

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Fluvial Sediment Sampling**

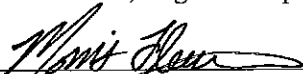
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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
<p>SESDPROC-500-R3, <i>Fluvial Sediment Sampling</i>, replaces SESDPROC-500-R2.</p> <p>General: Corrected any typographical, grammatical, and/or editorial errors.</p> <p>Cover Page: Changed the Ecological Assessment Branch Chief from Bill Cosgrove to John Deatruck. Changed the FQM from Laura Ackerman to Bobby Lewis.</p> <p>Revision History: Changes were made to reflect the current practice of only including the most recent changes in the revision history.</p> <p>Section 1.2: Added the following statement – “Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.”</p> <p>Section 5: References to preserving samples at “4°C” were replaced with “preserved using ice or an equivalent temperature reduction method.”</p>	July 19, 2013
SESDPROC-500-R2, <i>Fluvial Sediment Sampling</i> , replaces SESDPROC-500-R1.	December 7, 2009
SESDPROC-500-R1, <i>Fluvial Sediment Sampling</i> , replaces SESDPROC-500-R0.	November 1, 2007
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1 General Information

1.1 Purpose

The purpose of this procedure is to document both general and specific procedures, methods and considerations to be used and observed when collecting fluvial sediment samples for field screening or laboratory analysis.

1.2 Scope/Application

This document describes both general and specific methods to be used by field personnel when collecting and handling fluvial sediment samples in the field. On the occasion Science and Ecosystem Support Division (SESD) field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a suspended sediment sample, the alternative procedure will be documented in the field log book in accordance with SESD Operating Procedure for Logbooks (SESDPROC-010), along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

ASTM. 1999. Standard Test Methods for Determining Sediment Concentration in Water Samples: American Society of Testing and Materials, D 3977-97, Vol. 11.02, ps. 395-400.

Emmett, W.W. 1980. A field calibration of the sediment-trapping characteristics of the Helley-Smith bedload sampler. U.S. Geological Survey Professional Paper 1139. 44 p.

Gray, J.R. Glysson, D., Turcios, L.M., and G. E. Schwarz 2000. Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data. U.S. Geological Survey Water-Resources Investigations Report 00-4191. 14 p.

Harrelson, C.C., C.L. Rawlins and J.P. Potyondy. 1994. Stream channel reference sites: An illustrated guide to field technique. United States Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. General Technical Report RM-245.

Hubbell, D.W. 1964. Apparatus and techniques for measuring bedload. U.S. Geological Survey. Water-Supply Paper 1948. 74 p.

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

Leopold, L.B. M.G. Wolman, and J.P. Miller. 1964. Fluvial processes in geomorphology. W.H. Freeman and Company, San Francisco, CA. 522 p.

Rosgen, D.L., 1996. Applied River Morphology: Wildland Hydrology, Pagosa Springs, CO, 354 p.

SESD Operating Procedure for Field Turbidity Measurements (SESDPROC-103), Most Recent Version.

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version

USACOE/FISP. 1981. Instructions for Sampling with Depth-Integrating Suspended Sediment Samplers, US DH-59 and DH-76. Vicksburg, MS. 6 p.

USACOE/USDA/USBLM/FISP. 2000. Sampling with the US DH-48 Depth-Integrating Suspended –Sediment Sampler. Vicksburg, MS. 12 p.

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting suspended sediment samples. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. Sampling from bridges may present an unreasonable risk to the sampling crew. If at any time a person feels it is unsafe to work from a bridge, work will be discontinued at that site. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting fluvial sediment samples:

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and stored in a secure place.

2 Introduction

The objective of this section is to provide guidance on collecting fluvial sediment (bedload and suspended).

2.1 Bedload Sediment

Bedload is defined as sediment that is transported along the streambed by sliding, rolling, or bouncing (Hubbell, 1964; Leopold *et al.*, 1964; Emmett, 1980). Bedload samplers are designed to estimate mobilized bedload which is usually conveyed within 3 inches of the streambed.

2.1.1 Bedload Sediment Interferences/Sample Collection Error

Obtaining bedload measurements representative of the actual bedload is problematic. Sampling personnel should recognize and take steps to minimize the following potential error associated with bedload sampling and sampling equipment:

- If the streambed is irregular, the sampler could be posed unevenly on the streambed and a representative sample would not be collected;
- When deployed on the streambed, the sampler may disturb the existing stream flow and bed material; and
- There is a time and space (in cross-section and planform) variation in bedload transport rate and stream velocity; consequently, the sample collected at a given point may not be representative of the actual mean sediment transport rate.

2.2 Suspended Sediment

The premise behind integrated sampling is to composite the vertical water column resulting in a sample which is representative of the relative quality and quantity of suspended sediment throughout the water column at a point in space and time.

2.2.1 Suspended Sediment Interferences/Sample Collection Error

Sampling personnel should recognize and take steps to minimize the following potential error associated with suspended sediment sampling:

- The stream may not be completely mixed in cross-section;

- When deploying the suspended sediment sampler, the sampler may cause re-suspension of bed material; and
- There is a time and space (in cross-section and planform) variation in suspended sediment transport rate and stream velocity, consequently, the sample collected at a given point may not be representative of the actual mean sediment transport rate

3 Equipment

3.1 Bedload Sediment

Helley-Smith bedload samplers or an equivalent should be used to sample sediment being transported along the streambed. Both hand-held and suspended models are acceptable with either a 3-inch or 6-inch intake. The preferred intake size will depend upon the anticipated channel particle size. For instance, bed material found within the Piedmont and Coastal Plain physiographies are fine-grained, thus the 3-inch intake size may be adequate. However, a comparative study between different sized samplers should be conducted before proceeding with the 3-inch sampler *in lieu* of the 6-inch sampler. A sampler bag constructed of Nitex™ nylon or equivalent is attached to the bedload sampler. For most applications, the sampler bag should have a 0.25 millimeter (mm) mesh size.

3.2 Suspended Sediment

An integrated sampler (e.g., DH-59, DH-48 or equivalent) should be capable of compositing the vertical water column and collecting a sample which is representative of the fluvial sediment being conveyed in the water column of the stream. The integrated sediment sampler should be capable of isokinetic sampling (i.e., the nozzle orientation and orifice are designed to simulate the flow and sediment transport rate of the stream).

4 Sampling Methodology

4.1 Site Selection

In order to collect representative bedload samples, reduction in the error associated with sample collection identified above is important. The step-wise field procedure for bedload deployment is meant for general guidance and not a replacement for judgment in identifying station locations that reduce error associated with bedload collection. Selection of sampling locations requires evaluation of local conditions. The following criteria should be utilized to identify representative stations:

- The stream should be relatively free of obstructions including large boulders, center bars, detrital debris, and standing vegetation;
- The stream should have relatively even velocity in cross-section;
- Upstream of the station, the stream should be free of recent activities (e.g., beaver dams, man-made structures) that impede the natural conveyance of sediment; and
- In general, the station should not be located immediately downstream of a sediment source that does not have an adequate mixing zone resulting in an uneven distribution of sediment at the sample collection cross-section.

4.2 Bedload Deployment

Once an appropriate cross-section is established, the cross-section should be cleared of large boulders and debris and a relatively flat surface maintained throughout sampling. The width of the wetted surface of the stream should be determined by locating zero tape on the left-edge-of-water (LEW) and measuring across to the right-edge-of-water (REW). LEW and REW are determined looking down stream. It may be required to repeat this step during storm event sampling, given the temporal variation in stage and wetted surface width. However, once cross-sectional spacing for bedload and suspended load sampling is established during baseflow conditions, it is at the discretion of the project leader if horizontal spacing is to be re-established. In general, the more intervals sampled per traverse, the greater the probability that the composited sample is representative of the true bedload discharge. However, the number of points sampled per traverse must be weighed against the allowable time at each station during a storm event. In general, for stream widths less than 100 feet, the bedload sampler should be deployed at five (5) pre-determined, equally-spaced points per traverse for 2 minutes. Two traverses are recommended for a total of 20 minutes of bedload sampling per station.

Depending on stream conditions (i.e., stream depth and velocity), the bedload sampler is outfitted with a 6 to 8 foot pipe handle for wading or is lowered off the culvert or bridge from a cable and winch system.

4.3 Integrated Sampler Deployment

Sampling stations should be established, taking into consideration the criteria identified above in bedload sampling. Sampling personnel should be familiar with manufacturer's instructions on the use of the specific integrated sampler to be used. In general, the container (glass milk bottle) should not be completely filled during vertical integration of the water column. If the container is completely filled, it is not representative (both quality and quantity) of the suspended sediment throughout the water column and should be discarded. The optimal volume of sample collected should be between 375 and 440 milliliters (ml). Sampling personnel should develop the skills required to collect a fully integrated sample given variation in local conditions (e.g., water depth, velocity).

Once an appropriate cross-section is established, deploy the integrated sampler at evenly-spaced points across the stream cross-section. It is at the discretion of the project leader to determine the number of sample points required. In general, in streams less than 50 feet wide that are well mixed, two evenly-spaced sample points are adequate. Larger stream widths may require 3 or 4 sample points. The sample bottle should be filled according to manufacturer's specifications. Depending upon the required sample volume, the sample can be composited across sample points within the bottle or samples from each sample point can be decanted into a small mixing pail and additional samples collected until an adequate volume of sample is produced. While gently swirling the pail, fill a glass cuvette, and measure turbidity following SESD Operating Procedure for Field Turbidity Measurement (SESDPROC-103).

4.4 Bedload and Integrated Suspended Load: Stepwise Procedure

- 1) Install safety equipment and traffic control as required/when necessary (crew chief to determine level of protection);
- 2) Record tape down (TD) for stage/discharge determination - *RECORD TD, Date, Time, weather conditions and field personnel*;
- 3) Establish location for bedload and suspended load cross-section:
 - a. locate zero tape on left bank or bridge;
 - b. identify (LEW) (REW) - *RECORD*;

Note: Steps 4 and 5 can be conducted simultaneously being cautious of preventing cross-contamination:

- 4) Deploy bedload sampler at five (5) pre-determined, equal intervals across the stream cross-section for 2 minutes each and repeat cross-section for a total of 2 traverses totaling 20 minutes;
- 5) Carefully, concentrate sediment into one corner of the nitex bag and decant into 1-liter, wide-mouth Nalgene jar;
- 6) Deploy integrated sampler at 2 evenly distributed intervals across the stream cross-section (larger cross-sections may require 3 or 4 intervals);
 - a. allow milk bottle to fill according to manufacturer's specifications;
 - b. estimate volume of sample collected in milk bottle - *RECORD*;
 - c. decant milk bottle contents into small mixing pail and repeat (a) and (b) until an adequate volume of sample is collected;
 - d. while gently swirling the pail, fill a glass cuvette and measure turbidity - *RECORD*;
 - e. discard cuvette contents;
 - f. decant remainder of sample from pail to the appropriate sample containers;
 - g. clean DH-59 or DH-48 nozzle and glass bottle with three (3) rinses of deionized water; and
- 7) Record end tape down and time.

5 Sample Handling

5.1 Bedload Sediment

The composited sample is concentrated into one corner of the bedload mesh bag and decanted into 1-liter, wide-mouth Nalgene™ jar or equivalent. Samples should be preserved using ice or an equivalent temperature reduction method and transported to the laboratory for analysis.

5.2 Suspended Sediment

Following field determination of turbidity, decant the remainder of sample into a 1-liter plastic container for total suspended solids/total dissolved solids (TSS/TDS) and/or suspended sediment concentration (SSC) analysis or .5-gallon milk jug for nutrients (if required). For nutrient analysis, preserve samples with 10% H₂SO₄ to pH < 2. TSS, TDS, SSC and nutrient samples should be preserved using ice or an equivalent temperature reduction method.