Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Measuring Sediment Size and Channel Dimensions: 11-Count Method

Version 1.0

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SIGNATURES ON FILE

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical experts. Their primary purpose is for internal Ecology use, although SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure or process.

SOP Revision History

Revision date	Rev number	Summary of changes	Sections	Reviser(s)
3/25/2009	1	Numerous edits	All	Chris Clinton
7/20/2009	2	Numerous edits	All	Brian Engeness
8/15/2009	3	Numerous edits	All	Martha Maggi
9/28/2009	4	Numerous edits	All	Brian Engeness
11/17/2009	5	Removed underlining	All	Bill Kammin

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for measuring stream sediment size and channel dimensions across a transect using the 11-count method.

1.2 Habitat quality for fish, amphibians, and macroinvertebrates is largely determined by the size of substrate found in streams. Forest management activities often influence stream sediment by increasing the amount of finer particles introduced.

2.0 Applicability

2.1 This SOP is intended for use in determining substrate characteristics in wadeable streams and was adapted from the Integrated Status and Effectiveness Monitoring Program's "A Field Manual for the Habitat Protocols of the Upper Columbia Monitoring Strategy" (Moberg, 2006). This procedure should be employed on streams in which depth and flow are not great enough to prevent wading and reaching to the stream bed to handle substrate.

3.0 Definitions

3.1 Bankfull edge: the line on the bank that coincides with the water's elevation during bankfull stage.

3.2 Bankfull stage: the point at which a river or stream completely fills its channel, just before water begins to flow into the flood plain; bankfull stage is defined by the flow during moderate-sized floods that occur an average of every 1.5 years.

3.3 Bankfull height: vertical distance between the water's surface and the point above which water enters the flood plain or intersects a terrace or hillslope.

3.4 Bankfull width: the horizontal distance between bankfull edges at a given point perpendicular to flow; if a channel is dry, measure distance perpendicular to perceived flow.

3.5 Bankfull zone: the area between the channel's bankfull edges and along the streambed; bankfull zone can be seen as a two-dimensional plane at a transect or as a three-dimensional area along the stream.

3.6 Embeddedness

3.6.1 For substrate particle diameters greater than or equal to 10 cm along the B-axis, embeddedness is: percent of the particle's total surface area that is surrounded by sand and fine sediment.

3.6.2 For substrate particle diameters less than 10 cm along the B-axis, embeddedness is: percentage of sand and fine sediment on the surface of a 10 cm diameter circle on the stream bed surrounding the particle being examined.

3.6.3 Note: sand and fines are considered 100% embedded; bedrock and hardpan are 0% embedded.

3.7 Island: a stream feature of consolidated materials that is elevated above the bankfull zone; an island is confined by a side channel and the main channel.

3.8 Main channel: when a stream is divided by an island the main channel is the division of largest flow.

3.9 Particle Axes

3.9.1 A-axis: the longest dimension of a particle.

3.9.2 C-axis: the shortest dimension of a particle, measured perpendicularly from the A-axis.

3.9.3 B-axis: the intermediate dimension of a particle, perpendicular to both the A-axis and C-axis.

3.10 Side channel: when a stream is divided by an island the side channel is the division of smaller flow.

3.11 Stream left: left hand side when facing downstream.

3.12 Stream right: right hand bank when facing downstream.

3.13 Substrate class size abbreviations.

3.13.1 RS Bedrock, smooth: 400+ cm, smooth to touch (larger than a car).

3.13.2 RR Bedrock, rough: 400+ cm, rough to touch (larger than a car).

3.13.3 BL Boulder: 25 – 400 cm (basketball to car).

3.13.4 CB Cobble: 6.4 – 25cm (tennis ball to basketball).

3.13.5 GC Gravel, course: 1.6 – 6.4 cm (marble to tennis ball).

3.13.6 GF Gravel, fine: 0.2 – 1.6 cm (ladybug to marble).

3.13.7 SA Sand: 0.006 – 0.2 cm (gritty between fingers to ladybug).

3.13.8 FN Fines: Silt, Clay, Muck - not gritty between fingers.

3.13.9 HP Hard pan: firm consolidated fine substrate.

3.13.10 WD Wood (any size).

3.13.11 OT Other: anything not covered under other categories; make notes in the notes section.

3.14 Undercut bank: bank which has been eroded by the stream so that a protrusion of the upper portion of the bank (i.e. bank above the bankfull edge) overhangs the water surface.

3.15 Wetted edge: the point at which substrate particles are no longer surrounded by free water.

3.16 Wetted width: the distance between the left wetted edge and the right wetted edge, including bars.

4.0 Personnel Qualifications/Responsibilities

4.1 Knowledge of the contents of all SOP's related to the Extensive Riparian Status and Trends monitoring program.

4.2 Data collection: Staff members must understand the notations on the datasheet (see Appendix A, B, and C). Each staff member should be adequately trained to identify the bankfull zone and wetted width, to classify substrate by size and texture, to use the appropriate abbreviations, and to quantify embeddedness.

4.3 The staff member's aptitude for field tasks is more important than job class.

5.0 Equipment and Supplies

5.1 5 meter stadia rod
5.2 1.5 meter graduated PVC pole
5.3 String box

5.4 Wading Boots and Chest Waders
5.5 Waterproof "11 Count Substrate: Depth, Class, Embeddedness" datasheet (Appendix A)
5.6 Waterproof "Transect Dimensions, Canopy Cover, Riparian Vegetation" datasheet (Appendix B)
5.7 Waterproof information sheet (Appendix C)
5.8 Waterproof field notebook
5.9 Pencils

6.0 Summary of Procedure

6.1 Conduct the 11-Count Substrate Method at each of the six transects. For efficiency, designate one staff member as the data collector and one as the data recorder. The data collector will verbalize measurements to be entered by the data recorder.

6.2 Bankfull Width

6.2.1 Using bankfull indicators, identify the bankfull height on the left and right banks. See Bankfull Width SOP.

6.2.2 If the width of the stream permits, suspend the stadia rod horizontally over the channel, adjusting the rod to rest on the bankfull edges. The bankfull width is the distance between the bankfull edges. Measure bankfull width to the nearest 0.1 m. Record this measurement in the appropriate "BFW" cell under "Dimensions" on the "Transect Dimensions, Canopy Cover, Riparian Vegetation" datasheet. If the channel is too wide to use a stadia rod, measure the bankfull width with a 50m tape or a string box.

6.2.3 If there are multiple channels present, decide which has most flow and designate it as the main channel. Substrate assessment is not performed on side channels.

6.3 Substrate Assessment

6.3.1 Determination of Depth

6.3.1.1 The 11-count method is based on the bankfull width. Divide the bankfull width by ten. The channel depth will be assessed from left bank to right bank at 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% of bankfull width.

6.3.1.2 Measure depth in centimeters relative to the water level. The water level is the 0 cm mark. Measurements above water are negative and measurements below water are positive. If the stream is above flood stage, all measurements are positive. Conversely if the stream is dry, all measurements are negative – measured from the deepest part of the channel

6.3.1.3 Depth at 0%

6.3.1.3.1 The depth at 0% of bankfull width is the vertical distance between the left bankfull height and the left wetted edge. If the stadia rod can be suspended across the bankfull zone, use it as an indication of bankfull height and measure the vertical distance from the water level to the stadia rod with the graduated PVC pole. If the stadia rod cannot be suspended across the bankfull zone, hold the stadia rod horizontally at the left bankfull edge and place the PVC pole at the wetted edge. Measure up to the stadia rod and record this measurement to the nearest 1 cm in the appropriate "0% dep" cell on the Substrate datasheet.

6.3.1.3.2 The depth at 0% bankfull distance is usually negative, but may be positive if the bank is vertical or undercut. If the bank is vertical or undercut, drop down vertically from the bankfull edge to the water level and measure the depth of water at this point. If this point is within the wetted width, depth will be positive; if it is not within the wetted width, depth will be negative.

6.3.1.4 Depth at 10% to 90%

6.3.1.4.1 Continuing to use the stadia rod as an indication of left bankfull height, measure horizontally to 10% of bankfull width. If this point on the stream profile is not within wetted width, measure vertically from bankfull height and subtract this measurement from bankfull height. If this point is within the wetted width, measure the water depth. Record this measurement in the appropriate "10% dep" cell on the Substrate datasheet.

6.3.1.4.2 Follow this procedure for the 20%, 30%, 40%, 50%, 60%, 70%, 80% and 90% bankfull distances.

6.3.1.4.3 For the 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, and 90% bankfull distances, depth is measured from the highest point of the substrate to the surface of the water. If the substrate is totally submerged, depth is a positive number. If the substrate is exposed, depth is a negative number.

6.3.1.5 Depth at 100%

6.3.1.5.1 Once you reach the right wetted width, begin using the right bankfull height (i.e. 100% bankfull distance) as the reference for depth. The depth at 100% bankfull distance is the vertical distance between the right bankfull height and the right wetted edge. It is measured using the same procedure as depth at 0%.

6.3.2 Determination of Substrate Size

6.3.2.1 Concurrently with depth measurements, determine substrate size. At each of the 11 points on the stream bed (0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100%) randomly (i.e. without looking) choose a piece of substrate within a 10cm radius of the point. Estimate the size of this particle using the length of its intermediate axis (B-axis). Using the sediment classes listed in Appendix C, determine the particle's substrate class size. Record substrate class size as a two letter abbreviation (enter **RS**, **RR**, **HP**, **BL**, **CB**, **GC**, **GF**, **SA**, **FN**, **WD**, or **OT**) in the appropriate "sub" cell on the Substrate datasheet. When classifying substrate as "OT," describe specifically what the material is in the notes section of the Substrate datasheet. Record any additional notes on substrate in the notes section.

6.3.3 Determination of Embeddedness

6.3.3.1 Concurrently with depth measurements and substrate determination, determine embeddedness of the substrate. If the piece of substrate that was randomly chosen is 10 cm in diameter or greater, embeddedness is defined as the percent of the particle's total surface area that is surrounded by sand and fines. If the piece of substrate randomly chosen is less than 10 cm in diameter, embeddedness is defined as the percentage of sand and fines on the surface of a 10cm diameter circle on the stream bed. Substrate that is classified as sand or fines is by definition 100% embedded. Substrate that is classified as bedrock or hardpan is by definition 0% embedded. Record substrate embeddedness in the appropriate "emb" cell on the Substrate datasheet to the nearest 10%.

6.3.4 For the sake of efficiency, substrate size, depth, and embeddedness should be determined and recorded at the same time for each of the 11 points, working through the points from left bank to right bank.

7.0 Records Management

7.1 Blank datasheets available to print are located in
Y:\SHARED Files\Engeness\ERST\Data Sheets

7.2 All completed datasheet hard copies from a specific site are filed together.

7.3 Datasheets are scanned and saved in folders according to year of survey and site type (Type N or Type F). These folders are located in

Y:\SHARED Files\Engeness\ERST\Type F07E
Y:\SHARED Files\Engeness\ERST\Type F08W
Y:\SHARED Files\Engeness\ERST\Type N08W
Y:\SHARED Files\Engeness\ERST\Type N09W

7.4 Data is entered into Access Database tables. These are located in Y:\SHARED Files\Engeness\ERST\Database Stuff\ERST_DATABASES

8.0 Quality Control and Quality Assurance

8.1 Data collection

8.1.1 Select 10% of the total number of sites for QA and take all field measurements twice; the second time with a different staff member collecting data. Record the QA measurements on separate data sheets. For the sake of efficiency, reassess the site immediately after the first assessment.

8.1.2 Review all field data for completeness before leaving the site.

8.2 Data entry: After manually transferring field data to a database file, two staff members check each entry of each record. Alternatively, enter the data twice and compare the resulting two electronic data tables.

9.0 Safety

9.1 Safety Equipment
9.1.1 Hard hat
9.1.2 Field vest
9.1.3 Wading Boots / Chest Waders
9.1.4 Compass
9.1.5 Whistle
9.1.6 First aid kit
9.1.7 Weather protection (i.e., raingear, sun protection, extra clothing)

9.2 Field team must always consist of at least two staff members.

9.3 Applicable Ecology Safety Policies

9.3.1 Accessing Private Property: Follow Ecology Executive Policy 1-11

9.3.2 Field work Notification Procedures: Follow procedure outlined in EAP Safety Manual on pages 1-19 through 1-22

9.3.3 Working in Rivers and Streams: Follow procedure outlined on pages 1-35 and 1-36

9.4 Use a CB radio to communicate with other traffic on one-way logging roads.

10.0 References

10.1 Ecology, 2006. Environmental Assessment Program Safety Manual. Olympia, WA.

10.2 Ehinger, W., McConnell, S., Schuett-Hames, D., Black, J. 2007. Study plan: Extensive Riparian Status and Trends monitoring program. Draft. Prepared for CMER's Riparian Scientific Advisory Group.

10.3 Moberg, J. 2006. A Field Manual for the Habitat Protocols of the Upper Columbia Monitoring Strategy,. Final Draft of 2006 Working Version. Prepared for Bonneville Power Administration's Integrated Status and Effectiveness Monitoring Program. Wauconda, WA: Terraqua, Inc. pgs 16-18

11.0 Appendices

11.1 Appendix A. 11 Count Substrate: Depth, Class, Embeddedness

ERST TYPE N F Westside MM/DD_____ 2009 CREW_____ Site ID #_____

11 Count Substrate: Depth, Class, Embeddedness

POS	T-1			T-2			T-3			T-4			T-5			T-6		
	dep	sub	emb	dep	sub	emb	dep	sub	emb	dep	sub	emb	dep	sub	emb	dep	sub	emb
0%																		
10%																		
20%																		
30%																		
40%																		
50%																		
60%																		
70%																		
80%																		
90%																		
100%																		

Notes:

dep = depth (cm), sub = substrate size class, emb = embeddedness (%)

ERST TYPE N F Westside MM/DD_____ 2009 CREW_____ Site ID #_____

Transect Dimensions, Canopy Closure, Riparian Vegetation Cover

Tr.	DIMENSIONS(m) WW	BFW	BAR	THD	CANOPY CLOSURE Up	Left	Down	Right	Notes:
1									
2									
3									
4									
5									
6									

RIPARIAN VEGETATION COVER	T - 1 LB	T - 1 RB	T - 2 LB	T - 2 RB	T - 3 LB	T - 3 RB	T - 4 LB	T - 4 RB	T - 5 LB	T - 5 RB	T - 6 LB	T - 6 RB
Vegetation Type (> 5m)												
Big Trees (> 5m)												
Small Trees (> 5m)												
Vegetation Type (5 - 0.5m)												
Woody Plants (0.5 - 5m)												
Non-Woody Plants (0.5 - 5m)												
Woody Plants (< 0.5m)												
Non-Woody (< 0.5m)												
Barren, Bare Dirt or Duff												
Unstable Bank (%)												

Vegetation Type (D = deciduous, C = coniferous, E = broadleaf evergreen, M = mixed, N = none). For big/small trees, woody/non-woody, dirt/duff use: 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

11.3 Appendix C. Information sheet explaining Substrate size classes and abbreviations

	Substrate Size Class Codes:
RS	Bedrock, Smooth (larger than a car)
RR	Bedrock, Rough (larger than a car)
BL	Boulder (25 - 400 cm) (basketball to car)
CB	Cobble (6.4 - 25 cm) (tennis ball to basketball)
GC	Coarse Gravel (1.6 - 6.4 cm) (marble to tennis ball)
GF	Fine Gravel (0.2 - 1.6 cm) (ladybug to marble)
SA	Sand (0.006 - 0.2) (gritty up to ladybug)
FN	Fines (Silt, Clay, Muck) (not gritty)
HP	Hard Pan (firm consolidated fine substrate)
WD	Wood (any size)
OT	Other (identify material)

5 Count Substrate Postions:

LB/RB = at wetted bank, stream left/right. CTR = center of wetted channel. LCTR/RCTR = midway between banks and center.

11 Count Substrate Positions:

0% = Left Bank, 100% = Right Bank.

Embeddedness:

Give a % of sand/fines touching the entire surface of the substrate pariticle (if >10cm). If particle is <10cm determine the % of sand/fines on surface of area w/ 10cm radius. Bedrock = 0% and sand/fines = 100% embedded.

Wetted Width:

Length of stream surface water measured perpendicularily to the direction of the water flow. Record to nearest 0.1m

Bankfull Width:

The distance from the left and right bank edges to eachother at a point on the stream, measured perpendicular to the direction of water flow. Record to nearest 0.1m

Bar:

A conglomeration of substrate within the wetted width that elevates above the water. Record to nearest 0.1m.

Island:

Islands split the channel into a main channel and a side channel. The difference between an island and a bar is that a bar would be covered in water at high flows, whereas an island extends above the channels bankfull height, and thus retains the water flow within it's bank. When an island is encountered, follow the channel with the greatest flow. Takes notes of the island.

Thalweg:

The deepest part of a stream at any given cross section.

Transects:

T-1 = the furthest downstream transect at the random point. T-6 is the furthest transect upstream.