Continuous Water Quality Monitoring

A Community Science Project

Volunteer Manual

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PROJECT OVERVIEW

Project Background

Continuous Water Quality Monitoring is a community science project developed by The Watershed Center and partners. The project has a dual aim of filling in monitoring gaps across the St. Vrain Basin and engaging community in the process. Water quality is a key indicator of watershed health. It can change depending on the season or elevation and is impacted by a changing climate as well as inputs like surrounding land use or development. Monitoring and management agencies and organizations from across the St. Vrain Basin identified water quality monitoring in the upper watersheds (canyons and foothills) as a monitoring gap that could be filled with the help of volunteers. So, The Watershed Center and Trout Unlimited St. Vrain Anglers have partnered on a community science effort to help fill this gap.

If you are reading this, thank you for joining us in this effort! The data you collect will be part of a growing database of watershed health information from across the St. Vrain Basin. In this pilot year, your efforts will also help inform future volunteer monitoring programs as we learn what works and what doesn't. We appreciate your time and your dedication!

What is expected of me?

As a volunteer with Continuous Water Quality Monitoring, you are the adopting a site and will have a short but crucial list of responsibilities:

1. **Honor your time commitment**. You will be asked to visit your site monthly, and it's important that you do your best to stick to this schedule or let us know if you're unable to.
2. **Take responsibility for your adopted site**. You will be the primary visitor to your station, so if something looks wrong or isn't working, let somebody know! We want to make sure we have the chance to iron out any wrinkles in the operation of these sensors.
3. **Follow data collection and input protocols**. We will provide you with all the direction and instruction you need, but please keep in mind that consistency is key to valuable scientific data. Following protocols helps maintain consistency of collection and record.
4. **Think critically about the data you collect**. We will also ask you to do a quick review of the data you're collecting from the sensor, and, when you do, to look twice at it to make sure everything looks okay. We'll go over things to look out for.
5. **Have fun!** Be sure and take the time to enjoy your watershed while you're out! Let the project team know of other interesting observations you make while out on your site visit.

What can I expect from the Project Team?

The project team includes leadership from Trout Unlimited St. Vrain Anglers and staff from The Watershed Center. We are here to support you and make your data actionable. As a volunteer monitor, you can expect the project team to provide technical and general support for both field and data entry tasks, as well as updates on how we use your data (analysis and reporting). Your data will be used to address both annual and multi-year trends through monitoring questions. 2023's pilot year monitoring

questions will assess the reliability and accuracy of the monitoring equipment and the feasibility of volunteer participation in the maintenance and upkeep of equipment and data collection efforts. We have no doubt our team will succeed!

Project Timeline

April 2023 - Volunteer Training

May 2023 - Sensor Installations and Monitoring Begins

Nov 2023 - Monitoring Ends

Nov-Dec 2023 - Gear Return and Project Wrap-Up

PROJECT IMPACT

Importance of Water Quality Monitoring

Water quality can cover a broad swath of metrics, from nutrients to plastics to water depth to volatile organic compounds (toxic human-made chemicals). The goal of our monitoring work is to evaluate trends in key water quality indicators. Our indicators include creek temperature, specific conductivity, water depth, and, in some locations, turbidity; these indicators give us a top-level understanding of how water quality changes. While we might not know the direct cause of a change from our data, we have metrics that indicate change and reason to investigate further. Below is a summary of our indicators and their significance.

Water Quality Metric	**Significance**
Creek Temperature	This metric is a major driver to ecological processes in the aquatic system and the impacts of varying flow regime (e.g., annual snowpack). It also has implications for impacts of water use (e.g., diverting, effluent, return flows) or human inputs like development or surrounding land use. Reduced water availability or inputs like effluent can change natural water temperature.
Water Depth	This metric captures water and habitat availability and is a major driver for water quality (e.g., the more water= the more dilution of inputs). It has implications for water use (e.g., diverting, effluent, return flows) or changing climate (e.g., annual snowpack). It also has implications for morphological changes such as channel aggradation (widening) or degradation (condensing and eroding down).
Specific Conductivity	This metric assesses the biotic and abiotic conditions of aquatic systems. This metric is the collective concentration of ions in a body of water. Inputs like road salts or mine drainage would increase the specific conductivity and indicate an impact on conditions. This metric has implications for stream

	habitat suitability and impacts of surrounding land use (e.g., abandoned mines, agriculture and urban runoff/return flows, road salts).
Turbidity	This metric assesses the biotic and abiotic conditions of aquatic systems. This metric is a measurement of how cloudy a water body is. Inputs like fine sediment from erosion, high flows, or post-fire will increase turbidity and indicate an impact on conditions. This metric has implications for stream habitat suitability and surrounding watershed process and inputs.

Monitoring Questions

What are we hoping to learn from this pilot program? Monitoring questions are foundational to all monitoring efforts. The project team will use data collected by volunteers and the sensors to assess changes in water quality over time (annually and over multiple years) and space (between sites). Since we are piloting a new project, we also have questions related to the feasibility of monitoring using the proposed methods. Here is a list of the current monitoring questions we will work collectively to answer:

1. How effective and accurate are the enviroDIY monitoring probes at collecting high quality, continuous data from May-October each year?
2. How effectively can scientists and volunteers maintain equipment, collect continuous data, and quality check data using the enviroDIY sensors?
3. How does water quality data change throughout seasons from May-October and between years?
4. How does water quality data differ among monitoring locations across and within watersheds?
5. Does post-fire or erosion impact turbidity at the James Creek or South St. Vrain Creek locations?

PROJECT LOGISTICS

Site Selection

You will be assigned one or more specific sensor sites to “adopt”. This is the site you will visit each month during sensor operation. During the training session, you will receive information on which sites are available and what the access considerations and specific needs are for each site. Based on that information, you will be asked to select which site or sites would best suit your preference. The project team will then assign sites based on all volunteer selections.

Gear List

You will be provided with a Site Visit Kit at installation. This kit will contain some of the tools you will need to maintain your sensor and site. Please keep track of these items, as they will be used at each site visit and should be returned upon project completion.

Site Visit Kit

- Backup MicroSD card
- Handheld temperature and conductivity sensors
- Staff gauge and/or ruler
- Datasheets
- Pencil
- Cleaning brush(es)
- Pruner (for clearing branches, twigs, etc out of the way)

<u>Other Materials You Might Want</u>

- Clipboard
- Smartphone or camera to take photos
- Boots or waders
- Sun protection

Station Overview

An EnviroDIY Monitoring Station consists of a few different elements, all working together to allow for collection and storage of data. Each station is made up of the following components:

- Meter Hydros 21 CTD sensor – measures water temperature, depth, and conductivity
- *Optional* Turner Turbidity Plus sensor – measures turbidity (only at some sites)
- Mayfly Data Logger – logs collected data
- Logger box – houses all components except in-stream sensor and solar panel
- MicroSD card – stores data; mounted on data logger
- Cell antenna and SIM card – transmit data in areas with cellular service
- Lithium battery – powers data logger and sensor
- Solar panel – charges battery

Data are collected automatically at a predetermined interval (usually every 15 minutes) and either transmitted via cellular signal or stored on the microSD card. In areas where data are not transmitted via a cellular network (likely the case at the majority of our sites), it will be part of your job at each site visit to retrieve the microSD card in order to collect stored data. You will be provided with a spare card to

swap out for the full one. If your station is using cellular signal, a microSD card will still be provided and may need to be retrieved if there are issues with transmission.

Site Visit Overview

There are two types of site visits you'll conduct throughout the year. First, there is a **monthly site visit**. This is largely to clean the in-stream sensors and make sure nothing has been damaged, as well as to collect stored data in the form of a microSD card. The second type is a **quarterly site visit,** which will (in addition to your regular sensor-cleaning tasks) involve taking several on-site measurements to compare to the sensor-reported measurements. These will be used to determine whether the sensor is working properly or in need of calibration.

Monthly Site Visit

1. **Inspect your station and perform necessary maintenance actions**. Lots of little things have the potential to interfere with data collection, so good site maintenance is key.
2. **Clean your sensor(s)** in the stream. Step-by-step instructions below.
3. **Swap the microSD card** if cellular data transmission is not available for your site.
4. **Fill out the datasheet** with your findings.
5. Once at home, **download data** from the microSD card to your computer and save. Instructions below.
6. **Email** your downloaded data files to the project team.
7. Don't forget to **review your data each month**!

Quarterly Site Visit

1. **Conduct steps from the Monthly Site Visit** section (above).
2. **Take secondary measurements** to compare to station-reported data. Step-by-step instructions below.
3. **Record your measurements** on the datasheet.
4. Once home, take time to **look up the corresponding sensor-reported data** (whether they were reported automatically online or you had to manually collect them via microSD card). Record these sensor-reported data on your datasheet so they can be compared with the secondary measurements you took at the site.
5. Access our project page on CitSci.org and **enter your recorded data** into the online datasheet.
6. **Take a photo or make a scan** of your paper datasheet and email to the project team along with any downloaded sensor data.

Site Maintenance

When you arrive on site, check out your logger box and the area around it. Is there vegetation shading the solar panel so it can't charge the battery in the logger box? Has wind disrupted the logger box setup? Has anything gone missing or gotten damaged? Please fix or record (and let the project team know about) anything you see amiss.

Some things to look out for:

- Dust, debris, or snow collecting on the solar panel
- Vegetation blocking the solar panel
- Moisture in the logger box (the box is waterproof, but should be opened periodically to check everything is dry)

Helpful hint: when closing the logger box, always double check to make sure no vegetation or debris has been caught in the seal. A broken seal could introduce moisture into the logger box, damaging the electronics inside!

Clean Your Sensor (Monthly Site Visits)

Sensor cleaning should take place at your monthly site visits. You should be able to complete sensor cleanings without removing the sensor bundle from the stream; in fact, we recommend it! Removing and reinstalling the sensor bundle can result in a disruption of data collection.

To clean the sensors in-stream:

1. Before cleaning the station, take care to **ensure that cleaning does not take place while the sensor is recording a measurement**. This can either be accomplished by turning the station off or cleaning the sensor during the interval between measurements.
2. **Clear all accumulated debris on the stream bottom** away from the sensors using hands and feet or a tool if necessary.
3. **Remove all large pieces of material (leaves, sticks) from the sensor bundle** by hand or with the long bristles of the sensor brush.
4. Use the longer bristles of the sensor brush to **gently clean the side slot under the CTD sensor**.
5. *Carefully* **clean around the pressure transducer** (the white disc on the CTD sensor cable - this can be easily damaged, so take care!).
6. Use the long bristles to **gently clean the four screw heads inside the side slot** (these are the points at which conductivity is measured, located on the bottom of the sensor).

   Note: Trapper gloves (such as these) are a recommended purchase for winter station maintenance.

Take Secondary Measurements (Quarterly Checks)

Secondary measurements are taken quarterly to ensure sensors are working and recording data correctly. You will use these measurements to compare what you've observed in the field to what the sensor is reporting. You can do this by comparing your readings to those reported online (for sensor stations with cell service) or sensor readings collected from an SD card (for stations without cell service). When you're taking secondary measurements in the field, make sure to record the date and time on your datasheet so you can reference the corresponding sensor readings from the same time period in order to cross-check measurements.

Secondary measurements include:

- A **temperature** reading
- A **conductivity** reading
- A **depth** measurement

A certain level of error is inherent in monitoring station sensors and in all handheld sensors, so there is no defined limit specified for what is acceptable in terms of variability in these measurements. If something looks wrong, let someone know that your sensor may not be working properly. If you're unsure whether something is a problem, just ask!

Temperature

Temperature should be measured within a foot of the sensor location. Place the provided probe in the stream and wait for the temperature measurement to stabilize, then record your measurement. Make sure to measure temperature using the same temperature scale your station reports water temperature in (typically Fahrenheit).

Generally, if your handheld sensor measurement deviates more than 2 or 3 degrees Fahrenheit from the sensor station, you should consider troubleshooting potential sensor issues.

Conductivity

Check to make sure your conductivity probe is correctly calibrated before using it to take a measurement.

Conductivity should be measured within a foot of the sensor location. Place the provided probe in the stream - ensuring you have completely submerged the probe - and wait for the measurement to stabilize, then record your measurement.

Generally, if your handheld sensor measurement deviates more that 30-40 us/cm from your sensor station, you should consider troubleshooting potential sensor issues.

Depth

Using a ruler or depth rod, carefully measure water depth directly adjacent to the sensor.

Note that your depth measurement will likely not be exactly the same as that of the sensor. The station sensor is not designed for high-precision depth measurements, but is better suited to tracking changes in depth over time. As long as your measurement is off by a similar amount each time you take a measurement, we can track change using this method to learn whether the depth sensor is operating correctly.

Data Entry

As a volunteer, you will use multiple forms of technology to collect and enter data. You will most likely be collecting two types of data from your sensor station:

1. **Volunteer-collected data**, consisting of secondary measurements taken on site at your Quarterly Site Visits.

2. **Sensor-collected data**, which are either transmitted via cellular signal or, more likely, hand-collected from a MicroSD card store in the station's logger box.

Both of these types of data will ultimately end up in online databases, which will allow for public review of the data and easy access to the data for professionals interested in water quality at your site. For your volunteer-collected data, however, you will also be asked to use and store a paper datasheet. This paper copy will provide a data backup in the event of any technological failures. After completing your paper datasheet in the field, you will then transfer your volunteer-collected data directly into the online datasheet on the citsci.org website. Between the two forms of data storage, we hope to minimize data loss!

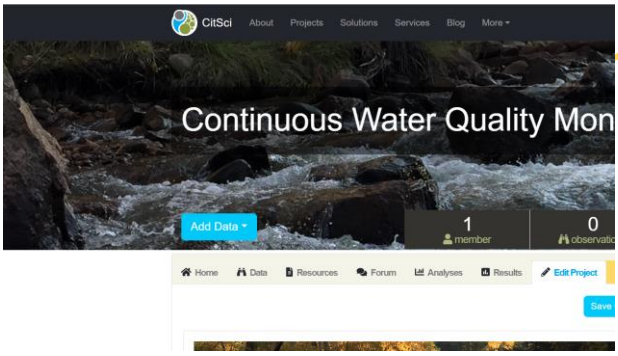
Volunteer-Collected Data

These are the data that you will fill out on your datasheet in real time at your station. Later, you will enter your datasheet contents into an online datasheet on CitSci.org. The paper datasheet will be provided to you, or you can print new copies using the link in the Resources section at the end of this manual.

Once you have filled out the paper datasheet and are ready to transfer your info into the online database, access the project website at https://citsci.org/projects/continuous-water-quality-monitoring. If this is your first time contributing data, you will need to request to join the project. We recommend doing this in advance so you don't have to worry about waiting on your request when you have data ready to add!

If you don't have one already, you will need to create a username and login for CitSci.org before you can proceed any further. Then navigate back to the project page (linked above) and request to join the project.

Once logged in and on the project page, data can be uploaded via the blue "Add Data" button near the top left-hand corner of the project home page. You will find an electronic datasheet there containing the same fields as your paper datasheet. Please transfer your data here. You will then **scan or snap a photo of your paper datasheet** and send it to the project team along with your sensor-collected data (see below).



Click here to add data on CitSci.org

Sensor-Collected Data

If data at your site is being transmitted via cellular signal, this section will often be irrelevant to your work. That said, it is good practice to check your station online at MonitorMyWatershed.org to ensure it is transmitting properly. If not, you will need to follow the steps below to collect data manually.

If your station lacks cellular service, you will need to upload data manually to MonitorMyWatershed.org.

Once you have collected your MicroSD card from the logger box at your station, you will upload data from the card onto your computer using the following steps:

1. Insert microSD card into a standard SD card adapter.
2. Insert adapter into appropriate port on computer.
3. Save data file to secure hard drive or server with the recommended format: SL#_mm-dd-yy.
4. Delete data from microSD card for return to Mayfly Data Logger.

Once you have the data on your computer, this will need to be uploaded to MonitorMyWatershed.org. For now, as we explore all the features of this platform, you can accomplish this by simply **emailing your data to the project team**. Don't forget to include the photo or scan of your paper datasheet!

At a later date, you may be asked to take on this step yourself. The project team will provide directions and support for this.

RESOURCES

Project Team Contact Information

When you need help with your monitoring, something needs reporting, or you have questions, contact the project team!

Maria Pezza - The Watershed Center

mpezza@watershed.center

303-746-6600 (cell)

Helpful Links and Resources

Datasheet: https://docs.google.com/document/d/1FaPUOhNYguphPMo

EnviroDIY (sensor station) Manual: https://www.envirodiy.org/kbcategory/monitoring-station-manual/