field Personnel:**

Cell 2	**Pools**								
Pool #	D/S Station	U/S Station	Max Pool Depth (ft)	Pool Tail Crest Depth (ft)	Pool Type	Pool Size	Pool Formative Feature	Pool Cover Type	Undercut Depth (ft)

Depositional Spawning Area Grid Toss

Pool #	Spawning Gravels Observed	Location (PT, NT)	Estimate D50	Grid Toss # 1	Grid Toss # 2	Grid Toss # 3	Place **X** if Tosses Overlap	Comments
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						

Riffles

Downstream Station	Upstream Station

Large Woody Debris

Station	# of Individual Pieces	# of Individual Pieces / Aggregate	Willow Bunch

Location: **PT =** Pool Tail**, NT =** Non-Typical, comment clarifying location

Pool Type: **S** = Scour, **D** = Dammed (for dammed pools, write "N/A" in the Pool Tail Crest Depth column)

Pool Size: **S** = Small (<1/3 of bankfull width), **M** = Medium (1/3-2/3 of bankfull width), **L** = Large (>2/3 bankfull width)

Pool Formative Feature: **LS** = Lateral Scour, **P** = Plunge, **B** = Boulder, **W** = Woody Debris (cite primary type if > than 1)

Pool Cover Type: **V** = Overhanging Vegetation, **D** = Depth, **U** = Undercut, **B** = Boulder, **W** = Woody Debris, **N** = No apparent cover (cite primary type if > than one). **Note:** if undercut present, it is the primary cover type.

Pools, Riffles and Large Woody Debris Field Form

Reach ID / Date: **Field Personnel:**

Cell 3

Pools

Pool #	D/S Station	U/S Station	Max Pool Depth (ft)	Pool Tail Crest Depth (ft)	Pool Type	Pool Size	Pool Formative Feature	Pool Cover Type	Undercut Depth (ft)

Depositional Spawning Area Grid Toss

Pool #	Spawning Gravels Observed	Location (PT, NT)	Estimate D50	Grid Toss # 1	Grid Toss # 2	Grid Toss # 3	Place **X** if Tosses Overlap	Comments
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						

Riffles

Downstream Station	Upstream Station

Large Woody Debris

Station	# of Individual Pieces	# of Individual Pieces / Aggregate	Willow Bunch

Location: **PT =** Pool Tail**, NT =** Non-Typical, comment clarifying location

Pool Type: **S** = Scour, **D** = Dammed (for dammed pools, write "N/A" in the Pool Tail Crest Depth column)

Pool Size: **S** = Small (<1/3 of bankfull width), **M** = Medium (1/3-2/3 of bankfull width), **L** = Large (>2/3 bankfull width)

Pool Formative Feature: **LS** = Lateral Scour, **P** = Plunge, **B** = Boulder, **W** = Woody Debris (cite primary type if > than 1)

Pool Cover Type: **V** = Overhanging Vegetation, **D** = Depth, **U** = Undercut, **B** = Boulder, **W** = Woody Debris, **N** = No apparent cover (cite primary type if > than one). **Note:** if undercut present, it is the primary cover type.

Pools, Riffles and Large Woody Debris Field Form

Reach ID / Date: **Field Personnel:**

Cell 4	Pools								
Pool #	D/S Station	U/S Station	Max Pool Depth (ft)	Pool Tail Crest Depth (ft)	Pool Type	Pool Size	Pool Formative Feature	Pool Cover Type	Undercut Depth (ft)

Depositional Spawning Area Grid Toss

Pool #	Spawning Gravels Observed	Location (PT, NT)	Estimate D50	Grid Toss # 1	Grid Toss # 2	Grid Toss # 3	Place **X** if Tosses Overlap	Comments
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						

Riffles

Downstream Station	Upstream Station

Large Woody Debris

Station	# of Individual Pieces	# of Individual Pieces / Aggregate	Willow Bunch

Location: **PT =** Pool Tail**, NT =** Non-Typical, comment clarifying location

Pool Type: **S** = Scour, **D** = Dammed (for dammed pools, write "N/A" in the Pool Tail Crest Depth column)

Pool Size: **S** = Small (<1/3 of bankfull width), **M** = Medium (1/3-2/3 of bankfull width), **L** = Large (>2/3 bankfull width)

Pool Formative Feature: **LS** = Lateral Scour, **P** = Plunge, **B** = Boulder, **W** = Woody Debris (cite primary type if > than 1)

Pool Cover Type: **V** = Overhanging Vegetation, **D** = Depth, **U** = Undercut, **B** = Boulder, **W** = Woody Debris, **N** = No apparent cover (cite primary type if > than one). **Note:** if undercut present, it is the primary cover type.

Pools, Riffles and Large Woody Debris Field Form

Reach ID / Date: **Field Personnel:**

Cell 5	Pools								
Pool #	D/S Station	U/S Station	Max Pool Depth (ft)	Pool Tail Crest Depth (ft)	Pool Type	Pool Size	Pool Formative Feature	Pool Cover Type	Undercut Depth (ft)

Depositional Spawning Area Grid Toss

Pool #	Spawning Gravels Observed	Location (PT, NT)	Estimate D50	Grid Toss # 1	Grid Toss # 2	Grid Toss # 3	Place **X** if Tosses Overlap	Comments
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						
	Y / N / ?	**PT / NT**						

Riffles

Downstream Station	Upstream Station

Large Woody Debris

Station	# of Individual Pieces	# of Individual Pieces / Aggregate	Willow Bunch

Location: **PT =** Pool Tail**, NT =** Non-Typical, comment clarifying location

Pool Type: **S** = Scour, **D** = Dammed (for dammed pools, write "N/A" in the Pool Tail Crest Depth column)

Pool Size: **S** = Small (<1/3 of bankfull width), **M** = Medium (1/3-2/3 of bankfull width), **L** = Large (>2/3 bankfull width)

Pool Formative Feature: **LS** = Lateral Scour, **P** = Plunge, **B** = Boulder, **W** = Woody Debris (cite primary type if > than 1)

Pool Cover Type: **V** = Overhanging Vegetation, **D** = Depth, **U** = Undercut, **B** = Boulder, **W** = Woody Debris, **N** = No apparent cover (cite primary type if > than one). **Note:** if undercut present, it is the primary cover type.

Riparian Greenline Field Form - Page 1

Reach ID / Date: **Field Personnel:**

Cell 1	**Left Bank**					**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
10						**10**					
20						**20**					
30						**30**					
40						**40**					
50						**50**					
60						**60**					
70						**70**					
80						**80**					
90						**90**					
100						**100**					

Cell 2	**Left Bank**					**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
110						**110**					
120						**120**					
130						**130**					
140						**140**					
150						**150**					
160						**160**					
170						**170**					
180						**180**					
190						**190**					
200						**200**					

Cell 3	**Left Bank**					**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
210						**210**					
220						**220**					
230						**230**					
240						**240**					
250						**250**					
260						**260**					
270						**270**					
280						**280**					
290						**290**					
300						**300**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote

ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 2

Reach ID / Date: **Field Personnel:**

Cell 4	**Left Bank**						**Right Bank**				
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
310							**310**					
320							**320**					
330							**330**					
340							**340**					
350							**350**					
360							**360**					
370							**370**					
380							**380**					
390							**390**					
400							**400**					

Cell 5	**Left Bank**						**Right Bank**				
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
410							**410**					
420							**420**					
430							**430**					
440							**440**					
450							**450**					
460							**460**					
470							**470**					
480							**480**					
490							**490**					
500							**500**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 1

Reach ID / Date: **Field Personnel:**

Cell 1	**Left Bank**					**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width
10						**10**					
20						**20**					
30						**30**					
40						**40**					
50						**50**					
60						**60**					
70						**70**					
80						**80**					
90						**90**					
100						**100**					
110						**110**					
120						**120**					
130						**130**					
140						**140**					
150						**150**					
160						**160**					
170						**170**					
180						**180**					
190						**190**					
200						**200**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely denote ground cover type as **"B/D". Understory & Canopy**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 2

Reach ID / Date: **Field Personnel:**

Cell 2	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width
210							**210**					
220							**220**					
230							**230**					
240							**240**					
250							**250**					
260							**260**					
270							**270**					
280							**280**					
290							**290**					
300							**300**					
310							**310**					
320							**320**					
330							**330**					
340							**340**					
350							**350**					
360							**360**					
370							**370**					
380							**380**					
390							**390**					
400							**400**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely denote ground cover type as **"B/D"**. **Understory & Canopy**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 3

Reach ID / Date: **Field Personnel:**

Cell 3	Left Bank					Right Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width
410						**410**					
420						**420**					
430						**430**					
440						**440**					
450						**450**					
460						**460**					
470						**470**					
480						**480**					
490						**490**					
500						**500**					
510						**510**					
520						**520**					
530						**530**					
540						**540**					
550						**550**					
560						**560**					
570						**570**					
580						**580**					
590						**590**					
600						**600**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely denote ground cover type as **"B/D". Understory & Canopy**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 4

Reach ID / Date: **Field Personnel:**

Cell 4	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width
610							**610**					
620							**620**					
630							**630**					
640							**640**					
650							**650**					
660							**660**					
670							**670**					
680							**680**					
690							**690**					
700							**700**					
710							**710**					
720							**720**					
730							**730**					
740							**740**					
750							**750**					
760							**760**					
770							**770**					
780							**780**					
790							**790**					
800							**800**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely denote ground cover type as **"B/D"**. **Understory & Canopy**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 5

Reach ID / Date: **Field Personnel:**

Cell 5	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	Place an **X** if measurement at gravel bar	Riparian Buffer Width
810							**810**					
820							**820**					
830							**830**					
840							**840**					
850							**850**					
860							**860**					
870							**870**					
880							**880**					
890							**890**					
900							**900**					
910							**910**					
920							**920**					
930							**930**					
940							**940**					
950							**950**					
960							**960**					
970							**970**					
980							**980**					
990							**990**					
1000							**1000**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely denote ground cover type as **"B/D"**. **Understory & Canopy**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 1

Reach ID / Date: **Field Personnel:**

Cell 1	**Left Bank**				
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
15					
30					
45					
50					
60					
75					
90					
100					
105					
120					
135					
150					
165					
180					
195					
200					
210					
225					
240					
250					
255					
270					
285					
300					

Right Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
15					
30					
45					
50					
60					
75					
90					
100					
105					
120					
135					
150					
165					
180					
195					
200					
210					
225					
240					
250					
255					
270					
285					
300					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 2

Reach ID / Date: **Field Personnel:**

Cell 2	Left Bank						Right Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
315							**315**					
330							**330**					
345							**345**					
350							**350**					
360							**360**					
375							**375**					
390							**390**					
400							**400**					
405							**405**					
420							**420**					
435							**435**					
450							**450**					
465							**465**					
480							**480**					
495							**495**					
500							**500**					
510							**510**					
525							**525**					
540							**540**					
550							**550**					
555							**555**					
570							**570**					
585							**585**					
600							**600**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 3

Reach ID / Date: **Field Personnel:**

Cell 3	Left Bank						Right Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
615							**615**					
630							**630**					
645							**645**					
650							**650**					
660							**660**					
675							**675**					
690							**690**					
700							**700**					
705							**705**					
720							**720**					
735							**735**					
750							**750**					
765							**765**					
780							**780**					
795							**795**					
800							**800**					
810							**810**					
825							**825**					
840							**840**					
850							**850**					
855							**855**					
870							**870**					
885							**885**					
900							**900**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 4

Reach ID / Date: **Field Personnel:**

Cell 4	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
915							**915**					
930							**930**					
945							**945**					
950							**950**					
960							**960**					
975							**975**					
990							**990**					
1000							**1000**					
1005							**1005**					
1020							**1020**					
1035							**1035**					
1050							**1050**					
1065							**1065**					
1080							**1080**					
1095							**1095**					
1100							**1100**					
1110							**1110**					
1125							**1125**					
1140							**1140**					
1150							**1150**					
1155							**1155**					
1170							**1170**					
1185							**1185**					
1200							**1200**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 5

Reach ID / Date: **Field Personnel:**

Cell 5	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
1215							**1215**					
1230							**1230**					
1245							**1245**					
1250							**1250**					
1260							**1260**					
1275							**1275**					
1290							**1290**					
1300							**1300**					
1305							**1305**					
1320							**1320**					
1335							**1335**					
1350							**1350**					
1365							**1365**					
1380							**1380**					
1395							**1395**					
1400							**1400**					
1410							**1410**					
1425							**1425**					
1440							**1440**					
1450							**1450**					
1455							**1455**					
1470							**1470**					
1485							**1485**					
1500							**1500**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 1

Reach ID / Date: **Field Personnel:**

Cell 1

Left Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
20					
40					
50					
60					
80					
100					
120					
140					
150					
160					
180					
200					
220					
240					
250					
260					
280					
300					
320					
340					
350					
360					
380					
400					

Right Bank					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
20					
40					
50					
60					
80					
100					
120					
140					
150					
160					
180					
200					
220					
240					
250					
260					
280					
300					
320					
340					
350					
360					
380					
400					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 2

Reach ID / Date: **Field Personnel:**

Cell 2	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
420							**420**					
440							**440**					
450							**450**					
460							**460**					
480							**480**					
500							**500**					
520							**520**					
540							**540**					
550							**550**					
560							**560**					
580							**580**					
600							**600**					
620							**620**					
640							**640**					
650							**650**					
660							**660**					
680							**680**					
700							**700**					
720							**720**					
740							**740**					
750							**750**					
760							**760**					
780							**780**					
800							**800**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 3

Reach ID / Date: **Field Personnel:**

Cell 3	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
820							**820**					
840							**840**					
850							**850**					
860							**860**					
880							**880**					
900							**900**					
920							**920**					
940							**940**					
950							**950**					
960							**960**					
980							**980**					
1000							**1000**					
1020							**1020**					
1040							**1040**					
1050							**1050**					
1060							**1060**					
1080							**1080**					
1100							**1100**					
1120							**1120**					
1140							**1140**					
1150							**1150**					
1160							**1160**					
1180							**1180**					
1200							**1200**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 4

Reach ID / Date: **Field Personnel:**

Cell 4	**Left Bank**						**Right Bank**					
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width		Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
1220							**1220**					
1240							**1240**					
1250							**1250**					
1260							**1260**					
1280							**1280**					
1300							**1300**					
1320							**1320**					
1340							**1340**					
1350							**1350**					
1360							**1360**					
1380							**1380**					
1400							**1400**					
1420							**1420**					
1440							**1440**					
1450							**1450**					
1460							**1460**					
1480							**1480**					
1500							**1500**					
1520							**1520**					
1540							**1540**					
1550							**1550**					
1560							**1560**					
1580							**1580**					
1600							**1600**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Field Form - Page 5

Reach ID / Date: **Field Personnel:**

Cell 5	**Left Bank**						**Right Bank**				
Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width	Station	Ground Cover (<1.5 ft)	Understory (1.5-15 ft)	Canopy Layer (>15 ft)	**X** if at gravel bar	Riparian Buffer Width
1620						**1620**					
1640						**1640**					
1650						**1650**					
1660						**1660**					
1680						**1680**					
1700						**1700**					
1720						**1720**					
1740						**1740**					
1750						**1750**					
1760						**1760**					
1780						**1780**					
1800						**1800**					
1820						**1820**					
1840						**1840**					
1850						**1850**					
1860						**1860**					
1880						**1880**					
1900						**1900**					
1920						**1920**					
1940						**1940**					
1950						**1950**					
1960						**1960**					
1980						**1980**					
2000						**2000**					

Ground Cover : **W** = Wetland (sedges & rushes), **G** = Grasses & Forbs, **B** = Disturbed bare ground, **R** = Rock, **RR** = Riprap, (-) = Base of shrub/tree
When hummocking is observed, denote ground cover type followed by: " **/ H** ". Where disturbed bare ground observed, if the potential for shrub growth is likely, denote ground cover type as **"B/D".** **Understory & Canopy layer**: **C** = Coniferous, **D** = Deciduous, **M** = Mixed, (-) = Understory or canopy layer is absent

Riparian Greenline Tally

	Left Bank					Right Bank				
Cell 1	Ground	W				Ground Cover	W			
		G					G			
		B		B/D			B		B/D	
		R					R			
		RR					RR			
	Understory	C				Understory	C			
		D					D			
		M					M			
	Overstory	C				Overstory	C			
		D					D			
		M					M			

	Left Bank					Right Bank				
Cell 2	Ground	W				Ground Cover	W			
		G					G			
		B		B/D			B		B/D	
		R					R			
		RR					RR			
	Understory	C				Understory	C			
		D					D			
		M					M			
	Overstory	C				Overstory	C			
		D					D			
		M					M			

	Left Bank					Right Bank				
Cell 3	Ground	W				Ground Cover	W			
		G					G			
		B		B/D			B		B/D	
		R					R			
		RR					RR			
	Understory	C				Understory	C			
		D					D			
		M					M			
	Overstory	C				Overstory	C			
		D					D			
		M					M			

	Left Bank					Right Bank				
Cell 4	Ground	W				Ground Cover	W			
		G					G			
		B		B/D			B		B/D	
		R					R			
		RR					RR			
	Understory	C				Understory	C			
		D					D			
		M					M			
	Overstory	C				Overstory	C			
		D					D			
		M					M			

	Left Bank					Right Bank				
Cell 5	Ground	W				Ground Cover	W			
		G					G			
		B		B/D			B		B/D	
		R					R			
		RR					RR			
	Understory	C				Understory	C			
		D					D			
		M					M			
	Overstory	C				Overstory	C			
		D					D			
		M					M			

Streambank Erosion Field Form

Reach ID / Date:		**Field Personnel:**	
Bank #_____Photo#_________ RR / RL	actively/visually eroding OR slowly eroding/undercut/vegetated		
BEHI Parameters	*Measurement*	*NBS Parameters*	
Bank height (toe to top of bank)	ft	**NBS Estimate:** VL / L / M / H / VH / E	
Bankfull height (toe)	ft	Bankfull mean depth calculations (5 measurements):	
Root depth	ft		
Root density (in 10% increments)		**Bankfull mean depth**	ft
Bank angle		**Near bank max depth** (deepest 1/3)	ft
Surface protection (% surface area)		**d_{nb}/d_{bkf} ratio**	
Material adjustments		**Method:** Measured (d_{nb} / d_{bkf}) / Channel Pattern Estimate	
Stratification		**NBS Calculated:** VL / L / M / H / VH / E	

Bank material adjustments - cobble: subtract 10 pts (unless gravel/sand >50%), gravel: add 5-10 pts (depending on amount of sand, sand: add 10 pts if exposed to erosion, silt/clay: no adjustment

Stratification - add 5-10 pts when a more erosive layer is situated between two less erosive layers within the bankfull zone

	d/s station	u/s station	length
Length of eroding streambank:			ft
Mean height of eroding streambank:	ft		
Bank composition (estimate percent):	coarse gravel, cobbles, boulders (>6mm):______ fine gravel (2-6mm):________ sand/clay(<2mm):______		
Hoof Shear Observed:	Present / Absent		

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Streambank Erosion Field Form

Bank #_____Photo#_________ RR / RL	actively/visually eroding OR slowly eroding/undercut/vegetated		
BEHI Parameters	*Measurement*	*NBS Parameters*	
Bank height (toe to top of bank)	ft	**NBS Estimate:** VL / L / M / H / VH / E	
Bankfull height (toe)	ft	Bankfull mean depth calculations (5 measurements):	
Root depth	ft		
Root density (in 10% increments)		**Bankfull mean depth**	ft
Bank angle		**Near bank max depth** (deepest 1/3)	ft
Surface protection (% surface area)		**d_{nb}/d_{bkf} ratio**	
Material adjustments		**Method:** Measured (d_{nb} / d_{bkf}) / Channel Pattern Estimate	
Stratification		**NBS Calculated:** VL / L / M / H / VH / E	

Bank material adjustments - cobble: subtract 10 pts (unless gravel/sand >50%), gravel: add 5-10 pts (depending on amount of sand, sand: add 10 pts if exposed to erosion, silt/clay: no adjustment

Stratification - add 5-10 pts when a more erosive layer is situated between two less erosive layers within the bankfull zone

	d/s station	u/s station	length
Length of eroding streambank:			ft
Mean height of eroding streambank:	ft		
Bank composition (estimate percent):	coarse gravel, cobbles, boulders (>6mm):______ fine gravel (2-6mm):________ sand/clay(<2mm):______		
Hoof Shear Observed:	Present / Absent		

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Additional Streambank Erosion Measurements

Reach ID / Date: **Field Personnel:**

Bank #	RR / RL	# of similar bank	d/s station	u/s station	mean height	comment
					ft	

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Bank #	RR / RL	# of similar bank	d/s station	u/s station	mean height	comment
					ft	

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Bank #	RR / RL	# of similar bank	d/s station	u/s station	mean height	comment
					ft	

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Bank #	RR / RL	# of similar bank	d/s station	u/s station	mean height	comment
					ft	

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Bank #	RR / RL	# of similar bank	d/s station	u/s station	mean height	comment
					ft	

Source of streambank instability (circle those that apply and estimate a percentage):

Transportation	Silviculture
Riparian Grazing	Irrigation-shifts in stream energy
Cropland	Historic or Other:
Mining	Natural Sources (must estimate %):

Bank type notes:

Riffle Pebble Count Field Form

		Cell_____	Count:_______		Cell_____	Count:_______		Cell_____	Count:_______	
particle		**mm**	dot & dash	count	**mm**	dot & dash	count	**mm**	dot & dash	count
very coarse sand and finer	SAND	< 2			< 2			< 2		
very fine	GRAVEL	2-4			2-4			2-4		
fine		4-6.35			4-6.35			4-6.35		
fine		6.35-8			6.35-8			6.35-8		
medium		8-11.3			8-11.3			8-11.3		
medium		11.3-16			11.3-16			11.3-16		
coarse		16-22.6			16-22.6			16-22.6		
coarse		22.6-32			22.6-32			22.6-32		
very coarse		32-45			32-45			32-45		
very coarse		45-64			45-64			45-64		
small	COBBLE	64-90			64-90			64-90		
small		90-128			90-128			90-128		
large		128-180			128-180			128-180		
large		180-256			180-256			180-256		
small	BOULDER	256-362			256-362			256-362		
small		362-512			362-512			362-512		
medium		512-1024			512-1024			512-1024		
large / very large		1024-2048			1024-2048			1024-2048		
			# < 2mm			# < 2mm			# < 2mm	
			# < 6.35mm			# < 6.35mm			# < 6.35mm	

Riffle Grid Toss	Toss # 1	Toss # 2	Toss # 3
Cell#_____			
Cell#_____			
Cell#_____			

Riffle Stability Index - measure the b-axis (mm) for 15 freshly moved dominant large particles found at the closest developed point bar

Cell#_____					
Cell#_____					
Cell#_____					

Site Visit Notes Field Form	
Reach ID / Date:	**Field Personnel:**

Existing Rosgen Stream Type:

Potential Rosgen Stream Type:

Description of human impacts and their severity:

Description of stream channel conditions:

Description of streambank erosion conditions:

Description of riparian vegetation conditions: