

Standard Operation Procedure (SOP) #23

Habitat Characterization at the Reach and Transect Scales

Version 2.01 (June 3, 2024)

Change History

New Version #	Revision Date	Author	Changes Made	Reasons for Change	Previous Version #
2.0	6/16/2022	Amanda McCutcheon, Anne Farahi	Revised text on how many and location of transects, added Table SOP 22.1 and additional details where needed, updated links, and added the datasheets. Clarified site/reach. Added footnotes for references.	Procedures had been changed in the field years ago. The SOP was not accurate with current methods. Improved descriptions for GCUs were needed and links were out of date. Datasheets were originally in an Appendix.	1.0
2.01	6/3/2024	Kim Weisenborn	Renumbered SOP from #22 to #23. Updated SOP references. Updated datasheets.	A new SOP has been added to the protocol therefore some SOP reference #s have changed. Datasheet had been updated.	2.0

Only changes in this specific SOP will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

Purpose

This SOP describes the conducting of habitat characterization work at each site and transect. This protocol is consistent with previously established habitat assessment techniques used by the national NAWQA and EMAP programs, and users can refer to those documents for additional information.

See Fitzpatrick et al. (Fitzpatrick 1998)¹ for NAWQA protocols, and Section 7 in Peck et al. (Peck 2001)² for EMAP protocols.

[datasheet](#) are included below. See [SOP #8-11 Conducting Surveys at Tau and Tutuila \(American Samoa\), Guam, and Hawaii](#) for details on how to set up the reach at each park.

Procedures Overview

Site length corresponds to the sampling reach for the fauna (30 meters). If possible, all physical habitat measurements should be made at each site on the same day that faunal samples are conducted. Habitat characterization is typically the last procedure performed at a site, but if there are enough observers some aspects of these procedures can be accomplished simultaneously with faunal surveys as long as observers take care to avoid disturbing the site. Within each site, three equally spaced transects will be established perpendicular to the direction of flow (Figure SOP 23.1) – at the 0-m, 15-m, and 30-m marks along the reach. See [SOP #8-11 Conducting Surveys at Tau and Tutuila \(American Samoa\), Guam, and Hawaii](#) for details on how to set up the site at each park. In Guam, the site will be divided into five sections for the purpose of the shrimp net and snail surveys, but those sections will not be used for habitat characterization. The habitat characterization encompasses three procedures: 1) Site characterization – describing the site and classifying geomorphic channel units for the entire 30-m reach, 2) Transect characterization – measuring channel width, substrate size (pebble count), and canopy closure at the three transects (at the 0-m, 15-m, and 30-m marks along the reach), and 3) Stream discharge – measurements of discharge along one transect at targeted location (ideally) within the reach.

¹Fitzpatrick et al. (1998). Revised Methods for Characterizing Stream Habitat in the National Water-Quality Assessment Program, <https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf> (last accessed 3 June 2024)

² Peck et al. (2001). Environmental Monitoring and Assessment Program-surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams, https://archive.epa.gov/emap/archive-emap/web/pdf/ewwsm_s7.pdf (last accessed 3 June 2024)



Figure SOP 23.1. Measuring habitat characteristics.

Site Characterization

The site characterization can be performed by one observer. The observer will fill out the site characterization datasheet (below) in full, beginning with the basic survey metadata. In many cases, GPS signal may be weak at the stream. If possible, the observer should include a description of a nearby landmark for reference. Total reach length should be 30 meters. The distance between transects is 15 m for the purpose of site characterization at all parks. The observer should record site notes describing the reach, including a description of the banks, general substrate types, and surrounding vegetation; any relevant recent events (rainstorms, landslides, etc.); and any notable fauna or flora that might not be captured in the faunal surveys. The observer will measure and identify all geomorphic channel units (GCUs) along the length of the reach. A list of the GCUs used in this protocol along with their descriptions are provided in Table SOP 23.1. The observer should avoid deviating from this list whenever possible. The observer should always begin the GCU survey starting from the downstream end of the reach. The observer records the corresponding (dominant) GCU at 1-m intervals along the reach from 0 m to 30 m.

Table SOP 23.1. Descriptions of Geomorphic Channel Units (GCUs) for Habitat Characterization.

GCU	Code	Description
Pool (unspecified type)	P	Still water, low velocity, smooth, glassy surface, usually deep compared to other parts of the stream. ¹
Plunge Pool	PL	Pool at base of plunging cascade or falls. ¹
Backwater Pool	BW	Pool separated from main flow off the side of the channel. ¹
Eddy	ED	Water moving counter to the main flow usually due to obstruction such as a large boulder or roots along the bank. Water looks to be moving in a circular pattern resembling a whirlpool off of the main channel.

GCU	Code	Description
Glide	GL	Water moving slowly, with a smooth, unbroken surface. Low turbulence. Often the transition from pool to riffle. ¹
Riffle	RF	Water moving, with small ripples, waves and eddies -- waves not breaking, surface tension not broken. Sound: "babbling", "gurgling". ¹
Boulder Riffle	BR	A riffle over boulders rather than gravel, cobble or other substrate.
Run	RU	Moving water with low turbulence. Generally, shallower than a pool and deeper than a glide. Often the transition from a riffle to a pool. ²
Rapid	RD	Water movement rapid and turbulent, surface with intermittent whitewater with breaking waves. Sound: continuous rushing, but not as loud as cascade. ¹
Chute or cutoff	CH	A new channel formed by erosion of the bank that shortens the course of the stream. ³
Cascade	CA	Water movement rapid and very turbulent over steep channel bottom. Most of the water surface is broken in short, irregular plunges, mostly whitewater. Sound: roaring. ¹
Falls	FA	Free falling water over a vertical or near vertical drop into plunge, water turbulent and white over high falls. Sound: from splash to roar. ¹
Abandoned/Dry Channel	AC	No water in the channel. ¹

¹ Peck et al. (2001). Environmental Monitoring and Assessment Program-surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams, https://archive.epa.gov/emap/archive-emap/web/pdf/ewwsm_s7.pdf (last accessed 3 June 2024).

² Fitzpatrick et al. (1998). Revised Methods for Characterizing Stream Habitat in the National Water-Quality Assessment Program, <https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf> (last accessed 3 June 2024).

³ Britannica (2009). chute, or Cutoff, <https://www.britannica.com/science/chute> (last accessed 3 June 2024).

Transect Characterization

The transect characterization is best performed by two observers. One observer will perform the in-water measurements and one observer will record the information collected using the Pebble Count datasheet (below). The observers will set up the transect line perpendicular to the main channel flow, from the left to the right bank (for this procedure it does not matter whether the 0-m end of the transect is on the left or right bank).

At each transect record:

1. Wetted channel width. Record the distance between the left and right edges of the water. The in-water observer will determine the location of the left and right edges of the water along the transect and the recorder will use these locations to calculate and record the wetted channel width.
2. Riparian canopy closure. Riparian canopy closure is measured at the bank on each side of the stream using a concave spherical densiometer (Figure SOP 23.2). The densiometer is modified by drawing a right angle on the mirror surface with an indelible marker. At the stream edge, the densiometer is held on the transect line facing the bank, 30 cm from and 30 cm above the water's edge. The measurement is made by counting the number of point

intersections (maximum is 17) covered by vegetation (Figure SOP 23.3). Record this number on the datasheet. At transects that are less than one meter in wetted width, one reading is made at the center of the stream. For the center measurements, the densiometer is held 30 cm above the water surface, halfway between the left and right edges of the water, while facing upstream.

It is extremely important to keep the densiometer in the same position for each reading. You may wish to use the measuring tape as a guide to maintain the densiometer in the same position relative to the water's edge as you rotate. It is also important to keep the densiometer level using the bubble level and to view the densiometer from the same angle with each reading. This can be accomplished by positioning yourself so that the top of your forehead appears in the top-center of the mirror as you make the reading.



Figure SOP 23.2. Using a spherical densiometer to measure riparian canopy closure.

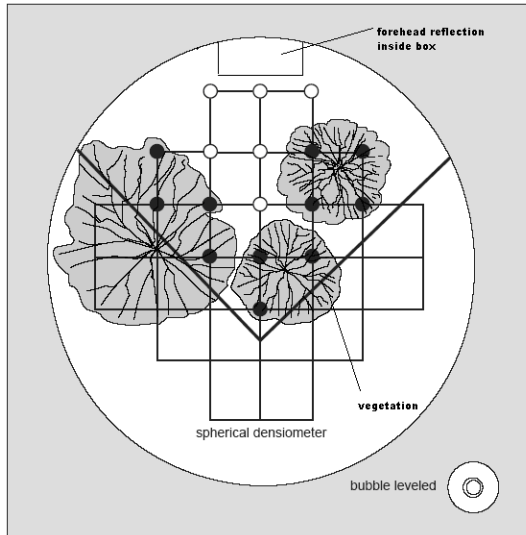


Figure SOP 23.3. A concave spherical densiometer.

Note the tape marking the right angle (above which points are counted) on the bubble level, and 17 points of intersection. Closed circles represent line intersections where vegetation is present and consequently counted in measurement of canopy closure, resulting in 11 out of 17 points (Fitzpatrick et al. 1998).

3. Pebble Count. The modified Wolman pebble count is a quantitative measurement of channel-substrate particle size. Across each transect, 20 pebbles should be collected and measured.
 - a. Begin the pebble count at each transect at the wetted edge on the left bank and proceed to the wetted edge on the right bank (or right to left depending on how the transect is laid out).
 - b. Divide the width of the transect by 21 to determine the interval length between points at which pebbles will be counted.
 - c. Using the measuring tape as a guide, aim your finger down vertically at each sampling point and pick up the first pebble that you touch.
 - d. To reduce sampling bias, look across and not down at the channel bottom when retrieving the pebble.
 - e. Measure each pebble across the longest axis.
 - f. Record the size in centimeters. If the rock or boulder is too large to pick up, measure it in-place. For silt record "0," and for bedrock record "999".

Stream Discharge

The stream discharge measurements are best performed by two observers. One observer will operate the flow tracker in-water and the second observer will be the recorder (datasheet is below). The observers will stretch a metric transect tape from the left bank to the right bank, perpendicular to the direction of flow, and secure each end to the ground using a stake. Depth and velocity are recorded at 20 equidistant points along the transect. Details of performing the stream discharge survey and FlowTracker operation are included [SOP #24 Using the FlowTracker](#). The parameters measured are as follows:

- a. Distance from left edge of water. The distance from the transect point to the left edge (facing downstream) of water is recorded.
- b. Depth. The depth of the stream is recorded at each transect point. The depth is determined by measuring the distance between the water surface and the bed substrate. Depth is measured using a wading rod. Note whether the wading rod is in metric or English units. For our purposes wading rod should be metric if at all possible.
- c. Velocity. The velocity at the sampling location is measured using a flow meter to record the 40-second average velocity of the water column. Record type of flow meter used on the datasheet. Velocity is recorded at 60% depth.

SITE CHARACTERIZATION DATASHEET

Park Name: _____

Stream Name: _____ Date: ____-____-____

Site: _____ Start Time: _____ End Time: _____

Lat: _____ Long: _____ Error +/- (m): _____

Observers: _____

Description of nearby landmark or reference location: _____

Directions from landmark or reference location to site: _____

Distance from landmark to downstream end of site, in meters (e.g., 0m): _____

Location of boundary markers: Upstream: left / right / both Downstream: left / right / both

Notes: _____

Dominant Riparian Land Cover (circle one): Grassland / Shrubs-Woodland / Wetland / Exposed Rock

Disturbed/Developed-Explain: _____

Geomorphic channel units (GCU) – Select dominant GCU type from the list below for each 1-m section of reach.

Riffle (RF), Boulder Riffle (BR), Run (RU), Glide (GL), Rapid (RD), Cascade (CA), Falls (FA), Chute (CH), Plunge-Pool (PL), Pool (P), Eddy (ED), Backwater (BW), Abandoned channel (AC).

Meter	GCU	Meter	GCU	Meter	GCU
0-1		10-11		20-21	
1-2		11-12		21-22	
2-3		12-13		22-23	
3-4		13-14		23-24	
4-5		14-15		24-25	
5-6		15-16		25-26	
6-7		16-17		26-27	
7-8		17-18		27-28	
8-9		18-19		28-29	
9-10		19-20		29-30	

PEBBLE COUNT DATASHEET

Park:	Stream:	Site:	Date:
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Transect Location:

Wetted channel width (m):

Observers:

Location	Size (cm)	Location	Size (cm)	Location	Size (cm)	Location	Size (cm)
1		6		11		16	
2		7		12		17	
3		8		13		18	
4		9		14		19	
5		10		15		20	

Riparian canopy closure (# intersections)

If stream is < 1m wide, only do center measurement.

Do measurements facing left and right banks if stream is > 1m wide.

Facing:	Left Bank	Center	Right Bank
# intersections:			

Transect Location:

Wetted channel width (m):

Observers:

Location	Size (cm)	Location	Size (cm)	Location	Size (cm)	Location	Size (cm)
1		6		11		16	
2		7		12		17	
3		8		13		18	
4		9		14		19	
5		10		15		20	

Riparian canopy closure (# intersections)

If stream is < 1m wide, only do center measurement.

Do measurements facing left and right banks if stream is > 1m wide.

Facing:	Left Bank	Center	Right Bank
# intersections:			

Transect Location:

Wetted channel width (m):

Observers:

Location	Size (cm)	Location	Size (cm)	Location	Size (cm)	Location	Size (cm)
1		6		11		16	
2		7		12		17	
3		8		13		18	
4		9		14		19	
5		10		15		20	

Riparian canopy closure (# intersections)

If stream is < 1m wide, only do center measurement.

Do measurements facing left and right banks if stream is > 1m wide.

Facing:	Left Bank	Center	Right Bank
# intersections:			

Note: 0=silt

999=bedrock

STREAM DISCHARGE DATASHEET

Park:	Stream:	Site:	Date:
Flowtracker Operator:		Observer:	

Habitat Notes:					
Transect Location:		Wetted Channel Width (m):		Habitat Type (see codes below):	
Point	Tape Reading (m)	Depth (m)	Velocity (m/s)	Microhabitat (see codes below)	
				Type	Structure
LEW					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
REW					
			Discharge (m³/s)	Error %	

Habitat Type: Abandoned Channel (AC), Backwater (BW), Boulder Riffle (BF), Cascade (CA), Chute (CH), Eddy (ED), Falls (FA), Glide (GL), Plunge-pool (PL), Pool (P), Rapid (RD), Riffle (RF), Run (RU), Sheet (SH), Not Applicable (NA)

Structure: Algal Mat (AM), Bedrock (BD), Filamentous Algae (FA), Leaf Pack (LP), Manmade Structure (MS), Rocks (cobble-to-boulder sized) (RK), Root Wad (RT), Vegetation (VG), Woody Debris (WD), No structure present (NONE), Sand (SD), Silt (ST)