DEPARTMENT OF
ECOLOGY
State of Washington

**Standard Operating Procedure
EAP113, Version 1.7**

Watershed Health Monitoring: Measuring Channel Dimensions

Purpose of this document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

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Contact information

For more information contact:

Communications Consultant
Environmental Assessment Program
P.O. Box 47600, Olympia, WA 98504-7600
Phone: 360-407-7680

Washington State Department of Ecology – ecology.wa.gov

Location of Ecology Office	Phone
Headquarters, Lacey	360-407-6000
Northwest Regional Office, Bellevue	425-649-7000
Southwest Regional Office, Lacey	360-407-6300
Central Regional Office, Union Gap	509-575-2490
Eastern Regional Office, Spokane	509-329-3400

Washington State Department of Ecology

Environmental Assessment Program

Watershed Health Monitoring: Standard Operating Procedures for Measuring Channel Dimensions

Version 1.7

Author – Jill Lemmon
Date –

Reviewers – Stephanie Estrella, George Onwumere, Glenn Merritt and Meghan Rosewood-Thurman
Date -

QA Approval - William R. Kammin, Ecology Quality Assurance Officer
Date -

EAP113

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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 and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative 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)
2/9/17	1.1	Changed title, added footers, re-formatted, added glossary terms, updated references	All	Meghan Rosewood-Thurman
2/22/17	1.2	Added glossary terms	3.0	Meghan Rosewood-Thurman
3/1/2017	1.3	Made changes and incorporated comments form review	6.3	Jill Lemmon
3/1/17	1.4	Added reviewers, general formatting	All	Meghan Rosewood-Thurman
3/8/17	1.5	Title match to Title page Added Peck et al., 2005. Removed references to BPA Don't subtract mid-channel bars Made coniststent with approved SOPs Parsons 2016 Cited Parsons et al retaher than policy Added wide layout SOP Cropped Figures Added Figure 9 Deleted first cite (unmatched in text) Updated links Noted this is only major transects – see Thalweg SOP for minor transects Rearranged to eliminate separate secrtions for Narrow/Wide Re-formatted	All	Glenn Merritt
3/10/17	1.6	Updated reviewers, general formatting	All	Meghan Rosewood-Thurman
3/13/17	1.7	Added Reference link	10.0	Meghan Rosewood-Thurman
3/13/17	1.7	Certified	All	Tom Gries

Environmental Assessment Program

Watershed Health Monitoring: Standard Operating Procedures for Measuring Channel Dimensions

1.0   **Purpose and Scope**

1.1   This document is the Environmental Assessment Program's (EAP) Standard Operating Procedure (SOP) for measuring channel dimensions at major transects of rivers and streams during a Data Collection Event (DCE) for the Watershed Health Monitoring (WHM) program or related studies. Specifically, it describes how to measure bankfull width, wetted width, bar width, and bankfull height. It applies to DCEs performed using either the WHM Narrow Protocol or the WHM Wide Protocol. It does *not* specifically discuss records for width measurements made at intermediate transects of Narrow Protocol streams; those are discussed in EAP SOP119 (Merritt, 2017).

2.0   **Applicability**

2.1   This SOP is used in conjunction with other WHM SOPs to complete a DCE for the Watershed Health Monitoring Program. This method is applied at every major transect at a site. Follow the method outlined in this SOP only after completing the site verification and layout procedures described in SOPs EAP106 (Merritt, 2017) or EAP105 (Hartman, 2017).

2.2   This SOP was adapted from field methods of the Environmental Protection Agency's Environmental Monitoring and Assessment Program (Peck et al., 2005 and 2006).

2.3   For the Narrow Protocol, this method is applied to right and left banks of the main channel at eleven major transects and ten minor transects.

2.4   For the Wide Protocol, this SOP applies to eleven stations within the sample site, each centered on a main transect, and each residing on just one of two banks. Either right or left bank is determined prior to field sampling according to SOP EAP105 (Hartman, 2017).

2.5   Data collected with the method outlined in this SOP are used to calculate physical habitat metrics that quantify channel dimensions at a site (Janisch, 2013).

3.0   **Definitions**

3.1   Bankfull depth: the vertical distance in cm between the channel bed substrate and bankfull elevation.

3.2   Bankfull height: the vertical distance between surface of water and bankfull stage. For WHM, this is measured in centimeters.

3.3   Bankfull Stage: This stage is delineated by the elevation point of incipient flooding, indicated by deposits of sand or silt at the active scour mark, break in stream bank slope, perennial vegetation limit, rock discoloration, and root hair exposure (Endreny, 2003).

3.4   Bankfull width: Horizontal distance between the bankfull stage on the left bank and the bankfull stage on the right bank. For WHM, this is measured to the nearest tenth of a meter

3.5   Bar: Dry or exposed portions of the streambed. For this method, we are only counting bars that have water on both sides. Figure 1 below provides an example. Bars are lower in elevation than the bankfull stage (islands are higher).
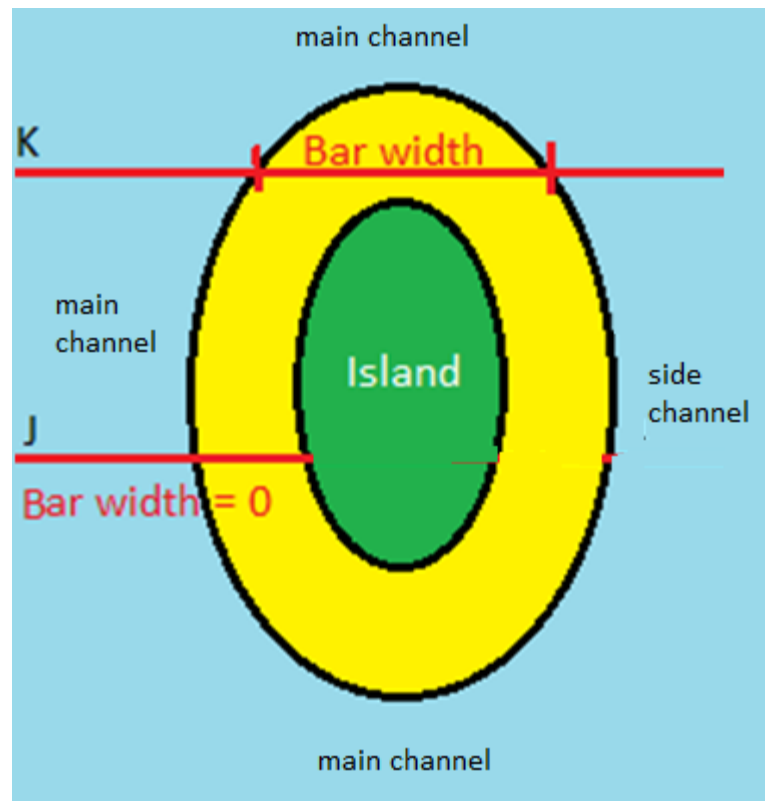

Figure 1. Example transects for recording bars. J has no bar. K does.

Note: *Single boulders that rise above the water surface are NOT recorded as bars.*

3.6   cm: centimeter

3.7   DCE: The *Data Collection Event* is the sampling event for the given protocol. Data for a DCE are indexed using a code which includes the site ID followed by the year, month, day, and the time (military) for the start time of the sampling event. For example: WAM06600-000222-DCE-YYYY-MMDD-HH:MM. One DCE should be completed within one working day, lasting 4-6 hours, on average.

3.8   EAP: Environmental Assessment Program

3.9   Ecology: The Washington State Department of Ecology

3.10   Index station: The distinct point location mapped by the site coordinates obtained from the Washington Master Sample List. The index station is called "X" and is generally located at major transect F; however the point may occur at any elevation in the stream between transects A and K.

3.11   Island: A dry area between channels. It extends vertically above the bankfull stage.

3.12   Left bank: A person facing downstream will have the left bank on their left side.

3.13   m: meter

3.14   Main Channel: Channels in a stream are divided by islands (dry ground that rises above bankfull stage). Main channels contain the greatest proportion of flow.

3.15   Major transect: One of 11 equidistant transects across the length of a site. These transects run perpendicular to the thalweg and are labeled as follows: A (furthest downstream), B, C, D, E, F, G, H, I, J, and K (furthest upstream).

3.16   Minor transect: One of 10 equidistant transects across the length of a site that is sampled using the Narrow Protocol. Each minor transect is located midway between major transects. Minor transects are A5, B5,C5, D5, E5, F5, G5, H5, I5, and J5.

3.17   Narrow Protocol: The set of Watershed Health Monitoring SOPs that describe data collection at wadeable sites with an average bankfull width of less than 25m at the index station.

3.18   QAMP: Quality Assurance Monitoring Plan. The QAMP for WHM is Cusimano et al., (2006). An updated version is in early stages of development.

3.19   Right bank: For WHM, a person facing downstream will have the right bank on their right side.

3.20   Side channel: Channels in a stream are divided by islands (dry ground that rises above bankfull stage). Side channels are those that contain less flow than the main channel.

3.21   Site: A site is defined by the coordinates provided to a sampling crew and the boundaries established by the protocol's site layout method SOP EAP105 (Hartman, 2017) for the Wide Protocol; SOP EAP106 (Merritt, 2017) for the Narrow Protocol. Typically, a site is centered on the index station and equal in length to 20 times the average of 5 bankfull width measurements. Sites cannot be longer than 2 km nor shorter than 150 m. Narrow Protocol sites range from 150 m to 500 m long. Wide Protocol sites are up to 2 km long and most-frequently longer than 500m . The most downstream end of a site coincides with major transect A; the most upstream end coincides with major transect K.

3.22   Transect: A straight line along which observations are made or measurements are taken. This line spans the stream channel and is perpendicular to the direction of flow.

3.23   Wetted width: Farthest horizontal distance between water edge on the left and right sides of a channel. Do not subtract mid-channel bars.

3.24   WHM: Watershed Health Monitoring, a status and trends monitoring program within the Environmental Assessment Program at the Washington State Department of Ecology.

3.25   Wide Protocol: The set of WHM SOPs that describes the sample and data collection at non-wadeable sites or sites wider than 25m bankfull width. It is an abbreviated version of the Narrow Protocol and is typically accomplished by use of rafts.

4.0   Personnel Qualifications/Responsibilities

4.1   This SOP pertains to all Environmental Assessment Program field staff collecting and entering data for WHM.

4.2   All field staff must comply with the requirements of the EAP Safety Manual (Ecology, 2017)

4.3   All field staff must have completed the annual WHM field training and be familiar with both WHM protocols: Narrow Protocol and Wide Portocol. The training includes sampling goals and objectives as defined in the QAMP (Cusimano et al., 2006)

4.4   Field staff must be annually trained to minimize the spread of invasive species. See SOP EAP070 (Parsons et al., 2016).

5.0   Equipment, Reagents, and Supplies

5.1   Disinfection solutions, brushes, or other equipment necessary to minimize the spread of invasive species from site to site. See Parsons et al., (2016) for more information.

5.2   Access gear (boats, rafts, or waders and boots). These should be pre-cleaned to avoid the spread of invasive species. See Parsons et al., (2016) for more information.

5.3   Fully-charged field tablet with WHM electronic field forms

5.4   Measuring or surveyor's rod or 50-meter tape

5.5   Bubble level or densiometer

5.6   Bubble level

5.7   Laser rangefinder

6.0   Summary of Procedure

6.1   Pre-sampling Preparation

6.1.1   File an Ecology Field Plan. Forms are available and should be posted on the EAP Program SharePoint site at: http://teams/sites/EAP/Pages/Default.aspx.

6.1.2   Determine the appropriate protocol to use (narrow versus wide) and establish the 11 major transects before measuring channel dimensions. Follow the method outlined in this SOP only after completing the site verification and layout procedures SOPs EAP106 (Merritt, 2017) or EAP105 (Hartman, 2017).

6.2   General Considerations and Cautions

6.2.1   Never compromise your personal safety or that of field partners to collect bank measurements. Always plan ahead to avoid falling and drowning hazards.

6.2.2   Be aware of wildfire activity. It may pose a safety threat or may change or limit access to certain areas.

6.3   **Measure the bankfull width** of the main channel at major transects. At the transect, visually estimate the bankfull stage (Figure 2). This is best done after considerable training. Below are some useful resources:

- Hydrologic Processes: Bankfull Discharge (EPA, 2012)
- Identifying Bankfull Channel Edge Part 1 (Grizzell, 2008a)
- Identifying Bankfull Channel Edge Part 2 (Grizzell, 2008b)
- A Guide for Field Identification of Bankfull Stage in the Western United States (Leopold et al., 1995)

- [Fluvial Geomorphology Module, UCAR COMET Program and NOAA River Forecast Center](#) (Endreny, 2003)
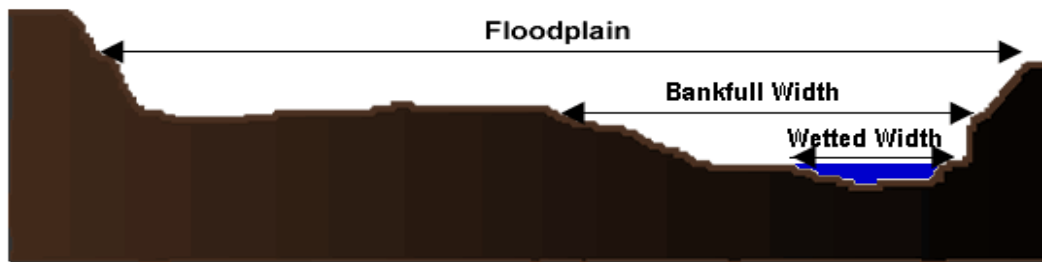

Figure 2. Diagram of widths at the transect (modified from Endreny, 2003).

After locating the bankfull stage at each bank, measure the horizontal distance between the left bankfull stage and the right bankfull stage. Measure to the nearest tenth of a meter. Width measurements can be made using a 50-meter tape, a measuring rod, or a laser rangefinder.

NOTE: If using a laser rangefinder, take at least 3 measurements and then record the estimated average.

6.4   **Record the bankfull width** values in the electronic field forms. Navigate to the *Transect* page, *Channel* tab. Record the bankfull width value in the "Bankfull Width (m)" field (Figure 3).

NOTE: If you have trouble determining the bankfull stage (for instance, if the bank is slumping) provide a brief comment in the "Note" field. Also record anything unusual about the transect or bank.

Figure 3. WHM electronic field form, *Transect* page (in green), *Channel* form. Notice the shaded *Channel* tab in the upper left part of the screen.

6.5   **Measure the wetted width** of the main channel at major transects. Observe the wetted margins of the channel. Measure the wetted width (or horizontal distance between these margins) to the nearest tenth of a meter. Include any wetted portion of the stream that is joined and connected to the main body of water. This may include side pools, alcoves, and backwaters.

         *NOTE: Do **not** subtract for bars. For WHM purposes, bars are included in the wetted width measurement.*

6.6   **Record the wetted width** value in the "Wetted Width (m)" field in the field forms (Figure 3).

6.7   **Measure the total width of all bars** (Figure 1) in the main channel. Measure the width of each bar within the wetted channel. If there is more than one bar within the wetted channel, measure each bar and add the measurements.

6.8   **Record the sum of all bars** to the nearest tenth of a meter in the "Bar Width (m)" field in the field forms (Figure 3).

6.9   **Measure bankfull height.** Do this at both banks for the Narrow Protocol. Do this at the one bank for the Wide Protocol. Measure at the wetted edge (Figure 4) using a surveyor's rod with one of the following tools: laser level, hand-bubble level, densiometer, or hypsometer.

Figure 4. Diagram of the left and right bankfull height measurements.

Using a surveyor's rod and laser level (Figure 5)

Place the rod at the water's edge and hold it upright, at 90 degrees to level. Point the laser light to the bankfull stage. Ensure that the laser is level. Read the height in cm on the rod. Measure for the each bank.

Figure 5. Measuring bankfull height using a surveyor's rod and laser level.

<u>Using a surveyor's rod and hand bubble level (Figure 6)</u>

Separate the surveyor's rod into two segments. Place one segment (0 cm end) at the water's edge and hold it vertically. Hold the other segment horizontally at the bankfull stage. Enure that it is level using a hand bubble level. Read the bankfull height in cm on the vertical segment.

Figure 6. Measuring bankfull height using a surveyor's rod and hand bubble level.

<u>Using a surveyor's rod and densiometer (Figures 7 and 8)</u>

This is similar to above, but the densiometer's level is used instead.

Figure 7. The densiometer and its bubble level.

Figure 8. Measuring bankfull height with a surveyor's rod and
a densiometer's level.

<u>Using a surveyor's rod and hypsometer (Figures 9 and 10)</u>

This method is best for wide sites (e.g., where the Wide Protocol is applied). Crew member 1 stands straight at the water's edge and sights on a surveyor's rod, held vertically at bankfull stage by crew member 2 (Figure 10). Observe the vertical hight on the rod where when hypsometer slope measures 0. Subtract this vertical height from eye height to determine bankfull height (cm).
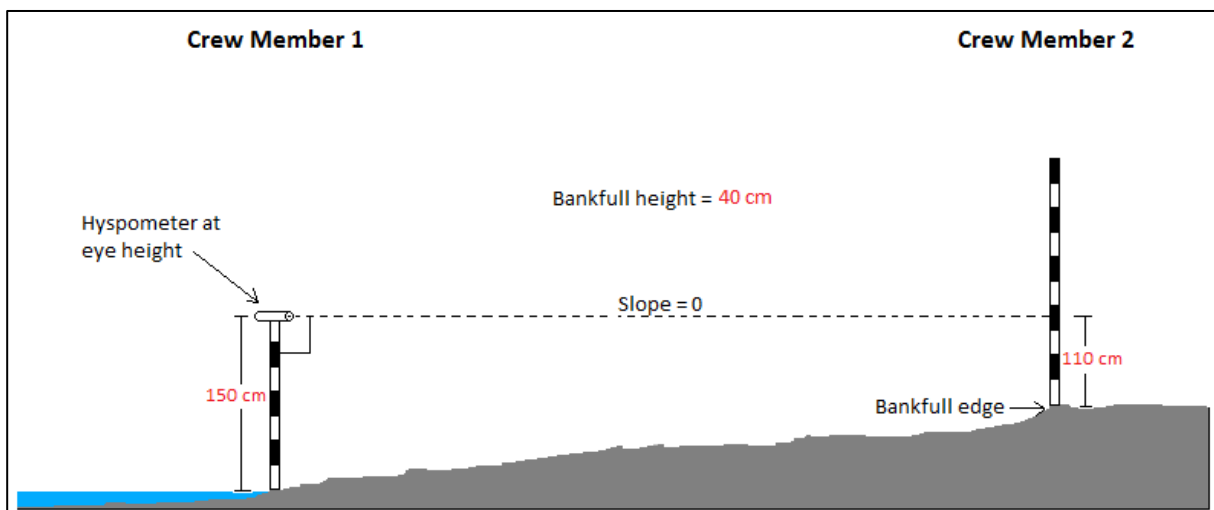

Figure 9. A hypsometer in hand.

Figure 10. Measuring bankful height using a hypsometer.

6.9.1   **Record bankfull height** (cm) for each bank (Narrow Protocol) or for one bank (Wide Protocol) in the WHM electronic field form (Figure 11).

NOTE: If you are unable to get an accurate bankfull height measurement due to poor bankfull stage indicators or obstruction (large woody debris jam, slumping bank, rock wall bank, etc.,) record a note in the "Note" section of the field form. Leave the "Bankfull Height (cm)" cell empty.

NOTE: For the Wide Protocol, the choice of bank to be measured is determined by SOP EAP105 (Hartman, 2017).

Figure 11. Transect page, Channel form. Bankfull height cells are shown in red.

7.0   Records Management

7.1   Refer to SOP EAP125 (Janisch, 2017), which describes the process for validating, loading, and committing completed WHM field forms to the WHM database.

8.0   Quality Control and Quality Assurance Section

8.1	Project QA/QC procedures are addressed thoroughly in the QAMP for this project (Cusimano et al., 2006), which is in the process of being updated.
8.2	SAMPLING PRECISION: Repeat the sampling for 10% of all sites per year per Status and Trends Region. Timing of replicates should be several weeks or more later than initial samples (as far apart in time as possible but within the same index period).
8.3	SAMPLING ACCURACY: Persons using this SOP must either attend the annual training event (June) or be trained by someone who did.

9.0 Safety

9.1   All field staff must comply with the requirements of the EAP Safety Manual (Ecology 2015).

10.0 References

10.1   Cusimano, R., G. Merritt, R. Plotnikoff, C. Wiseman, C. Smith, and WDFW. 2006. Status and Trends Monitoring for Watershed Health and Salmon Recovery: Quality Assurance Monitoring Plan. http://ecyapfass/Biblio2/documents/0603203.pdf

10.2   Ecology, 2015. Environmental Assessment Program Safety Manual. Washington State Department of Ecology. Olympia, WA. http://teams/sites/EAP/Pages/safety.aspx

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10.8   Janisch, J. 2013. Dictionary of Metrics for Physical Habitat: Definitions and Calculations Used for Watershed Health Monitoring and Related Studies. Washington State Department of Ecology. https://fortress.wa.gov/ecy/publications/publications/1303033.pdf

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10.10   Leopold, L.B. W.W. Emmett, H.L. Silvey, and D. L. Rosgen. 1995. A Guide for Field Identification of Bankfull Stage in the Western United States. Online video (31 minutes, closed captioned). Stream Systems Technology Center USDA, Forest Service, Rocky Mountain Research Station, Fort Collins, CO. https://www.fs.fed.us/biology/nsaec/assets/BankfullStageWestern/BankfullStageWesternUS1995.html

10.11   Merritt, G. 2017. Watershed Health Monitoring: Standard Operating Porcedures for Verification and Layout of Sites (Narrow Protocol) SOP EAP106. Washington State Department of Ecology, Environmental Assessment Program, Olympia. [Quality Assurance at the Department of Ecology | Washington State Department of Ecology, Standard Operating Procedures, QAQC, SOPs](#)

10.12   Parsons, J., D. Hallock, K. Seiders, B. Ward, C. Coffin, E. Newell, C. Deligeannis, and K. Welch 2016. Standard Operating Procedures to Minimize the Spread of Invasive Species, EAP 070 Version 2.1 http://www.ecology.wa.gov/programs/eap/quality.html

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+Field+Operations+Manual+for+Wadeable+Streams.pdf