

Northern Great Plains Network

National Park Service



Wadeable Stream Reach Scale Field Data Collection

Stream Channel Monitoring

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Summary

This standard operating procedure (SOP) discusses how to collect field data at wadeable stream reaches for NGPN Stream Channel Monitoring (Thornbrugh et al. 2019). The procedures are adapted from the Southeast Coast Network SOP 1.2.16 Wadeable Stream Reach-Scale Field Data Collection—Version 1.0 (McDonald et al. 2018).

Revision Log

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version
1.0	12/15/22	Anine Rosse	See New Changes below	Update field methods	1.1

This SOP was adopted with permission from McDonald (2018), with minor revisions for clarity, formatting, and NGPN-specific policies and procedures. The original SOP can be downloaded from the NPS Data Store at: <https://irma.nps.gov/DataStore/Reference/Profile/2254013>

Differences in Methods

- NGPN does not use the SECN equipment check-out process in described in Footnote 2. Likewise, equipment will be stored at NGPN headquarters.
- NGPN field crews will follow NGPN's safety and communication plans.

- Added routine equipment checks and daily preparation notes.
- SECN refers to their permanent transect marks as benchmarks, while NGPN calls them index site markers.
- Sparquat 256 has been discontinued by the manufacturer; the replacement product is GS High Dilution Disinfectant 256.
- Omitted total station storage instructions because NGPN will rent a total station instead of buying one.

New Changes

- Simplified Large Woody Debris collection, eliminating function and position.
- Added Erosion Length measurements on 10m segment on the left and right bank of each transect.
- Took 5 additional sediment particle size measurements per transect and recorded embeddedness.
- Simplified and clarified GCUs, bed sediment dominant size class and bank dominant size class.
- Clarified where to take bank and bank angle measurements.

Abbreviations and Acronyms

>	greater than
$\geq$	greater than or equal to
<	less than
$\leq$	less than or equal to
#	number
cfs	cubic feet per second
EPA	Environmental Protection Agency
cfs	cubic feet per second
HR	High Resolution
I&M	Inventory & Monitoring
IRMA	Integrated Resource Management Applications
NARS	National Aquatic Resource Survey (USEPA)
NAWQA	National Water Quality Assessment (USGS)
NGPN	Northern Great Plains Network
NPS	National Park Service
SECN	Southeast Coast Network
SD	South Dakota
SOP	standard operating procedure
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Introduction

The following standard operation procedure (SOP) outlines the procedure for collecting physical habitat data from previously selected index sites on wadeable streams (see SCM_SOP_ReachSelectionAndEstablishingIndexSites). The purpose of this SOP is to ensure that data are collected using methods that are consistent between reaches and surveys. Using the methods described in this SOP will also ensure that the data will be comparable to data collected by other DOI agencies as well as non-government monitoring efforts. This SOP provides step-by-step directions for field data collection; however it does not stand alone. Refer to the SCM_SOP_Datasheets for field datasheets tailored to the collection activities. Other SOPs directly needed for conducting an NGPN stream survey include:

- SCM_SOP_SettingUpAndConfiguringATotalStation
- SCM_SOP_UsingATotalStationToConductAStreamSurvey
- SCM_SOP_DischargeMeasurements

The latest SOPs can be found at under the Stream Channel Monitoring Project, <https://irma.nps.gov/DataStore/Reference/Profile/2259796> . The techniques and procedures outlined in this SOP were based on methods used by the U.S. Geological Survey (Fitzpatrick et al. 1998), the U.S. Environmental Protection Agency (EPA 2017), and the U.S. Department of Agriculture (Harrelson et al. 1994). These techniques were modified for the Piedmont and Coastal Plain rivers in SECN parks and in turn, modified from McDonald et al. (2018) for Northern Great Plains network parks.

Equipment/Materials List

For a complete list, refer to the Equipment and Supply Lists SOP.

- GPS or maps, Ipad with Field Maps and points loaded is appropriate and useful
- Government cell phone for back-up and additional pictures
- Digital camera with spare batteries
- Whiteboard, dry erase marker, and eraser
- Metal detector (to relocate possibly buried index marks and rebar)
- Data sheets (use water resistant paper, 2 sets per site)
- Pencils
- Clipboards (2)
- Scientific calculator with sin and cos buttons
- Total station and accessories ¹
 - Prism
 - Measuring tape
 - Compass
 - Batteries
 - Tripod
 - Bipod
 - Pole
 - Trimble TSC3/7 data collector (handheld)
 - Hand-held clamp and cradle (to attach to pole)
 - Radio-link antenna (for hand-held)

¹ See the Setting Up and Configuring a Total Station SOP and the Using a Total Station to Conduct a Stream Survey SOP for additional detail on use of total station.

- 100-meter (328 feet) reel tapes (2)
- 50-meter reel tape (1)
- Set of chaining pins for holding reel tapes
- Pin Flags/Flagging for cross-section identification
- Mason line for cross-section identification and bank heights
- Hanging level for bank heights
- Stadia rods (2)
- Gravelometer
- Range Finder
- Ruler/Meter stick (2)
- Compass
- Clinometer (2)
- Inclinator or digital level
- Spherical densiometer convex
- Backpacks for transporting equipment or fishermen's vests
- Walkie talkies or cell phones for communication
- Waders with pockets- one of each crew member
- Marsh McBirney with batteries and wading rod for discharge
- First aid kit

Procedures

Prior to Conducting Field Work

Be sure appropriate park personnel have been notified of your activities. See the NGPN Safety Manual for the minimum level of notification and the Preparations Prior to Field Season SOP for protocol-specific instructions.

Complete reach assessments only during low flow (baseflow) conditions. Check weather and flow conditions of the area you plan to visit. Do not conduct stream habitat assessments during stormflow and runoff conditions. Try to avoid times of significant dam releases from upstream reservoirs if at all possible, though these activities are beyond NPS control.

Prepare forms for each reach ahead of time for efficiency and consistency with past surveys (see the Preparations Prior to Field Season SOP for detailed instructions). If this is not the first survey of the reach, print a copy of Form 2 (Standard Transect Assessment Datasheet) from the previous survey to ensure use of similar geomorphic surface interpretations in the current survey.

Be sure the average wetted width and length of reach during the initial site visit is available and filled out on Form 1.

Check the site folders prepared by the Aquatic Ecologist to make sure they include all required data sheets (Data Sheets SOP), maps, and writing utensils (Preparations Prior to Field Season SOP; Equipment and Supply Lists SOP). Pack at least one extra set of data sheets in the vehicle or equipment box

Test any electronics before leaving for the field, including:

- Turn on the GPS receiver and check the batteries. Replace batteries immediately if a battery warning is displayed.
- If the GPS receiver has traveled more than 100 miles since its last compass calibration, recalibrate the internal compass (see the Using the Global Positioning System SOP or the user manual for details).
- Turn on the flow meter (if using one) and check for the accompanying flow rod. Be sure to have spare batteries (two D-size batteries for the Flow-Mate model 2000) and a screwdriver to change them.

Field Assessments

Work Flow

Field assessments may occur in two concurrent workflows accomplished by three to five people (Figure 1). Workflow A is focused on stream habitat assessment and standard transect data collection (Form 1: Reach Characterization Datasheet; Form 2: Standard Transect Assessment Datasheet). Workflow B is focused on using the total station to survey the detailed transects and longitudinal

profile of the stream (Form 3: Detailed Cross-Section Datasheet). The reach map (Form 4: Reach Map Datasheet) should be drawn after all other data collection activities have been completed. Figure 1 shows the ideal reach-scale data collection workflow. However, due to reach conditions and field personnel, the actual workflow may differ. The workflow may be accomplished by two to three people if Workflow B is done first, then Workflow A.

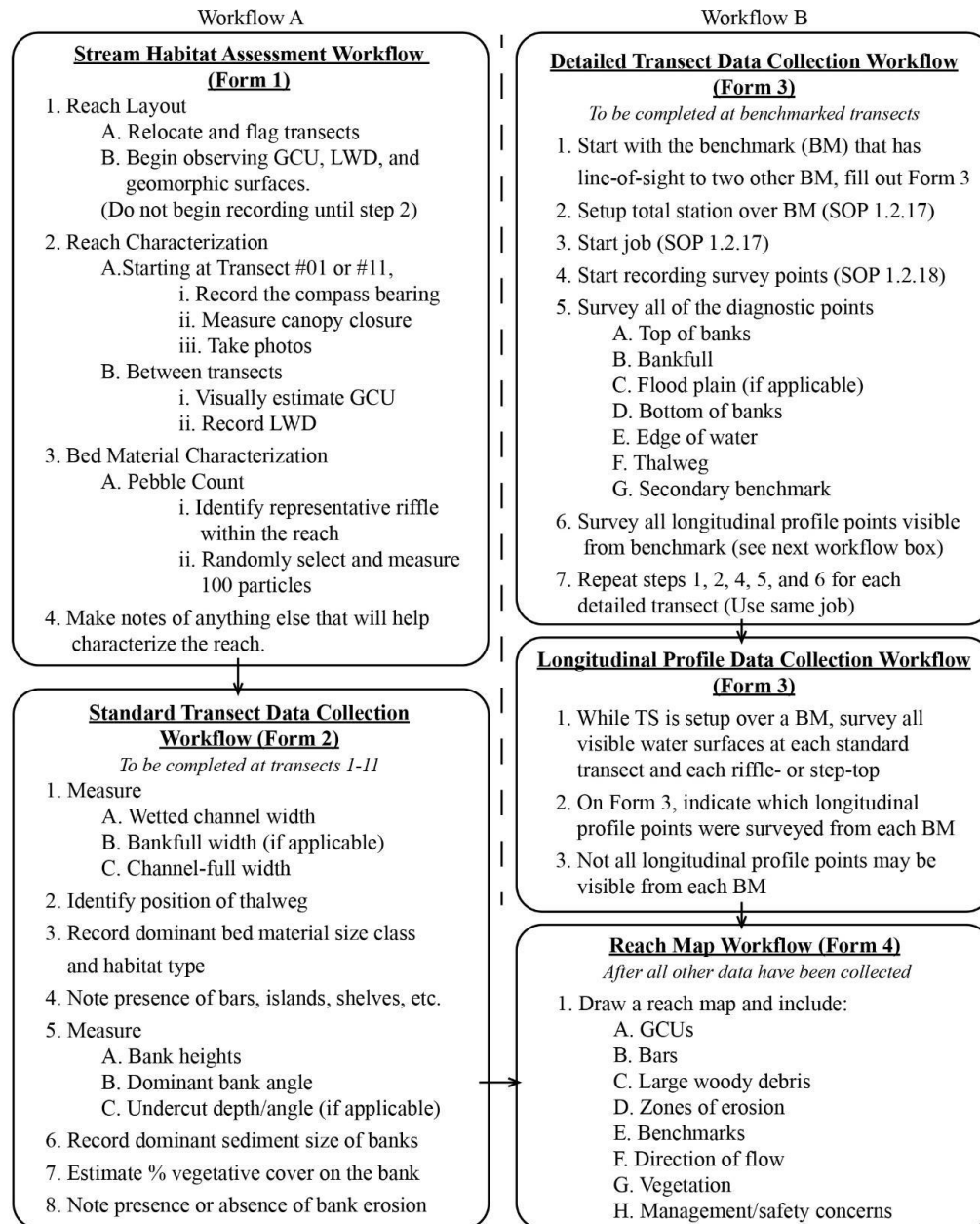


Figure 1. Ideal reach scale data collection workflow. Due to reach conditions and field personnel, the actual workflow may differ.

Procedures

Upon returning to the selected sample reach, locate the three permanently marked transects. For parks with rebar, use a metal detector and GPS to locate transect sites. For parks without rebar (i.e. KNRI and THRO), use an iPad with a high accuracy receiver to locate transect sites and mark with pin flags. Next, locate a central location to unpack gear near one of the permanently marked transects. Ideally, this will be a flat place on the floodplain or historical terrace. Locating the staging area in a central and easily accessible area will minimize reach disturbance and reduce the amount of time needed to complete the assessment.

Prior to conducting the survey, the field crew should walk the entire reach to ensure that it is still wadeable and safe to survey. If the surveying the reach is no longer safe (e.g., if colonized by beavers, or if a large tree fall has created a non-wadeable pool), the survey needs to be deferred to a later date. The protocol lead will make the decision to sample the reach later in the same season or to defer to the following year. If a reach cannot be surveyed for two consecutive years, the long-term viability of the site needs to be re-evaluated.

The total station will need to be set up over each permanent index mark (including any potential tie-in points), so place other equipment away from the index mark. It is best to unpack equipment so it is easily accessible to all crewmembers. Crewmembers should discuss an optimal data collection strategy and divide the tasks amongst the members. The optimal division of labor will depend on whether there are three or more people available to conduct the survey.

The person conducting the detailed survey will need to be skilled in operating the total station. Additionally, the detailed transect surveyor needs to possess an understanding of regional stream geomorphology so that the appropriate diagnostic reference points can be accurately identified and surveyed. Flags can be set at diagnostic points if that is helpful to workflow.

Reach Layout and Characterization (Stream Habitat Assessment Form 1)

Some of the header information on the Reach Characterization Datasheet (Form 1) should be filled out during field season preparation (e.g., name of stream, latitude/longitude, elevation of each reach). Once the middle index mark (# 2) has been located, begin the survey by recording the following information:

- **Date and time of survey**
- **Initials of persons involved in field data collection**
- **Weather conditions at the time of sampling including cloud cover, wind, temperature, water color, and water clarity**
- **GPS information**
- **Stream name, initial average wetted width, initial reach length, and distance between transects**

Average wetted width and derived measurements should be copied from the initial set up of the site. See the Reach Selection and Establishing Index Sites SOP (<https://irma.nps.gov/DataStore/Reference/Profile/2259862>) for details. In subsequent visits, make sure this information stays the same and is filled in prior to fieldwork.

Reach Layout

Once the supplementary data is recorded, lay out the reach using the 100-meter (328 ft) reel tape (Figure 2). Place a flag at bankfull on each side of the stream so that cross-sections can be laid out between the flags. While finding and flagging transects, begin observing the geomorphic channel units (GCU), presence of large woody debris (LWD), and important surfaces (i.e., point bars, floodplains, and historical terraces). During this initial setup, do not attempt to record any observations. In addition to flagging the 11 transects, the purpose of this initial setup is to become familiar with the stream. This will help ensure that once surveying begins, the measurements and identification of GCU and geomorphic surfaces will be consistent.

Once all 11 transects have been flagged, begin the survey at transect 1 (most downstream transect).

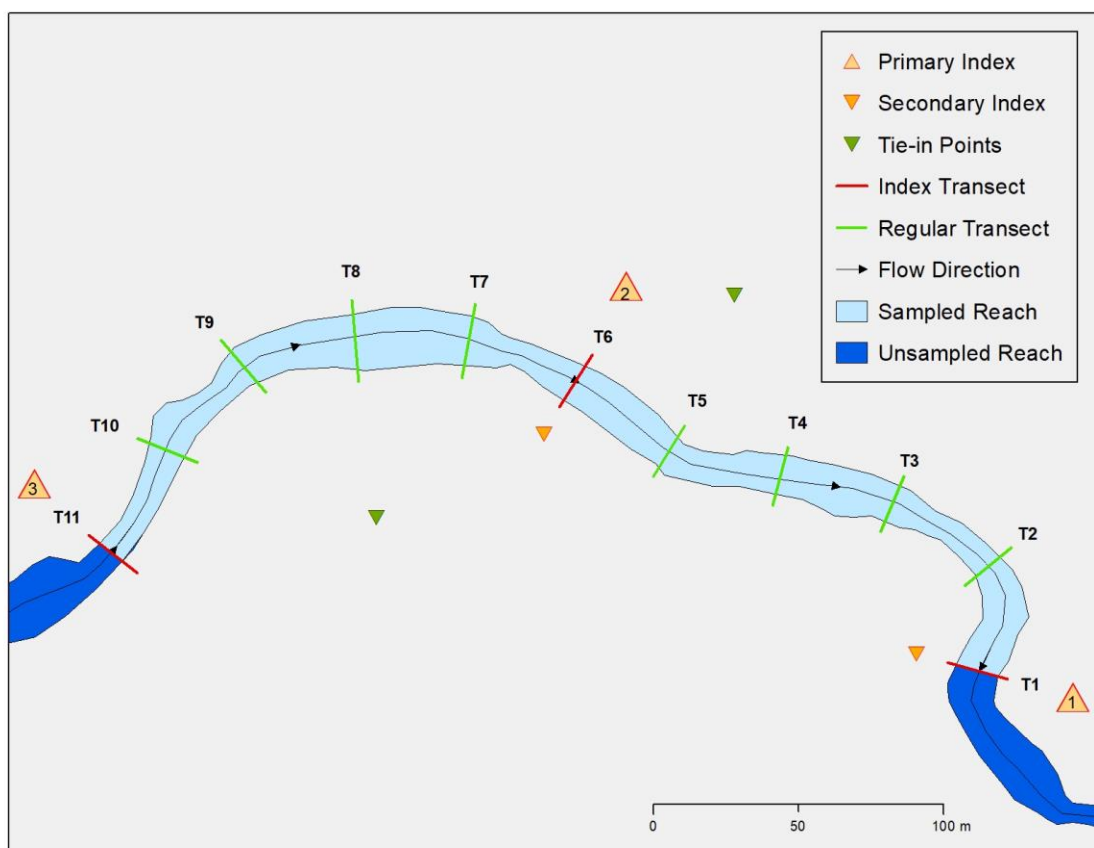


Figure 2. Hypothetical stream layout. Permanent index mark 1 should be the most downstream mark (transect 1) and permanent index mark 3 should be the most upstream mark (transect 11). Permanent index marks should preferentially be installed on river left as all future transects will be standardized based on distance from the left benchmark. Tie-in points are not always required and are only needed if impenetrable vegetation prevents line-of-sight between benchmarks.

Photos

Before taking measurements, **take 4 photos at every transect** (e.g., T1 up, T1 left, T1 down, or T1 right). Record **photo number** on Form 1 for each photo taken.



Figure 3a. Upstream photo: From the middle of the channel move downstream to take photo looking upstream, include both of the transect's bankfull flags in view if possible.



Figure 3b. Left bank photo: Take from right bank, put left bankfull flag in view. Focus on water's edge and bank surface.



Figure 3c. Downstream photo: From the middle of the channel move upstream to take photo looking downstream, include both of the transect's bankfull flags in view.



Figure 3d. Right bank photo: Take from left bank, put right bankfull flag in view. Focus on water's edge and bank surface.

Have a field crew member hold a small whiteboard in each photograph labeling the photograph (e.g., T1 up, T1 down, T1 left, or T1 right). Incorporate the bankfull flags on each side of the bank and include those flags in the picture for better reference. On very wide streams it will be impossible to get both flags in the picture from standing in the middle. In that case, try to include the flags from the up and downstream transects in the photos for reference.

Compass Bearing

Record the **compass bearing** standing in the stream from the middle of the transect to the middle of the next upstream transect (bearing is not recorded for transect 11). Hold the compass flat with the arrow pointed to the middle of the next transect. Adjust the dial so that “red is in the shed” so that the red end of the needle is aligned with 0° (North) on the dial. Then read the bearing which is directly pointing toward the next transect. Record compass reading in Upstream Bearing line on Form 1.

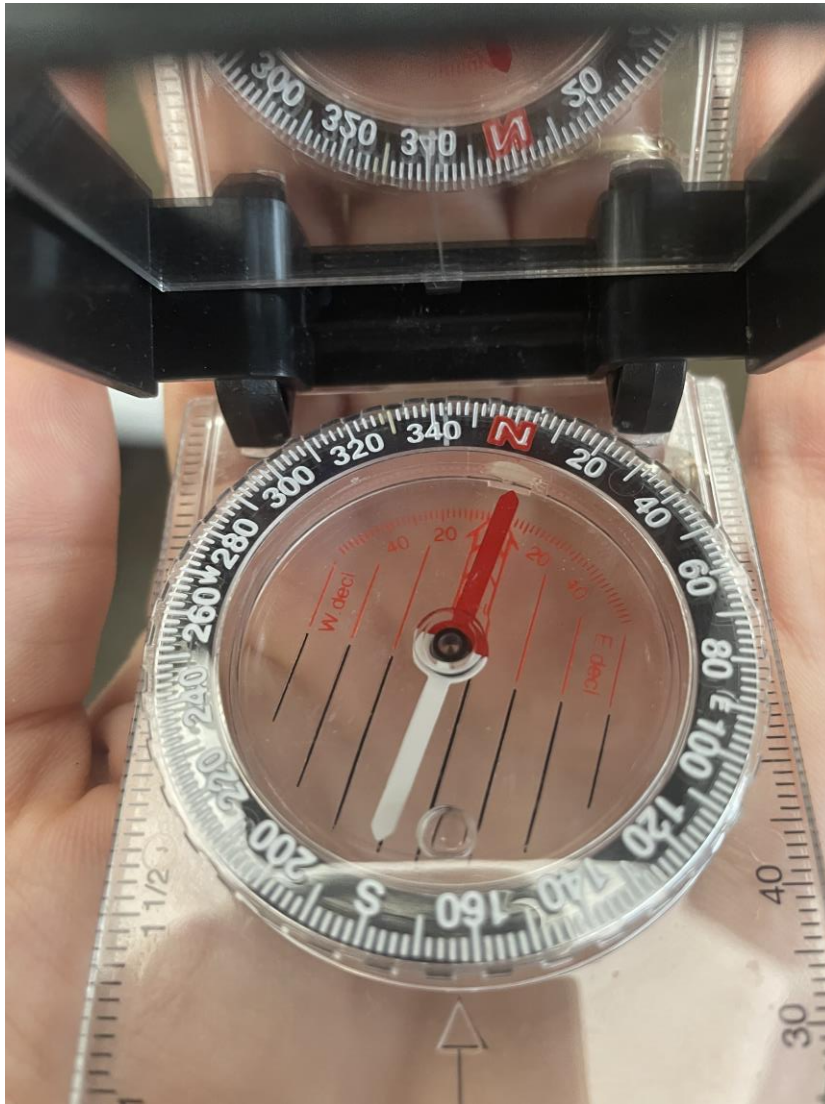


Figure 4. Find bearing of each transect. Bearing here is 343° when the dial is spun so that the North end of the needle aligns with the North marking, ie “red is in the shed”.

Canopy Cover

Use the modified spherical convex densiometer (Lazorchak 1998) to measure **canopy closure** from the center of the channel. The densiometer should be held one foot over the water's surface in the center of the stream. Canopy closure is measured by counting and recording the number of line intersections on the densiometer that are covered by vegetation facing: (1) upstream, (2) the left bank, (3) downstream, and (4) the right bank (Figure 3). Values range from 0 (no cover) to 17 (full cover).

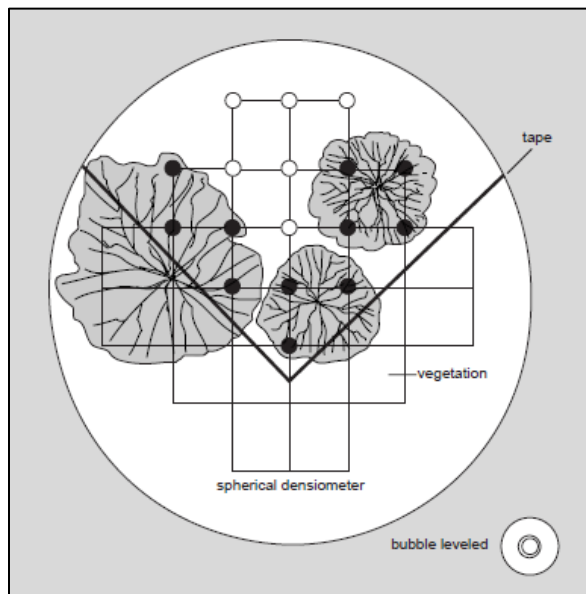


Figure 5. A convex spherical densiometer with bubble level, tape, and 17 points of observation. Lines of intersections at both open and closed circles are examined. Closed circles represent line intersections counted in the measurement of canopy closure (11 of 17 points) (from Fitzpatrick et al. 1998). Observer stands in the center of the stream with the point of the taped-V towards the observer.

Measure riparian canopy cover using densiometer (USEPA 2017). Face the bank and hold densiometer 1 ft away from the edge of water and 1 foot above the water. Take the measurements at the (5) left bank and (6) right bank. Record on Form 1.

Geomorphic Channel Units (GCUs)

Make a **visual estimate of the GCU areas** (Table 1) that are present between this transect and the next transect (e.g., 50% riffle, 10% run, and 40% pool). Record their percentages (to the nearest 5%) on Form 1. The terms ‘run’ and ‘glide’ are analogous.

Table 1. Types and descriptions of geomorphic channel units (GCU).

Geomorphic Channel Unit	Description
Pool	Portions of the stream that are slow moving and relatively deep.
Riffle	Relatively shallow areas of the channel where water flows swiftly over completely or partially submerged obstructions creating surface turbulence.
Run	Areas with moderate depth that are flowing with moderate velocity and have no surface turbulence. Typically found in the transitional area between riffles and pools.
Glide	Relatively deep portions of the stream that are free-flowing and have no surface turbulence. Similar to a run though the water depth will be greater (relatively rare GCU).
Rapid	Areas where stream gradient is relatively high and water flows swiftly over completely or partially submerged obstructions creating ‘white water’ areas.
Step	Created when a blockage (due to bedrock or large woody debris) is created in the stream creating a step-like structure in the longitudinal profile of the stream.

Large Woody Debris (LWD)

Once all of the above measures have been recorded for each transect, traverse upstream from T1 recording the **location, diameter (at mid-point), and length of all in-channel large woody debris (LWD)**. Record all pieces of LWD that have a diameter greater than 10 cm (3.9 in.) and are greater than 1 meter (3.3 ft.) in length. Record the location of a piece of LWD based on its mid-point. If the midpoint of a piece of large woody debris is between two transects, record its location as the closest downstream transect. Out of active channel (floodplain) pieces may be recorded if appropriate and if time allows.

Finish characterizing the reach by recording any additional information (e.g., animal activity or evidence of riparian clearing) that will help interpret the data recorded. Once the above measures have been recorded, use the steps in the following section to characterize bed material.

Pebble Count (Bed Material Characterization Form 1)

The type and size of bed material can be an important indicator of geomorphic processes occurring at multiple spatial scales and can reflect interactions between basin characteristics, climate, and land use/land cover. A Wolman pebble count will be used to describe the size and distribution of bed

material (pebble count) from a representative riffle within each reach (Wolman 1954). Use the following steps to conduct the pebble count:

- Identify a riffle within the study reach that is representative of the reach. Record the **starting and ending transects** the riffle is located between.
- Individually and indiscriminately **select 100 particles from the riffle, and measure (in millimeters) the b-axis of the particle using a meter stick or gravelometer**. The b-axis refers to the axis that would prevent the particle from passing through a sieve (Figure 6). Record the size of the hole that the particle passes through. If it passes through the 32 mm but not 16mm, record as size as 32 mm. If the particle is bigger than the biggest hole on gravelometer, record as 512 mm. If smaller than 2mm (sand), record as .062.
- An unbiased method that can be used to select particles is to select the first particle encountered at the end of your big toe (Wolman 1954). Do not preferentially select by size class (e.g., don't pick only large particles or small particles).
- Walk back and forth across the riffle randomly selecting and measuring sediment until 100 particles have been recorded. Large particles such as boulders or bedrock may be recorded more than once if selected.
- If the randomly selected particle is finer than sand (silt or clay), record the particle size as 0.062 millimeters. Standardized measurements will be used because a measurement of less than one millimeter for silt and clay cannot be used when calculating the statistics.

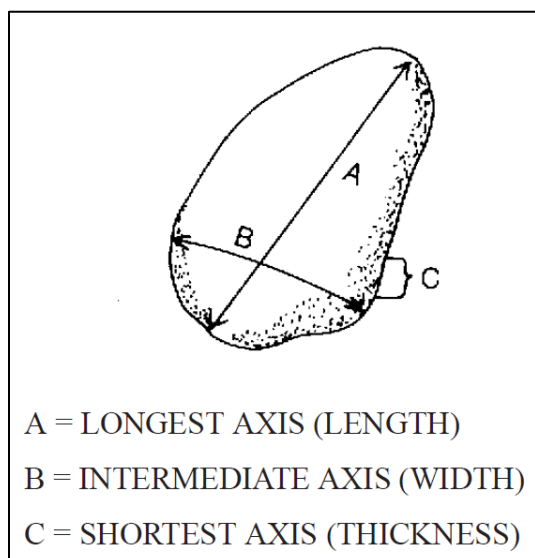


Figure 6. Particle axes. Measure and record the b or intermediate axis when conducting the pebble count on the representative riffle (from Harrelson et al. 1994).

Standard Transect Data Collection (Form 2)

Standard transect data collected at each of the 11 transects will be recorded on the Standard Transect Assessment Datasheet (Form 2). Fill out the header information before conducting the survey. Any information not collected should be filled with a dash or slash to indicate no data collected.

Make the following measurements or observations at each standard transect. The order that the data are collected need not be in the order that they are listed. All width and height measurements should be made with a stadia rod or survey tape (or a similar surveying instrument) and recorded in meters to two decimal places. A transect line may be set up using the 100-m reel tape, ideally from channel top to channel top perpendicular to the stream at each transect.

Transect measurements

Starting at the top of Form 2 in the Transect Measurements box,

- Record the **distance from T1** in the “Distance Upstream from T1” field.

Measure the **wetted channel, active channel, bank full, and channel full widths** (perpendicular to flow) (Figure 7).

- **Wetted channel width** - measured where water is flowing (including undercuts).
- **Active channel width** – measure to sides of channel from base of bank to base of bank, this is often to the beginning of vegetation within the stream channel (excluding macrophytes).
- **Bankfull width** – measured between the left and right bankfull indicators. Indicators may be only apparent on one bank. Bankfull should already be flagged on the left and right banks but adjust flags if needed. Use the rangefinder or a stadia rod and level to sight where bankfull on the opposite bank should be. The first terrace/change in slope where channel forming flow in the stream has a return interval of 1-2 years is considered bankfull.
- **Channel full widths** - measured from the top of terrace above the floodplain. Make ample use of the range finder to determine width.

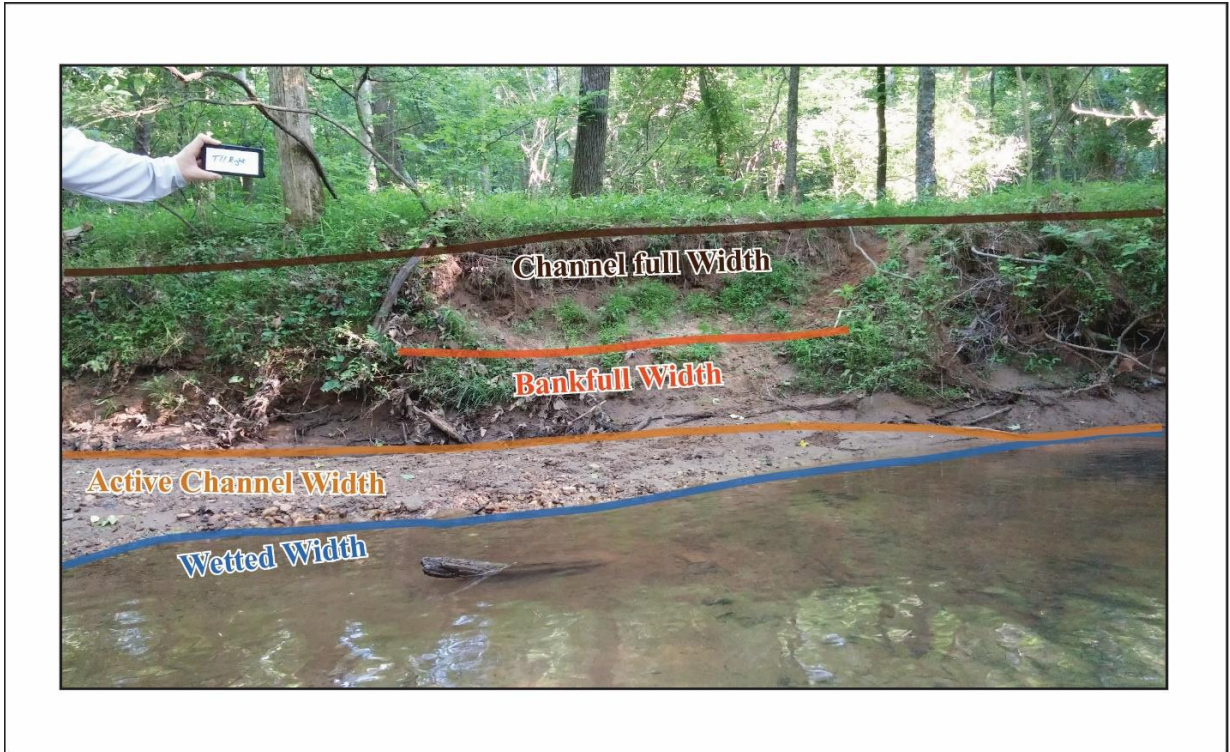


Figure 7. Annotated photo showing where wetted, active channel, bankfull, and channel full width measurements are measured. On the right-hand side of the figure, active channel width and wetted width are measured at the same spot.

If a mid-channel bar is present, subtract the width of the bar from wetted width. Only subtract the width of the bar from active channel width if the height of the bar is above active channel width height.

- **Thalweg position-** record percentage of distance from LEW in relation to wetted width. Round to nearest 5%.
- **Thalweg depth-** record the depth of the thalweg (deepest part of the channel) by using a stadia rod or meterstick.
- **Dominant Bed Sediment:** Determine the dominant bed sediment in the area one meter upstream and downstream of the transect line. Estimate visually, using a gravelometer if necessary. Categorize by bed sediment code on the datasheet or record the upper end of the code's size (Table 2).

Table 2. Stream bed sediment codes and recorded size.

Bed Sediment	Code	Size (mm)	Recorded size on form (mm)
Bedrock	BR	>1024	512
Boulder- medium	BM	512-1024	512
Boulder- small	BS	257-512	512
Cobble-large	CL	129-256	256
Cobble-medium	CM	91-128	128
Cobble-small	CS	65-90	90
Gravel-coarse	GC	33-64	64
Gravel-medium	GM	9-32	32
Gravel- small	GS	2-8	8
Sand	S	.062-2	2
Silt-clay	SiC	<.062	0.062

- Dominant particle size may be difficult to determine in mixed particle size situations — i.e. bedrocks with lots of fine sediment and some gravel. Try to visualize what the median particle size would look like and record it.

Streambed Sediment Size

At this point, the technicians will want to skip down to the Streambed Sediment Size box at the bottom of Form 2.

- We will take **5 points across the stream at each transect** along the transect line: at the LEW (left edge of water), left-center, center, right-center, and REW (right edge of water). Using a gravelometer, record the size of a randomly located particle at that point. **Record the size of the hole that the particle passes through.** If it passes through the 32 mm but not 16mm, record as size as 32 mm. If the particle is bigger than the biggest hole on gravelometer, record as 512 mm. If smaller than 2mm (sand), record as 0.062 mm. Use the same categories/ recorded sizes in Table 2.
- **Percent embeddedness** will be estimated to the nearest 5% for each particle. Embeddedness is the percent that particle is buried in smaller particles like silt or sand. Sand and silt should be 100% embedded,

Now, jump back up to the Transect measurements.

Transect measurements, continued

- Determine the **dominant habitat type (GCU) of the area one meter (3.3 ft) upstream and downstream of transect** (run, riffle, pool, step, rapid, step, or glide- see Table 1 for definitions).
- Note any **in-channel features** present at the transect (e.g., bars, islands, shelves).

Once the transects measurements box is complete on Form 2, make any additional notes that will help characterize the transect or this portion of the stream. Additional notes may include: presence of

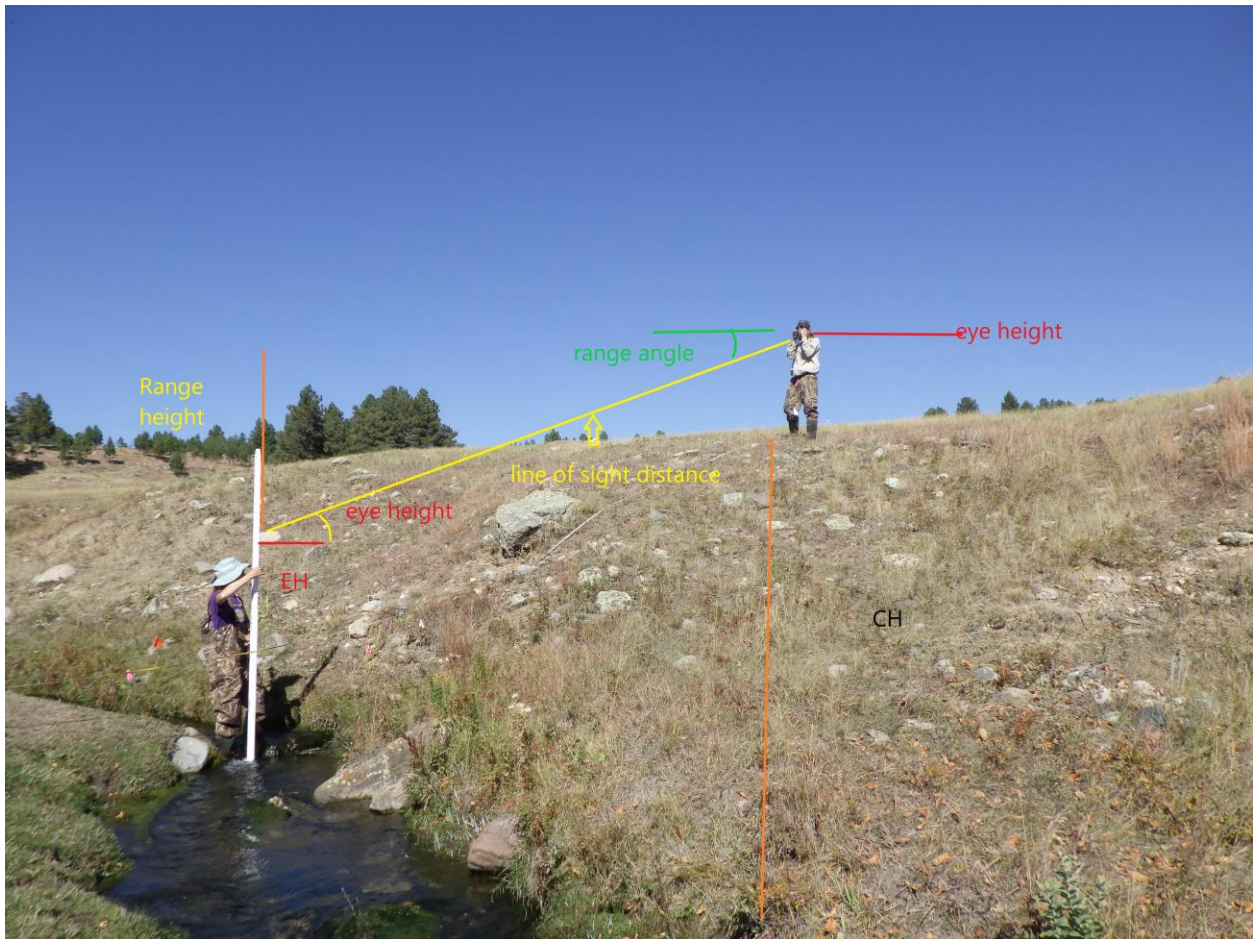


Figure 9. Measuring channel height. The reader's eye height is recorded. The reader aims for the eye height target on the stadia rod. The reader will note the range angle and line of sight distance to the stadia rod at the water's edge (here the stadia rod is pictured at thalweg). To calculate the channel height, the orange line, $CH = (\text{line of sight distance} * \sin(\text{range angle}))$. Use a calculator in the field and write result on datasheet.

See also Figure 12, for a detailed cross-section and more technical diagram of the cross-sectional area of a stream.

- Record **Water depth at base** of bank using a stadia rod or meter stick. If the base of the bank is above the water's edge, the water depth will be negative. Use a mason's line with level and meter stick to determine height above the water's edge (Figure 10).



Figure 10. Measuring water depth at base of bank. Chaining pin with line is placed at base of bank. Line is extended to water's edge and held level against a meter stick to determine the negative water depth of the base.

- Record **Bank undercut distance, horizontal and vertical if undercut is present.**
- Record **bank angle** and **bank undercut angle** (if present). Measure the dominant bank angle with an inclinometer and stadia rod. If the bank is undercut, note the presence of the undercut and measure the angle of the bank overhanging the stream (Figure 11).

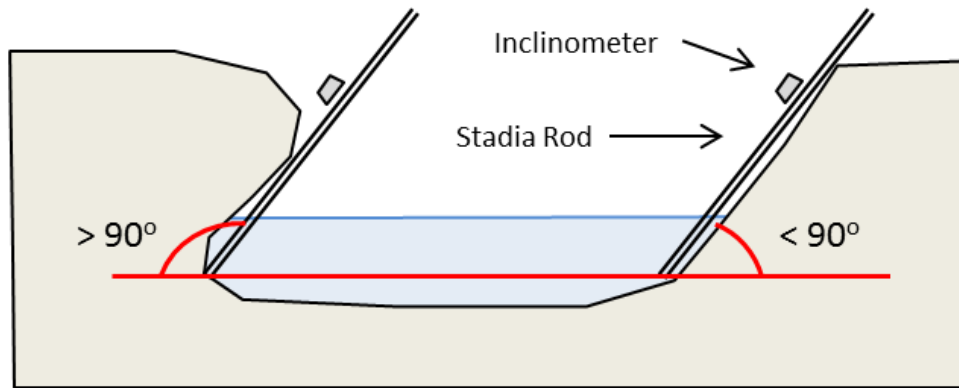


Figure 11. Examples for how to properly measure bank angle with and without an undercut. Hold stadia rod or meter stick at base of bank and lay across bank to bank full. Measure the angle by laying a clinometer on top of the rod or stick at the base of the active channel.

- Determine the **dominant bank sediment**, both visually and texturally (by rubbing between thumb and fingers), and categorize by bank code on the datasheet as shown in Table 3 below.

Table 3. Bank Sediment codes modified from Fitzpatrick 1998.

Substrate	Code
Bedrock	BR
Boulder	BL
Clay	C
Silt/Clay	SiC
Silt	Si
Sandy silt clay	SSiC
Silty clay sand	SiCS
Sand	S
Gravel/Sand	GS

- Note the **presence or absence of bank erosion** within 1 meter of transect line as ‘No’ or note the type(s) of erosion.
 - Fluvial – lateral reworking/erosion of the bank (FL)
 - Slump – vertical movement/reworking of the bank (SL)
 - Undercut – the bank is undercut (U)
 - Animal- erosion due to animal disturbance/trampling (AN)

- Record **bank erosion length** of a 10-meter segment centered on the transect line (5 meters downstream and 5 meters upstream of the line). Any visible erosion should count in the erosion length.
- Visually estimate the **vegetative cover** (including roots but not including leaf litter)) of each bank. Also estimate **bare ground** and **surface protection** (all bank protection-vegetation, rocks, logs, etc) **percentages**.
 - These estimates should be done on the transect and encompass an area of about 1 meter (3.3 ft.) wide from the bottom of the bank to the top of the bank. The top of bank is the first continuous flat spot- usually it is bank full, but can be to the channel top. If the bank area extends above bankfull, please make a note.
 - Use the example cover figures at the bottom of the form and record the estimates to the nearest 5%.

Detailed Transects Data Collection (Form 3 and 3a if tie ins)

In addition to the standard transect assessment, additional data will be collected at the detailed transects (optimally on standard transects 1, 6, and 11). For each detailed transect, fill out the Detailed Cross-Section Datasheet (Form 3) to provide a context for the points that will be surveyed along each transect. The purpose of the detailed transect surveys is to collect data that can be used to characterize the cross-sectional morphology, allowing for the identification and quantification of erosion and fluvial development. These measurements also provide an understanding of the out-of-channel features/habitats that characterize and influence the reach. The detailed transects are surveyed with a total station setup on a permanent benchmark. If tie-in points are needed to complete the survey network, their coordinates will be recorded on the Tie-In Points Datasheet (Form 3a) during reach set up (and should have been uploaded to the data collector prior to conducting the survey). See the Using a Total Station to Conduct a Stream Survey SOP for more details about tie-in points.

The information that should be recorded on Form 3 includes (but is not limited to) the presence/absence of diagnostic geomorphic surfaces (e.g., floodplain or terrace) and a short description of the riparian habitat on each side of the stream (i.e., ground cover and presence/absence of woody plants). A quick sketch of the surveyed cross-section with annotations (see point codes on Form 3 and Figure 12 below) will help identify channel-full, bankfull, bottom of bank, etc., when processing the data.

Refer to the Setting Up and Configuring a Total Station SOP for additional details and instructions for setting up the total station. Refer to the Using a Total Station to Conduct a Stream Survey SOP for more detailed instructions on how to properly survey each detailed transect and transfer the data from the data collector to the database. Follow the instructions in the Using a Total Station to Conduct a Stream Survey SOP to conduct the detailed transect surveys and:

- **Be absolutely sure** to survey the permanent index site markers (if this isn't where the total station was set up) as all surveys will be standardized using the location of each point relative to the benchmark on river left (or right if river left is not accessible).
- Record the file name used on the data collector on the bottom of Form 3.
- To set up total station unit:
 1. Pull legs out to chin level and level.
 2. Move legs over point.
 3. Set total station on top and secure.
 4. Move scanner (not legs) so side cross-hairs are over the point.
 5. Stomp in legs
 6. Level unit by first coarse adjusting legs, then by using knobs on total station.

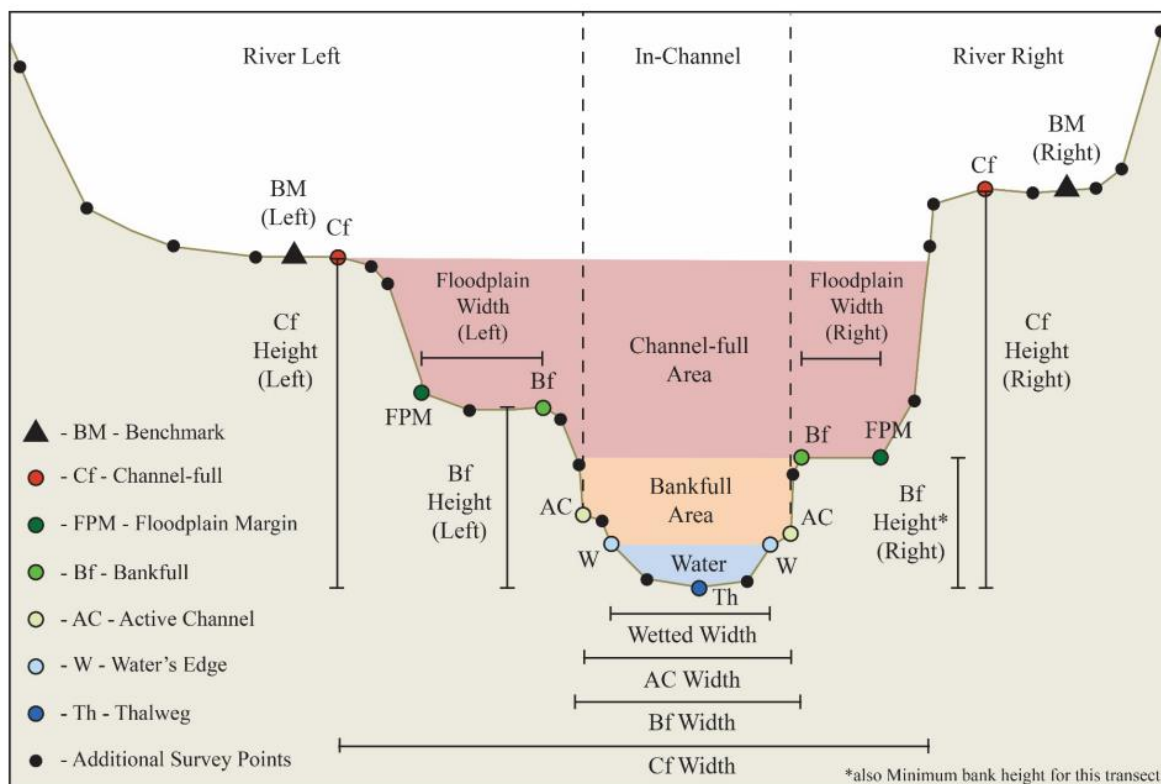


Figure 12. From SECN's SOP Using a Total Station to Create a Stream Survey, [DataStore - Standard Operating Procedure - \(Code: 2293670\) \(nps.gov\)](https://www.nps.gov/datastore/standard-operating-procedure-(code:2293670)) the diagnostic points along the cross-section of the detailed transect.

Stream Reach Maps (Form 4)

Once all data have been collected, draw a reach map [Reach Map Datasheet (Form 4)] that clearly defines areas characterized by riffles, runs, pools, and any other distinguishing in-stream features. Draw this map roughly to scale and in the correct orientation relative to the cardinal directions; include a compass-confirmed north arrow on the map.

Other important reference information to document on the maps includes:

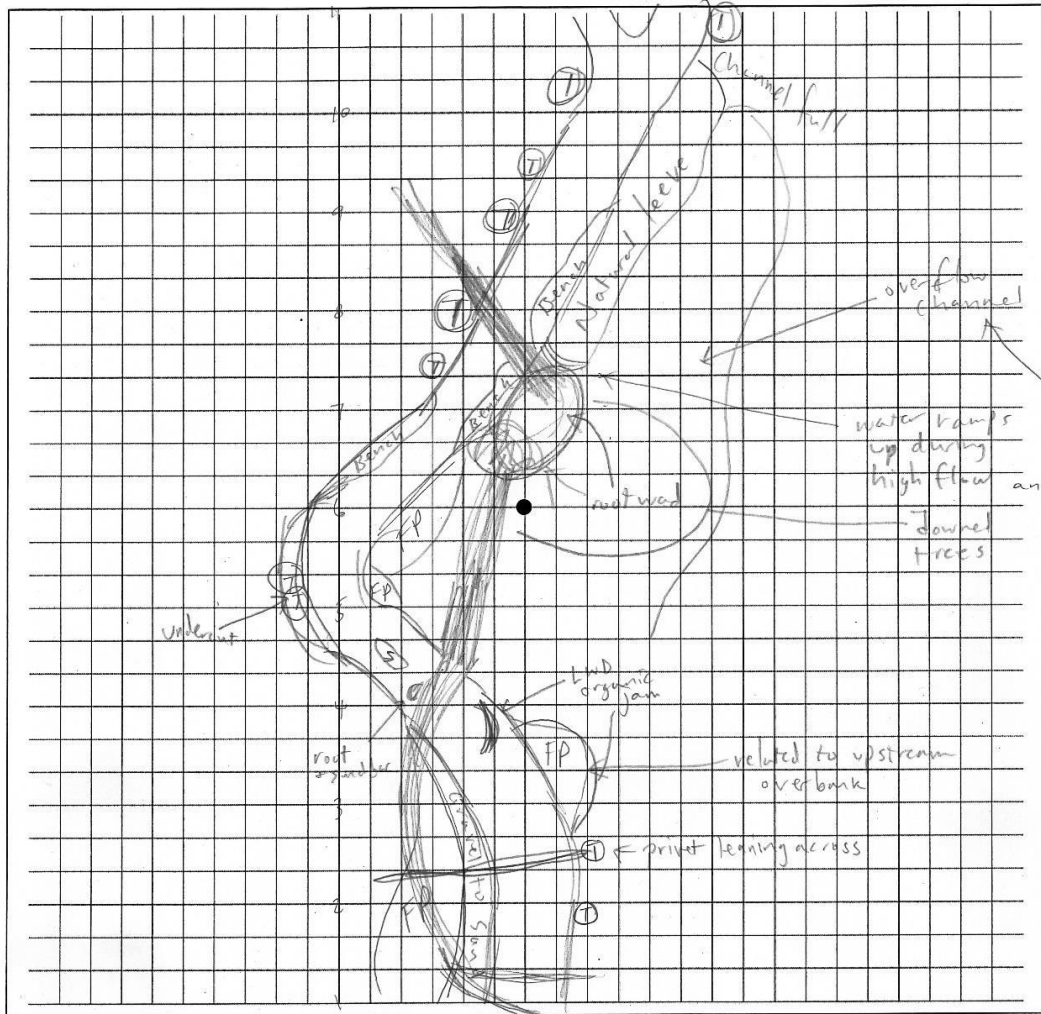
- general stream heading and direction of flow
- areas of bank erosion and undercutting
- riparian zone disturbances (e.g., tree falls or manmade clearances)
- location of trees along the bank
- any in-channel features (i.e., bars, benches, and islands)
- geomorphic channel units
- any other distinguishing features (e.g. large exposed roots in bank cut or presence of historical terrace or floodplain)

Detailed transect benchmarks and transect locations should also be included on the map.

See Figure 13 for an example of a stream habitat map. Reach maps will be scanned and archived with reach information in the database. Any symbols used in these maps need to be described in the comments section of Form 4 so that they can be interpreted once in the office.

SECN Wadeable Stream Habitat Assessment Form 4: Reach Map

Park: CHAT Site #: 002 Stream: Undercut Crk Date: 6.15.17



Comments / Map Legend:

Relatively small stream w/ a lot of undercutting and LWD.
 The bed sediment is relatively fine.
 An interesting feature of this reach is a flood chute that funnels water ramped out of the channel by the large downed tree @ T8 into the out of channel area and spills back near T3.
 A natural levee feature has also formed upstream of T8 potentially caused by the tree falls near T8 and T4 (These trees T1 → T2 → T3 → T4 → T5 → T6 → T7 → T8 → T9 → T10 → T11 → T12 → T13 → T14 → T15 → T16 → T17 → T18 → T19 → T20 → T21 → T22 → T23 → T24 → T25 → T26 → T27 → T28 → T29 → T30 → T31 → T32 → T33 → T34 → T35 → T36 → T37 → T38 → T39 → T40 → T41 → T42 → T43 → T44 → T45 → T46 → T47 → T48 → T49 → T50 → T51 → T52 → T53 → T54 → T55 → T56 → T57 → T58 → T59 → T60 → T61 → T62 → T63 → T64 → T65 → T66 → T67 → T68 → T69 → T70 → T71 → T72 → T73 → T74 → T75 → T76 → T77 → T78 → T79 → T80 → T81 → T82 → T83 → T84 → T85 → T86 → T87 → T88 → T89 → T90 → T91 → T92 → T93 → T94 → T95 → T96 → T97 → T98 → T99 → T100)

Figure 13. An example of a hand-drawn stream map showing some relevant habitat and geomorphic features.

Post- Survey Report (Form 5)

Fill out the Post-Survey Report Datasheet to help inform future surveys (Form 5).

Photographic Records Sheet (Form 6)

In addition to filling out the photo numbers on Form 1, use Form 6 to record additional photos taken during the survey.

Discharge Measurements Datasheet (Form 7)

Complete the Discharge measurements as in SOP [DataStore - Standard Operating Procedure - \(Code: 2259866\) \(nps.gov\)](#).

Completing the Reach Assessment

Complete the reach assessment by doing the following:

- After all forms have been filled out, check to make sure all of the forms are numbered as “page XX of XX pages” and the pages are in the correct order.
- If it is not the first survey, compare Form 2 to the previous survey to ensure similar interpretations of geomorphic surfaces were used (e.g., if a floodplain was measured previously, a floodplain (bankfull) probably should be measured on the subsequent survey).
- It is the responsibility of the crew leader to review all of the forms before leaving the reach to validate that all forms are filled out completely and correctly.
- Remove the temporary transect marking flags and examine the worksite for any equipment/trash associated with the reach visit.

Post Field Work Procedures**Decontamination of Sampling Equipment**

NGPN seeks to prevent the introduction and dispersal of aquatic invasive species. Therefore, the network requires all equipment used during stream sampling to be decontaminated prior to entering a waterbody in another park. Procedures have been modified from the Great Lakes Network – Large Rivers Water Quality Monitoring Protocol v1.0 (Elias 2005).

When finished with work in a park, minimum decontamination procedures are:

- Rinse and scrub mud, vegetation and other debris from sampling equipment using onsite river water. If available on site, tap water may be used, as long as debris are not rinsed into another waterbody.
- Allow waders, stadia rods, and other equipment to fully dry before proceeding to another park. If there is high humidity in the region, equipment may need more than 48 hours to dry. Placing equipment in direct sunlight will speed the process.

- Visually inspect all gear to verify that all equipment and gear has been cleaned and rinsed.

In general, fieldwork will not be conducted in multiple parks in the same day; however, if multiple parks will be visited within the same day the following procedures must be followed:

- Rinse equipment as indicated above.
- Soak all waders and boots in a 2% [GS High Dilution Disinfectant 256](#) solution for 10 minutes or spray a 10% GS High Dilution Disinfectant 256 solution on equipment and let stand for 5 minutes; quaternary ammonium disinfectants, such as GS High Dilution Disinfectant 256, are preferred over bleach since they are less harsh on nets and wader material. GS High Dilution Disinfectant 256 is available as a commercial cleaner manufactured by the Spartan Chemical Company, Inc.
- Thoroughly rinse disinfectant solution off sampling equipment.
- Visually inspect all gear to verify that all equipment and gear has been cleaned and rinsed

Equipment Storage

Following the field season, equipment will be stored at NGPN headquarters. Non-electrical equipment, including rebar, survey caps, clipboards, reel tapes, etc. are stored in well-marked plastic bins. Organization of equipment will ease field preparation for the following season and prevent damage caused by improper storage. Electronic equipment, including GPS units, cameras, and the total station, will have their batteries removed during the winter months to prevent corrosion and leaking, and will be stored in NGPN's electronics cabinets.

If using a rented total station, clean it and carefully pack it for return shipping. Follow the rental company's instructions to return it promptly to avoid additional charges.

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