Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Determining Canopy Closure using a Concave Spherical Densiometer – Model C for the Extensive Riparian Status and Trends Monitoring Program

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)
5/20/2009	1	Numerous edits	All	Liz Werner
6/10/2009	2	Numerous edits	All	Brian Engeness
8/15/2009	3	Numerous edits	All	Martha Maggi
9/25/2009	4	Numerous edits	All	Brian Engeness
11/17/2009	5	Removed Underlining	All	Bill Kammin
2/27/2016	6	Recertified	All	Bill Kammin

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1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for determining canopy closure using a Model C Concave Spherical Densiometer on streams.

1.2 Riparian canopy cover plays a vital role in moderating stream temperatures through shading. The extent of riparian canopy cover as measured by a densiometer is an important covariate of stream temperature.

2.0 Applicability

2.1 This SOP was adapted from the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) Field Manual for Wadeable Streams (Peck et al., 2003) for use on streams in the Extensive Riparian Status and Trends (ERST) monitoring program. This procedure may be applicable for other studies assessing canopy closure on streams.

2.2 The full 180^{o} view provided by hemispherical photos taken with a fish eye lens may provide a more accurate assessment of canopy closure than a densiometer which provides a narrower view. However, densiometers are often chosen to assess canopy closure for their ease of use, efficiency, and transportability.

3.0 Definitions

3.1 Canopy closure: the amount of forest overstory measured with a densiometer from the center of the bankfull channel.

3.2 River left: left hand side when facing downstream.

3.3 River right: right hand side when facing downstream.

3.4 Spherical densiometer: a pocket-sized instrument which employs a mirror with curvature, either convex (outward) or concave (inward), enabling the reflection of a large overhead area. See Figure 1.

Figure 1. Concave Spherical Densiometer – Model C

3.5 Transect: a line which crosses perpendicular to stream flow across the bankfull channel; each site for the ERST project has six transects

4.0 Personnel Qualifications/Responsibilities

4.1 Knowledge of the contents of all SOP's related to the ERST monitoring program.

4.2 Staff members must be adequately trained in how to position their bodies relative to stream flow, hold densiometers, and take canopy closure readings in order to maintain consistency in results.

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

5.0 Equipment and Supplies

5.1 Concave Spherical Densiometer - Model C
5.2 Waterproof "Transect Dimensions, Canopy Cover, Riparian Vegetation" datasheet (Appendix A)
5.3 Waterproof field notebook
5.4 Pencils
5.5 Wading Boots and Chest Waders

6.0 Summary of Procedure

6.1 Determine and record canopy closure for each of the six transects.

6.1.1 Transect 1, Upstream

6.1.2 Stand mid-channel at the transect and face upstream. Hold the densiometer at elbow height above the water level. (Recognize that use of this procedure may result in different readings due to different heights of operators.)

6.1.3 Hold the densiometer at a distance away from your body so that your forehead is visible in the mirror, but not within the grid area (see Figure 2).

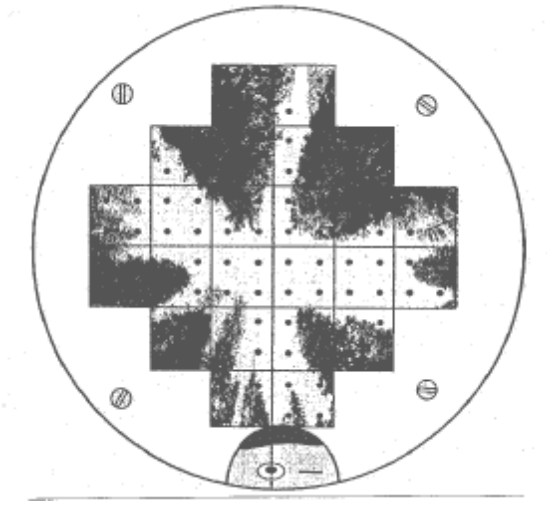

Figure 2. View of densiometer mirror showing placement of operator's head and with the 96 imaginary dots represented. (Pleus & Shuett-Hames, 1998)

6.1.4 Using the bubble in the lower right corner of the instrument as a guide, hold the densiometer level.

6.1.5 The spherical densiometer consists of 24 ¼" squares engraved onto a concave mirror. Each square of the grid must be subdivided mentally into 4 smaller squares and represented by an imaginary dot in the center of each of the smaller squares (See Figure 2). A total of 96 dots can be counted within the grid. Densiometer readings can range from 0 (no canopy cover) to 96 (maximum canopy cover).

6.1.6 Using only the dominant eye (keeping the other eye closed), count the number of dots in each engraved square that is blocked by canopy cover. Enter the total number of dots blocked into the appropriate cell on the datasheet (see Appendix A). Conversely, count the number of dots that are not occupied by canopy and subtract this total from 96.

6.1.7 If forest understory blocks the densiometer's view of the canopy, move to a place where readings can be taken with minimal understory blockage. However, it is important to maintain relative proximity to the transect. If not standing at the transect, note the distance from the transect that the readings were taken and why.

6.1.8 If sun glare is interfering with the view of the densiometer grid, block the sun's image by placing your finger in a position so that your finger is covering the sun in the densiometer's mirror.

6.1.9 Enter densiometer readings records into the *Canopy Closure* section on the "Transect Dimensions, Canopy Closure, Riparian Vegetation Cover" form (see Appendix A). Write all additional notes on a separate blank sheet that is clearly labeled with site information.

6.2 Transect 1, Left Bank, Downstream, and Right Bank

6.2.1 Repeat steps 6.1.2 through 6.1.9 for the Left Bank, Downstream, and Right Bank of Transect 1.

6.3 Review field data for completeness before leaving the transect.

6.4 Repeat steps 6.1.1 through 6.3 for the remaining transects.

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 databases are in
Y:\SHARED Files\Engeness\ERST\Database Stuff\ERST_DATABASES

7.5 Canopy Closure Conversion to Percent

7.5.1 Enter final readings in the Canopy Entries Spreadsheet located at Y:\SHARED Files\Engeness\ERST\ERST 2008 Spreadsheets\Canopy_Entries.xlsx. Use this spreadsheet to convert final readings to percent canopy cover by multiplying by 1.04. Enter the percent canopy cover measurements into the Access database. Databases are in: Y:\SHARED Files\Engeness\ERST\Database Stuff\ERST_DATABASES

8.0 Quality Control and Quality Assurance Section

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 Ensure data sheets are completely filled out.

8.2 Data entry: After transferring data to a database file, two staff members check each entry of each record. Alternatively, enter the data twice and compare the 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 traffic on logging roads.

10.0 References

10.1 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.

10.2 Kaufmann, P., Robison, E. 1998. Physical Habitat Assessment. Environmental Monitoring and Assessment Program – Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams pp 77-118. EPA/620/R-94/004F. U.S. Environmental Protection Agency, Washington D.C.

10.3 Lemmon, P. 1957. A New Instrument for Measuring Forest Overstory Density. Journal of Forestry 55 (9) pp 667-668.

10.4 Peck, D., J.M. Lazorchak, and D.J. Klemm (editors), 2003. Environmental Monitoring and Assessment Program-Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams. U.S. Environmental Protection Agency, Western Ecology Division, Corvallis, OR. http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/ewwsm01.pdf

10.5 Pleus, A.E. and D. Schuett-Hames, 1998. TFW Monitoring Program Methods Manual for the Reference Point Survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-98-002. DNR #104.

11.0 Appendices

11.1 Appendix A. Datasheet for recording densiometer readings for each transect

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

Transect Dimensions, Canopy Closure, Riparian Vegetation Cover									
	DIMENSIONS(m)				CANOPY CLOSURE				Notes:
Tr.	WW	BFW	BAR	THD	Up	Left	Down	Right	
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%)