DEPARTMENT OF
ECOLOGY
State of Washington

Standard Operating Procedure EAP018, Version 1.2

Turbidity Threshold Sampling

August 2019
Publication 19-03-222
Recertified 2019

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/1903222.html.

Ecology's Activity Tracker Code for this SOP is 16-053.

***Recommended citation*:**
Estrella, S. 2019. Standard Operating Procedure EAP018, Version 1.2: Turbidity Threshold Sampling. Publication No. 19-03-222. Washington State Department of Ecology, Olympia. https://fortress.wa.gov/ecy/publications/SummaryPages/1903222.html. Recertified 2019.

Contact Information

For more information contact:

Publications Coordinator
Environmental Assessment Program
P.O. Box 47600, Olympia, WA 98504-7600
Phone: (360) 407-6764

Washington State Department of Ecology – https://ecology.wa.gov

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

Original Author – Stephanie Estrella
Date – March 2008

Original Reviewer – William Ehinger
Date – March 2008

Current Author – Stephen Nelson
Date – 3/4/2019

Current Reviewer – Stephanie Estrella
Date – 3/4/2019

QA Approval – Arati Kaza, Ecology Quality Assurance Officer
Date – 03/04/2019

APPROVED: 10/20/10
RECERTIFIED: 03/04/2019

Signatures on File

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
03/13/2008	1.1	Updated equipment list, summary of procedures, and records management; deleted Figures 2 and 3, added new Figure 2	5.0, 6.0, 7.0, 11.0	S. Estrella
2/24/2016	1.1	Recertified	All	B. Kammin
3/4/2019	1.2	Various edits	All	S. Nelson
8/2/2019	1.2	Accessibility and formatting edits	All	R. Froese

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program's Standard Operating Procedure (SOP) for Turbidity Threshold Sampling.

1.2 Turbidity Threshold Sampling (TTS) describes a procedure that uses data from a pressure transducer and an *in situ* turbidity sensor to activate a pump sampler to collect water samples. TTS is used to create a regression model (not covered in this SOP) to relate turbidity with suspended sediment concentrations collected over a range of flow conditions. The regression model can then be used to quantify sediment export from a stream over time or in response to ecosystem disturbances.

2.0 Applicability

2.1 This document was developed as a TTS procedure for the Type N Experimental Buffer Treatment (Type N) Study. The procedure may be applicable for other studies assessing sediment transport in freshwater streams.

3.0 Definitions

3.1 Turbidity Threshold Sampling: a turbidity sampling method using a pressure transducer, *in situ* turbidity sensor, datalogger, and an automatic pump sampler programmed to activate at a specific stage and turbidity threshold value, to collect water samples during high-turbidity events (Lewis, 1996).

3.2 Type N: perennial and seasonal non-fish-bearing streams under Washington State's current stream typing system (WAC 222-16-030).

4.0 Personnel Qualifications/Responsibilities

4.1 Knowledge of the contents of this SOP.

4.2 This document supplements but does not replace the need for on-the-job training. Field staff responsible for maintaining equipment and downloading data from the datalogger must first receive training from the project or field lead. The field lead is responsible for ensuring that all field staff follow appropriate procedures while downloading data.

4.3 For installation, field staff should be familiar with the pressure transducer and turbidity sensor manufacturer's installation manual. Field staff should also be comfortable using basic power tools if recommended by the manufacturer's instructions.

4.4 Staff charged with reviewing data for quality control and assurance must have training before accessing and using the Forest Technology Systems (FTS) StreamTrac/Auto Caller software.

4.5 EAP staff who conduct turbidity threshold data downloads and equipment maintenance are responsible for complying with this SOP and the requirements of the EAP safety manual, particularly Chapter 1 "General Field Work" and the following sections of Chapter 2: "Using Hand or Power Tools" and "Driving on Logging Roads" (Ecology, 2019).

5.0 Equipment, Reagents, and Supplies

- Pressure transducer—Ott Messtechnik pressure sensor OTT PS 1 or equivalent
- Electrical conduit pipe, 1.5-inch diameter
- *in situ* turbidity sensor—FTS DTS-12 turbidity sensor or equivalent
- Metal support beams—Unistrut or equivalent
- Pipe and tee connector, 3-inch diameter
- Pipe cement
- Hose clamps
- Wire cable—diameter determined by size of stream
- Cable clamps—size determined by diameter of cable used
- Cable ties
- Suction tubing—tubing diameter determined by pump sampler used; length determined by distance from pump sampler to sampling location in the stream
- Datalogger—FTS Axion H2 datalogger or equivalent
- Automatic pump sampler—Teledyne ISCO 6712C portable sampler or equivalent
- Batteries—Two 12-volt valve-regulated lead acid batteries (one battery for installation, plus an extra to swap out and charge between visits).
- Enclosure—FTS enclosure for Turbidity Threshold Sampling station or equivalent. Example enclosure from FTS.
- 8 GB USB flash drive
- Pump sampler bottles and caps—size determined by pump sampler model used
- Data management software—FTS StreamTrac/Auto Caller software or equivalent
- CB Radio (if visiting stations requires driving on one-lane logging roads)
- Camouflage netting (if necessary)

6.0 Summary of Procedure

6.1 Install a pressure transducer on an installed flume following the manufacturer's instructions (Ott Messtechnik). Installation requires two people on-site as a safety precaution (in case of accidents and to help carry equipment). The vertical position of the sensor should be the same as that of the flume crest or the streambed. If not, record the offset and adjust the data post-process. Use a conduit or other device to protect the sensor (**Error! Reference source not found.**). Secure the apparatus to a stilling well or another stable structure.

Figure 1. Pressure transducer and conduit in a Type N study stream. Cable ties secure the pressure transducer within the conduit. Holes drilled into the base of the conduit allow water exchange. Bolts secure the conduit to a stilling well and flume.

6.2 Install an *in situ* turbidity sensor in a pool at the downstream end of the study basin following the manufacturer's instructions (Forest Technology Systems, 2003). Use metal support beams, pipe, tee connector, and hose clamps to suspend the sensor over the stream (**Error! Reference source not found.**). Secure the entire apparatus to trees, posts, or another stable structure with wire cable, cable clamps, and cable ties.

6.3 Submerge the open end of the suction tubing in the water near the turbidity sensor (**Error! Reference source not found.**).

Figure 2. Turbidity sensor apparatus. The turbidity sensor is suspended inside the pipe and secured with hose clamps. The tee connector allows the pipe to move freely with the stream flow. Water is pumped from the stream through the suction tubing and into the pump sampler.

6.4 Plug the pressure transducer and turbidity sensor into a datalogger (**Error! Reference source not found.**). Attach the other end of the suction tubing to an automatic pump sampler. Connect the datalogger to the automatic pump sampler using the provided cables and/or interface. Plug the datalogger and pump sampler into a battery. House the electronic components in an enclosure.

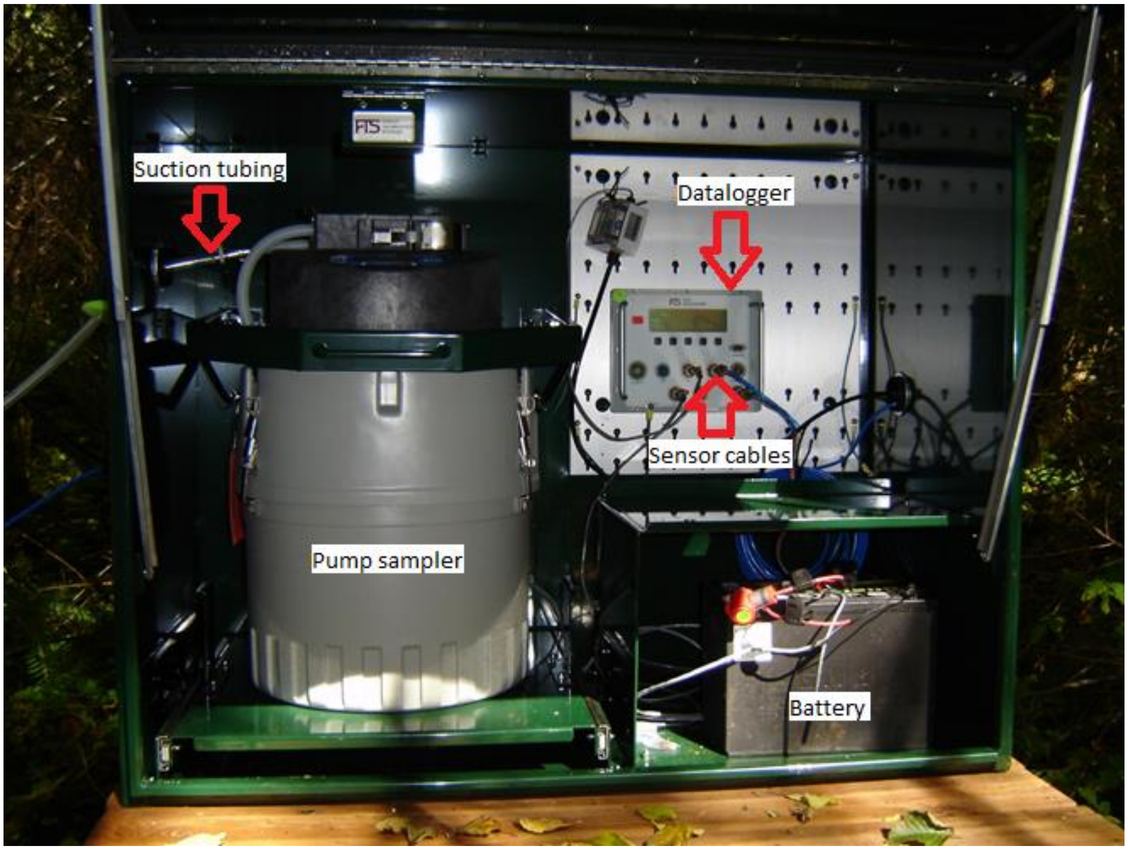

Figure 3. Datalogger and automatic pump sampler with attached components. The datalogger obtains stage height and turbidity readings from the pressure transducer and turbidity sensor at specified intervals. Readings above the specified flow and turbidity threshold trigger the automatic pump sampler to collect a water sample.

6.5 Program the datalogger to record stage height and turbidity at specified intervals and to activate the pump sampler at a specified stage and turbidity threshold (see Lewis, 1996).

6.6 Program the automatic pump sampler for flow-paced sampling (see Lewis, 1996).

6.7 Retrieve the samples from the automatic pump sampler following high flow and rain events. Fill the pump sampler with clean pump sampler bottles.

6.8 Submit the samples to the Manchester Environmental Laboratory for suspended sediment concentration analysis. Preserve and ship the samples to the laboratory as described in the laboratory user’s manual (Manchester Environmental Laboratory, 2016).

6.9 If the enclosure is visible from any roads or trails, cover the enclosure with camouflage netting.

6.10 Visit the study site periodically to maintain the sensors, flume, stilling well and tubing, download data using a USB flash drive, retrieve water samples, and replace batteries. Pressure transducer maintenance includes removing accumulated sediments from the stilling well, re-securing the sensor if needed, re-measuring the pressure transducer offset, and replacing the desiccant in the cable interface. Turbidity sensor maintenance includes replacing wiper blades, removing accumulated sediments from the turbidity sensor pool, and re-securing the sensor and pipe if needed. Flume and stilling well maintenance includes removing accumulated sediment and debris (using a jaw scoop if necessary). Pump sampler maintenance includes replacing the pump tube and desiccant annually. Return the pressure transducer to the manufacturer every three to five years and the turbidity sensor once a year for recalibration.

7.0 Records Management

7.1 Once back from the field, transfer the raw data on the USB flash drive to the appropriate folder on the Y: drive (Raw Data Folders). Store the raw data at least until the end of the project.

7.2 Maintain data in the FTS StreamTrac/Auto Caller database or equivalent (database is housed on the SQL server ecybeap under database name FTSData).

8.0 Quality Control and Quality Assurance

8.1 Keep a record of all other sampling activities in the study basin to help explain observed increases in turbidity resulting from sampling activities.

8.2 Ensure that site visit data forms are completely filled out in the field (Water Quality Site Visit Datasheets).

8.3 Staff trained in the use of the FTS StreamTrac/Auto Caller software must upload raw data into the database, then check all data for accuracy and completeness.

9.0 Safety

9.1 File a fieldwork plan on the Ecology SharePoint site, and send a copy to the Unit Supervisor or substitute before commencing field activities.

9.2 Be aware of potential hazards in the field. Hazards include heavy lifting, wildlife, hunting activity, weather, steep, slippery, or uneven terrain, and falling branches or trees.

9.3 Use a CB radio to communicate with other traffic on one-way logging roads. See “Driving on Logging Roads” in Chapter 2 of the EAP Safety Manual (Ecology, 2019).

9.4 All field staff are required to complete and maintain First AID/CPR certification.

10.0 References

10.1 Forest Technology Systems. 2003. DTS-12 SDI Turbidity Sensor Operating Manual, Revision 7. Forest Technology Systems, Victoria, BC. 18 pp.

10.2 Lewis, J. 1996. Turbidity-controlled suspended sediment sampling for runoff-event load estimation. Water Resources Research 32:2299-2310.

10.3 Manchester Environmental Laboratory. 2016. Lab User's Manual, 8th edition. Environmental Assessment Program, Washington State Department of Ecology, Manchester, WA. 194 pp.+

10.4 Ott Messtechnik. No date. Operating Manual Pressure Sensor OTT PS 1. Ott Messtechnik, Kempten, Germany. 27 pp.

10.5 Ecology [Washington State Department of Ecology]. 2019. Environmental Assessment Program, Safety Manual.