

Standard Operating Procedure: Continuous Monitoring of Stream Water Quality, Version 1.0

Arctic Inventory and Monitoring Network

Stream Communities and Ecosystems Monitoring Protocol

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The main Narrative for the Protocol for monitoring Stream Communities and Ecosystems and Lake Communities and Ecosystems for the National Park Service's (NPS) Arctic Inventory and Monitoring Network (ARCN) is available from the NPS ARCN website (<http://science.nature.nps.gov/im/units/arcn>).

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Version 1.0 (September 2018)

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Introduction

This Standard Operating Procedure (SOP) describes the methods for continuous monitoring of stream water quality. This SOP is a component of the Stream Communities and Ecosystems Monitoring Protocol (O'Donnell and Miller 2018). Tasks associated with this SOP include (1) programming (2) deploying, and (3) retrieving the multi-parameter sonde. Instrument calibration methods are described in detail in *SOP: Instrument Calibration for Water Quality Monitoring*.

Site Selection

Site selection is a critical component of monitoring water using continuous water-quality sensors. Many of the methods developed for continuous monitors have been modified from methods developed by the U. S. Geological Survey (Wagner et al. 2006). For the ARCN Stream Communities and Ecosystem vital sign, continuous monitoring will only be conducted in a subset of small, headwater streams in ARCN parklands. Site selection for deployment should consider the following factors:

1. ***How representative is the site with respect to variability across a stream cross section?*** To evaluate spatial variability in water quality, project staff will conduct lateral surveys across stream cross sections using a hand-held multi-parameter sonde. See detailed description of methods in *SOP: Field Measurements*.
2. ***What is the range and velocity of streamflow in this location?*** In most cases, little is known about temporal variability in streamflow at continuous monitoring sites, as discharge is not actively measured by the U. S. Geological Survey or NPS within ARCN park boundaries. However, habitat characteristics and stream channel geomorphology can help guide site selection. In particular, project staff can identify channel units (riffles, runs, and pools), and recent high-water marks. See Habitat Characteristic section of *SOP: Field Measurements* for more details.
3. ***How turbulent are conditions at this site?*** The habitat characterization survey can also serve to identify turbulent vs. non-turbulent reaches of the stream. When possible, continuous monitoring sensors should be deployed in a non-turbulent section of the stream to avoid disturbance from high-velocity flows.
4. ***Is the sonde vulnerable to damage from debris?*** Avoid deploying the continuous monitoring sensors downstream of an eroding bank for beaver dam or some other feature that might release debris and damage the sensors.

Programming Multi-parameter Sonde

Instructions for programming multi-parameter sondes will vary from one model to the next. Project staff should consult the instruction manual for their sonde to get details for customizing program

settings. Here, we provide some basic instructions for programming the Yellow Springs Instrument's (YSI) EXO2 (YSI Incorporated, Yellow Springs, Ohio): <https://www.ysi.com/exo2>.

1. Turn on the EXO2 and go to "Deployment Setup" menu.
2. Set "Log Interval" so that the sonde logs a measurement every one hour.
3. Ensure that the time zone is set for "Alaska" standard time.
4. Set a Site name where the sonde will be deployed to collect data.
5. Next go to "Start Deployment".
6. Select "Next Interval" so that the sonde will begin logging at the next specified time interval.

Deploying Multi-parameter Sonde

1. Sondes should be deployed by early June following the spring snowmelt period.
2. For all streams and rivers, measurements should be co-located with the location of water sample collection (see *SOP: Chemical Characterization of Surface Water*).
3. Prior to placing the sonde in the stream, mount it onto a fireplace grate using large zipties. This will weigh the sonde down and reduce movement during higher flows. The black square in the image below reflects the thickness dimension of the bars on the fireplace grate.



4. Next, attach one end of a length of stainless steel cable to the fireplace grate. Attach the other end to a tree or shrub or some other object (e.g. rebar) in the riparian zone. This will further prevent downstream movement of the sonde/grate during high flows and possible loss of the sonde.
5. Place the sonde in the deepest section of the designated stream cross-section that is still representative of the most of the flow. This will ensure that the sonde will remain below stage height at lower flows.

6. Be sure to measure and record four main water-quality parameters using a hand-held multi-parameters sonde. These measurements will serve as a check on continuous measurements and for calibration of continuous data sets.

Retrieving Multi-parameter Sonde

1. At the end of the field season and prior to river freeze-up, return to monitoring site to retrieve sonde.
2. Be sure to measure and record four main water-quality parameters using a hand-held multi-parameters sonde. These measurements will serve as a check on continuous measurements and for calibration of continuous data sets.
3. Upon returning from the field, clean and store sonde following standard procedures (see *SOP: Instrument Calibration for Water Quality Monitoring* for details).
4. Transfer logged data from the sonde or EXO handheld unit to your computer for data processing (see *SOP: Data Management*).

Literature Cited

- O'Donnell, J. A., and S. D. Miller 2018. Stream communities and communities and ecosystems monitoring protocol for the Arctic Network, Alaska. Natural Resource Report NPS/ARC/NRR—2018/1725. National Park Service, Fort Collins, Colorado.
- Wagner, R. J., R. W. Boulger Jr., C. J. Oblinger, and B. A. Smith. 2006. Guidelines and standard procedures for continuous water-quality monitors – Station operation, record computation, and data reporting: U. S. Geological Survey Techniques and Methods 1-D3, 51 p. + 8 attachments; accessed May 11, 2017 at <http://pubs.water.usgs.gov/tm1d3>.

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