

DEPARTMENT OF  
**ECOLOGY**  
State of Washington

## **Standard Operating Procedure EAP120, Version 1.3**

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### **Watershed Health Monitoring: Standard Operating Procedures for Quantifying Habitat Units**

August 2018  
Publication 18-03-225

## 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.

## Publication information

This SOP is available on the Department of Ecology's website at <https://fortress.wa.gov/ecy/publications/SummaryPages/1803225.html>.

Ecology's Activity Tracker Code for this SOP is 18-048.

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Washington State Department of Ecology

Environmental Assessment Program

Watershed Health Monitoring: Standard Operating Procedures for Quantifying Habitat Units

Version 1.3

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EAP120

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SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
2/27/17	1.1	Changed title, added footers, updated glossary, updated references, general formatting	All	Meghan Rosewood-Thurman
3/3/17	1.2	Added text to first sentence Deleted second Note after Table 1 Table 1 footnote grammar fix Removed reference to same SOP Figure 1 cite grammar fix Refined definition Removed reference to 2° form code Revise note to cite <i>early</i> (2005) version Deleted “(primary and secondary)” Added link Added link Spaces after initials Added cite	3.6  3.10 3.11 3.12  6.1 6.2.2.4 10.8 10.14 10.16 10.17	Glenn Merritt
3/6/17	1.3	Updated Version	Signature Page	Meghan Rosewood-Thurman
3/9/17	1.3	Recertified		Kammin
8/6/18	1.3	Updated links and references Edited for publishing	All	Ruth Froese

## Environmental Assessment Program

### Watershed Health Monitoring: Standard Operating Procedures for Quantifying Habitat Units

#### 1.0 **Purpose and Scope**

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for Quantifying Habitat Units for the Watershed Health Monitoring (WHM) program. This method explains how to identify and document habitat units at each of 100 thalweg stations across the length of a WHM sample site.

#### 2.0 **Applicability**

2.1 This SOP should be followed when performing data collection events (DCEs). It applies to DCEs performed using either the WHM Narrow Protocol or the WHM Wide Protocol. We will discuss this SOP's use in the Wide Protocol as if floating downstream, but boating is not a requirement for shallow rivers, even if sampled with the Wide Protocol.

#### 3.0 **Definitions**

3.1 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).

3.2 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.

3.3 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.

3.4 EAP: Environmental Assessment Program

3.5 Ecology: The Washington State Department of Ecology

## 3.6

Habitat units: See Table 1 and Figure 1. As assessed for WHM, all habitat units are part of the main channel. They are based on the Hawkins *et al.* (1993) classification system. Habitat units are “quasi-discrete areas of relatively homogeneous depth and flow that are bounded by sharp physical gradients... Different types of units are usually in close enough proximity to one another that mobile stream organisms can select the type of unit that provides the most suitable habitat” (Hawkins *et al.*, 1993). For WHM, any unit (with two exceptions) must be at least as long as half their wetted width and they must include the thalweg. Plunge pools and dry channels are the exceptions. Plunge pools can be shorter than half their width. Dry channels have no wetted width and only need to occupy a single thalweg station to be counted.

When deciding if a feature is long enough to constitute a habitat unit, the length is compared to the wetted width of the full main channel (exclude side channels and exclude edge pools).

Table 1. Habitat Units by type.

Type	Habitat Unit	Description <sup>1</sup>
Slow Water	Plunge pool	A pool created by water that passes over an obstruction and drops steeply to scour a basin in the streambed below. This plunge type of scour pool is treated separately because its length criteria are different. Plunge pools can be shorter than half the wetted width.
	Scour pool	Pool created by the scouring action of current flowing against an obstruction. Plunge pools are a type of scour pool, but for WHM, we treat plunge pools separately from scour pools.
	Dammed pool	A pool formed by impounded water from complete or nearly complete channel blockage.
Fast Water	Non-turbulent	Habitat unit with smooth, laminar flow that is less deep than in pools. Examples include a sheet or run.
	Turbulent	Habitat unit with supercritical flow, with hydraulic jumps sufficient to entrain air bubbles and create whitewater. Examples include waterfalls, cascades, rapids, and riffles.
Dry	Dry channel	A habitat unit is designated as dry channel where flow is subsurface. Dry channels only need to occupy a single thalweg station to be recorded.

<sup>1</sup> Definitions are from Hawkins *et al.* (1993), Armantrout (1998), and Moberg, (2007). Pools must each have a maximum depth of at least 1.5 times the crest depth. A dry channel habitat unit can have a wetted thalweg station if water is isolated and in a small patch.

- 3.7 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.
- 3.8 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).
- 3.9 Narrow protocol: The set of Watershed Health Monitoring SOPs that describes data collection at wadeable sites with an average bankfull width of less than 25 m at the index station.
- 3.10 Pool: For WHM, this is a habitat unit that has a maximum depth of at least 1.5 times its crest depth. Pool includes dammed pools, plunge pools, and scour pools.
- 3.11 Pool crest depth: This is the shallowest wetted depth within a pool. It is measured where the water exits the pool (the tail out or downstream end), except for dammed pools where it is measured at the head (Figure 1).

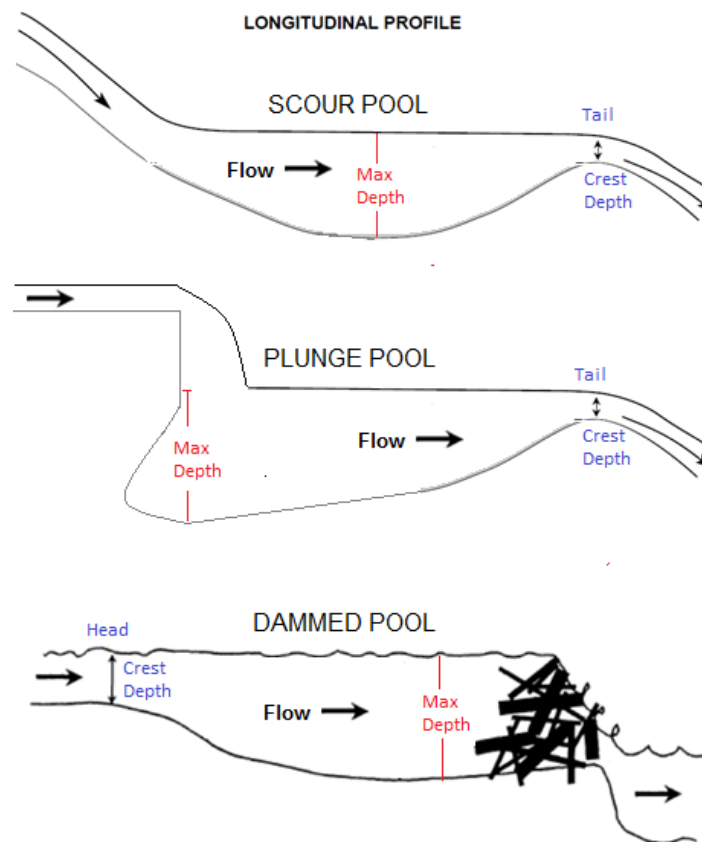


Figure 1. Pool depths for each pool type.  
 Top two images are modified from Hilton and Lisle (1993); bottom image is modified from Overton *et al.* (1997).



- 3.12 Pool forming features: The crew considers what the stream looked like when flow was at bankfull stage. Pool forming features are those obstructions that they think led to pool formation during bankfull flow. Unapparent obstructions are assigned as “fluvial” on the data form. Pool forming features are labeled on the electronic form as “pool forming code.”
- 3.13 Pool head: For WHM, the head of a pool is the upstream transition zone of a dammed pool (see Figure 1) where water velocity decreases upon entering the pool from a different habitat unit.
- 3.14 Pool max depth: Maximum pool depth (Figure 1). This is the deepest water depth in a pool habitat unit (measured within the thalweg, but not necessarily associated with a thalweg station).
- 3.15 Pool tail: For WHM, the tail of a pool is the shallow, downstream transition zone (to another habitat unit) of scour pools or plunge pools (see Figure 1), where water velocity increases upon leaving the pool. This is synonymous with pool tailout.
- 3.16 Protocol: A collection of SOPs used to accomplish a DCE. Watershed Health Monitoring uses two protocols. The Narrow Protocol is used for sampling wadeable streams that are less than 25 m average bankfull width. The Wide Protocol is used for rivers or streams that are wider than 25m average bankfull width or too deep to wade.
- 3.17 QAMP: Quality Assurance Monitoring Plan. The QAMP for WHM is Cusimano *et al.* (2006). An updated version is in early stages of development.
- 3.18 Site: A site is defined by the coordinates provided to a sampling crew and the boundaries established by the protocol’s site layout method (Hartman, 2017 (SOP EAP105) for the Wide Protocol; Merritt, 2017 (SOP EAP106) for the Narrow Protocol). Typically, a site is centered on the index station and equal in length to 20 times the average of five 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 500 m. The most downstream end of a site coincides with major transect A; the most upstream end coincides with major transect K.
- 3.19 Station: Any location within the site where an observation is made or part of a sample is collected.
- 3.20 Thalweg: Path of a stream that follows the deepest part of the channel (Armantrout, 1998). For WHM, we emphasize Armantrout’s use of the word “path” because the thalweg longitudinal profile excludes (sometimes deeper) side pools that are not part of the dominant flow path.
- 3.21 Thalweg depth: Water depth in the thalweg. This is measured at 100 equally spaced stations in a site.

3.22 Thalweg station: One of one hundred (100) equidistant measurement locations in the thalweg, across the length of a site. For example, the thalweg stations at/above each major transect are named as follows:

- A0, A1, A2, A3, A4, A5, A6, A7, A8, A9,
- B0, B1, B2, B3, B4, B5, B6, B7, B8, B9,
- C0, C1, C2, C3, C4, C5, C6, C7, C8, C9,
- ...
- J0, J1, J2, J3, J4, J5, J6, J7, J8, J9, and
- K0.

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

3.24 Wide protocol: The set of WHM SOPs that describes the sample and data collection at non-wadeable sites or sites wider than 25 m 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 of the WHM protocols: Narrow Protocol and Wide Protocol. Training includes sampling goals and objectives as defined in the QAMP.

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

4.5 Field staff should know how to identify bankfull stage. 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)

## 5.0 **General Equipment and Supplies**

5.1 Tablet (charged) with WHM e-forms

5.2 Measuring devices (measuring rod, 50-m tape, and laser rangefinder)

5.3 Wading/rafting gear (pre-cleaned of organisms)

5.4 Paper (waterproof) version of field data forms with number 2 pencil and clip board

## 6.0 **Summary of Procedure**

6.1 While traversing the length of the site to perform the thalweg profile in SOP EAP119 (Merritt, 2017), identify the habitat unit in which each thalweg station resides. For each habitat unit in the site, estimate the habitat unit width. If the habitat unit is a pool, identify the features estimated to have caused its formation. Measure the wetted maximum depth and crest depth of each pool.

This procedure is largely derived from an early version of Moberg (2007), namely, the 2005 methods for the Upper Columbia project as discussed in Roper et al. (2010).

6.2 For the Narrow Protocol, wade up the main channel. At each major transect, complete thalweg profile data, SOP EAP119 (see Merritt, 2017) using the Thalweg Page (Figures 2 and 3). Then, identify and describe each newly encountered habitat unit while traversing the site. Record all thalweg stations in which each habitat unit occurs.

A habitat unit may occur across forms (e.g., a given habitat unit might be on the page for Thalweg A and the page for Thalweg B). Don't create a new habitat unit simply because you are changing forms.

Main WAM06600-007350-DCE-2014-0630-20:34

Thalweg A Thalweg Large Woody Debris

	Depth (cm)	Bar	Edge Pool	None	Habitat Unit	Side Channel Count	Notes
A.0	140	Bar	Edge Pool	None	1	0 1 2 3+	
A.1	85	Bar	Edge Pool	None	1	0 1 2 3+	
A.2	58	Bar	Edge Pool	None	1	0 1 2 3+	
A.3	112	Bar	Edge Pool	None	1	0 1 2 3+	
A.4	110	Bar	Edge Pool	None	1	0 1 2 3+	
A.5	108	Bar	Edge Pool	None	1	0 1 2 3+	
A.6	108	Bar	Edge Pool	None	1	0 1 2 3+	
A.7	100	Bar	Edge Pool	None	1	0 1 2 3+	
A.8	112	Bar	Edge Pool	None	1	0 1 2 3+	
A.9	66	Bar	Edge Pool	None	1	0 1 2 3+	

General Thalweg Note:

Figure 2. An example Thalweg Page for data recorded between thalweg stations A0 and A9.

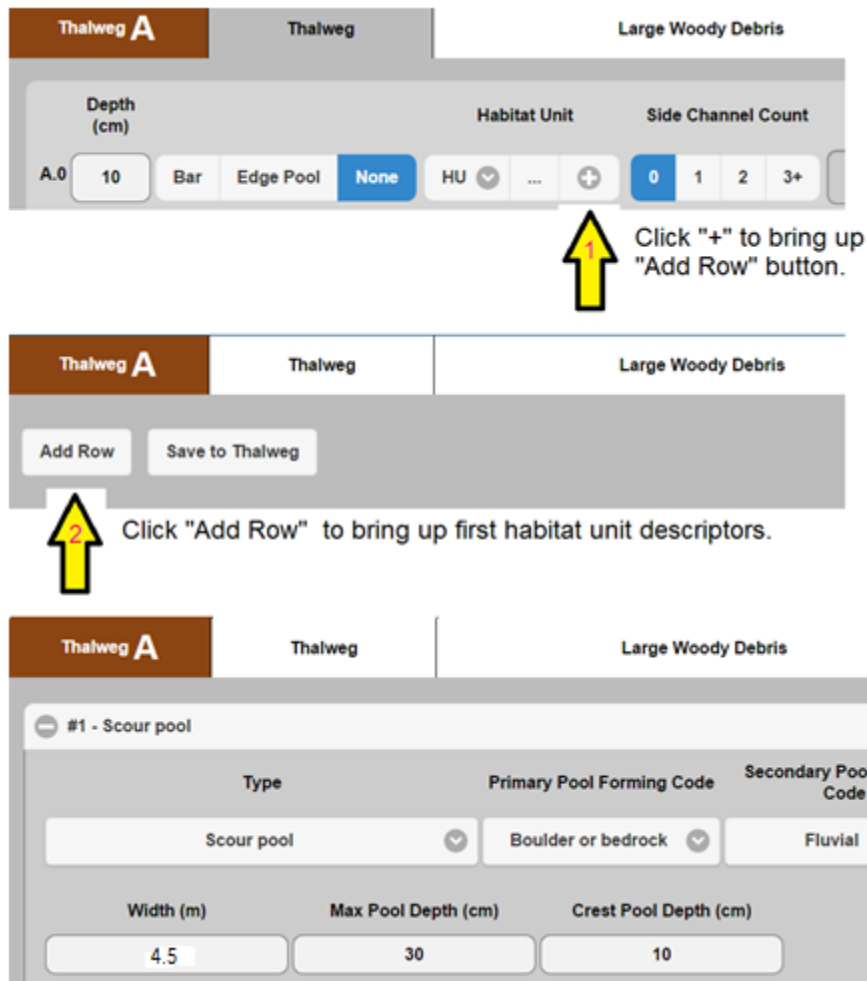


Figure 3. Auxiliary fields of the Thalweg Page.

For recording habitat unit information, click “+”, then “Add Row” for each new habitat unit, then describe the habitat unit.

- 6.2.1 Identify each new habitat unit encountered. Record this on the Thalweg Page (Figure 3) by clicking “+” then “Add Row” for each.
- 6.2.2 Describe each new habitat unit by completing relevant fields on the Thalweg Page (Figure 3).
  - 6.2.2.1 Identify the Type. See drop-down choices on the form (Table 1).
  - 6.2.2.2 Visually estimate the average wetted width (in decimal meters) of the habitat unit for the full course of its length. Record 0 m for dry channel units.

Note: Measurements are not required here, only visual estimates; however, the transect measurements from SOP EAP113, Channel Dimensions (Lemmon, 2017) can be used to help gauge your estimates.

- 6.2.2.3 If the habitat unit is a pool, measure “Pool max depth” (cm) and “Pool crest depth” (cm). See Figure 1.
- 6.2.2.4 Estimate “Pool forming features” using drop down choices on the form. Fluvial means “cannot specify”. If the habitat unit is not a pool, use the choice that says it is not a pool. Pool forming features are labeled “Pool forming codes” on the Thalweg Page, even though no codes are used here. This is erroneous vestigial language left over from past methods that used the paper forms.
- 6.3 For the Wide Protocol, float down the main channel starting at thalweg station J9. At thalweg stations at/above each major transect, start a new Thalweg Page (Figure 3), for the given transect profile (Merritt, 2017). Then perform the same Habitat Unit operations as described for Section 6.1, but perform them in reverse sequence for the site: starting at J9 and ending at A0 (Figure 4).
- To navigate safely when floating, crews may decide to initially record depths on paper while travelling between transects. They can then plot these depths on graph paper to evaluate the habitat unit membership of each thalweg station. They should enter habitat unit data to the tablet when beached at each new transect.

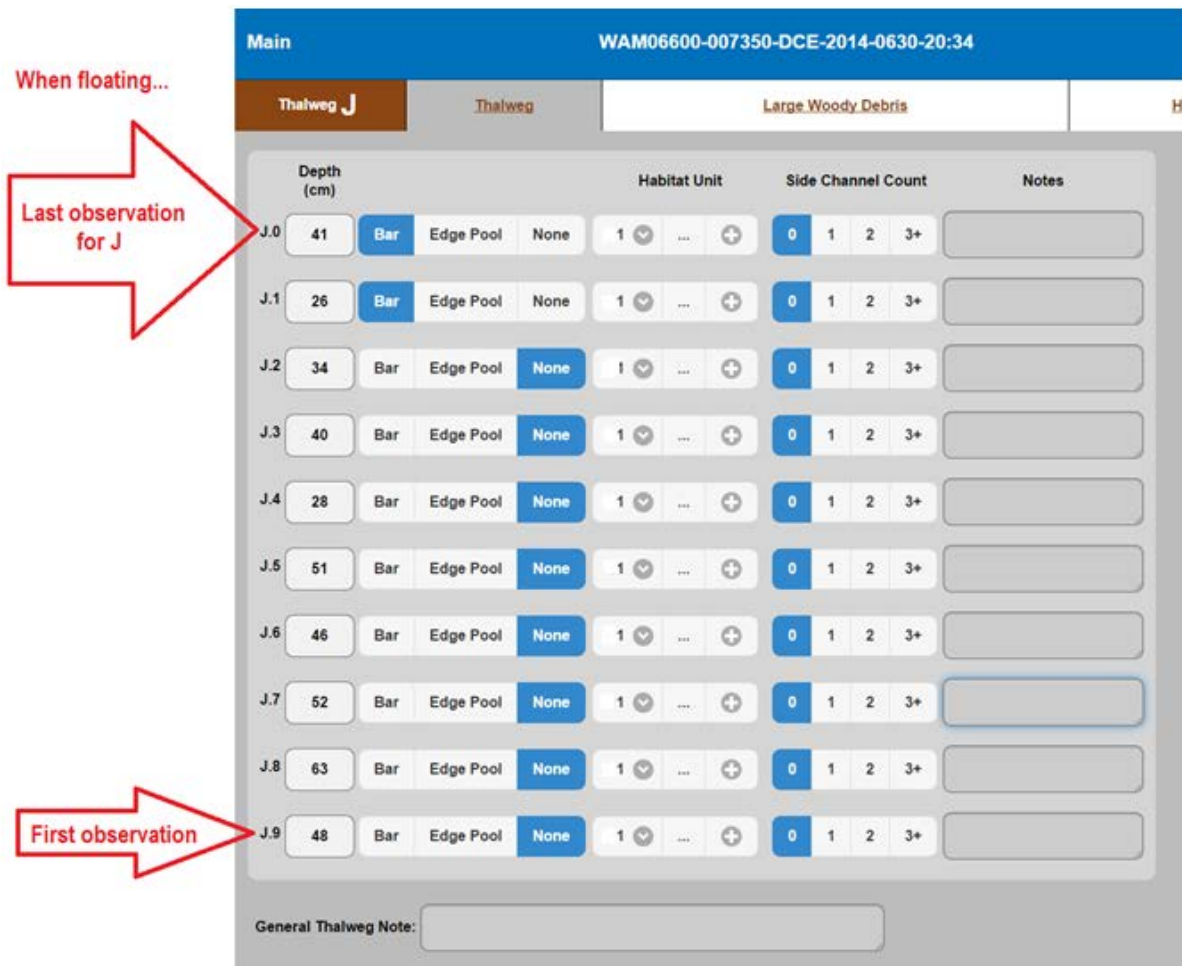


Figure 4. An example Thalweg Page for data recorded between thalweg stations J9 and J0 when floating downstream.

## 7.0 Records Management

- 7.1 Refer to SOP EAP125 (Janisch, 2017). Complete data collection for a DCE while on site.
- 7.2 Be sure to keep handy a set of paper (waterproof) forms with pencil and clipboard. These can be used in contingency.

## 8.0 **Quality Control and Quality Assurance**

8.1 Project QA/QC is discussed in the Quality Assurance Monitoring Plan (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 later than initial samples (as far apart in time as possible, but within the same index period).

8.3 Sampling accuracy: People using this SOP must either attend the annual training event in June, or be trained by someone who did.

8.4 Representativeness: Refer to the measurable criteria for habitat unit definitions. There are requirements of depth, width, length, and position:

- Habitat units (except plunge pools or dry channels) must be at least as long as half their wetted width.
- A pool must have a maximum depth of at least 1.5 times its crest depth.
- Habitat units must be in the main channel and include the thalweg flow.

## 9.0 **Safety**

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

## 10.0 **References**

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