MiCorps

Volunteer Stream Flow Monitoring

Project Procedures

2016 Field Season (Pilot)

Developed by

Huron River Watershed Council (HRWC) and the

Great Lakes Commission (GLC)

for the

Michigan Department of Environmental Quality (DEQ)

A. Introduction

The amount of water flowing down a stream or river is an important condition of a stream that controls almost all aspects of a stream's ecology. Water flow directly controls the amount of material (such as nutrients and sediment) that a stream is able to transport, which has consequences on both the stream itself as well as any downstream receiving waterbody. Also, the amount of water flowing in a stream directly controls what types of aquatic life can and cannot live there. While some amount of fluctuation in water flow is normal for most streams, extremely high flows or low flows will disrupt the habitat and the lives of everything that lives there. Therefore, tracking the amount of water flowing in a stream is of particular importance when determining how to best care for and manage these systems.

The amount of flowing water in a stream is often referred to colloquially as stream flow, or to be more technically accurate, stream discharge. Discharge is defined as the volume of water moving down a stream or river per unit of time. In the United States, the standard unit of discharge is cubic feet per second, abbreviated as "cfs". Occasionally discharge may be expressed as gallons per day.

Starting in 2016, the Michigan Clean Water Corps (MiCorps) is launching a volunteer-based Stream Flow Monitoring project. The following document provides the sampling effort, equipment, and procedures needed to conduct stream flow measurements in accordance with MiCorps protocols.

B. Required sampling effort

1. MiCorps grantees must commit to monitoring at least 10 sites per summer. The sites should be chosen in consultation with the DEQ prior to the start of the project. The DEQ is particularly interested in small streams (<30 feet in width).

2. For each site:

- Three measurements must be taken at each site from July 1 through September 30.
- Each measurement must be at least two weeks apart.
- Measurements are made at baseflow conditions (no less than 3 days without significant rain, or more days based on local knowledge of the stream. Many streams may take multiple days after a storm before they return to baseflow conditions).
- At least two different sets of people must take these measurements.
- Additional measurements can be also be taken at differing flow conditions to meet specific data needs.

3. Quality Control.

During each field season, three additional measurements must be taken at a USGS gauge, for quality control purposes. Baseflow measurements are not required. If the measurements are made at the same location they must be at least two weeks apart. If the measurements are made at different locations they can be done at any time, even on the same day. The USGS sites do not count towards the minimum 10 sites required by a grantee.

A completed Stream Flow Monitoring Calculations Worksheet (https://micorps.net/wp-content/uploads/VSMP-StreamFlow-Calcs.xls) giving the measured flow and the USGS flow must be emailed to Paul Steen, MiCorps Program Manager (psteen@hrwc.org). This will be used to keep a long term record of MiCorps measurements against USGS measurements. It is expected that the difference between MiCorps measurements and USGS measurements will not exceed 20%, but given the new nature of this program this data quality standard has yet to be evaluated.

Groups who do not conduct this data quality check each year will not be permitted to submit data to the MiCorps Data Exchange.

C. Equipment.

For the 2016 field season, some equipment will be provided to the MiCorps grantees. The equipment will remain the property of the DEQ and must be returned at the end of the project.

Provided to grantees:

1. 100 ft reel tape measure (incremented in tenths of feet)
2. Stakes
3. Water Velocity Meter (also known as a Flow Meter)

Not provided to grantees:

1. Clipboard
2. Pencil or water-insoluble ink (i.e. black sharpie)
3. Datasheet (https://micorps.net/wp-content/uploads/VSMP-StreamFlow-Datasheet.pdf)
4. (Recommended) Loppers, small hand-saws, and other simple brush clearing equipment

D. Procedures

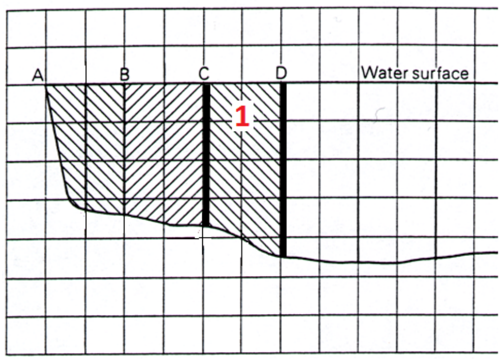
This methodology is derived from Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A8. Discharge Measurements at Gaging Stations, 1969.

In this methodology, the stream channel cross section is divided into numerous vertical subsections. In each subsection, the area is obtained by measuring the width and depth of the subsection, and the water velocity is determined by the current meter. The discharge in each subsection is computed by multiplying the subsection area by the measured velocity. The total discharge is then computed by summing the discharge measurements of each subsection.

A subsection’s velocity and depth is not determined by measurements at a single point, but is rather the average measurements of the two points.

Example

A,B,C, and D = locations of tape measure reading, depth, and water velocity



For subsection 1:

Width (feet) = Distance from C to D

Depth (feet) = Average depth of C and D

Velocity (feet/sec) = Average velocity of C and D

Discharge of Subsection 1 (cubic feet per second, cfs) = Width x Depth x Velocity

Total Discharge (cfs) = Sum of all subsection discharges

Procedure:

1. Pre-Measurement Steps

a. Print out the MiCorps Stream Flow Monitoring Datasheet (https://micorps.net/wp-content/uploads/VSMP-StreamFlow-Datasheet.pdf), or bring a portable device that is running the MiCorps Stream Flow Monitoring Calculations Worksheet (https://micorps.net/wp-content/uploads/VSMP-StreamFlow-Calcs.xls).

b. Location is important. Find a section of straight flowing water (do not do this around bends). Remove logs, branches, leaves, and anything else that could impede stream flow for 20 feet upstream and downstream of the intended cross sectional area. Give the stream 10 minutes to settle before taking measurements.

c. Stretch the measuring tape across the stream perpendicular to the stream channel. Stake the tape down at both sides. Make the measuring tape taut so that it doesn't sag near the middle.

d. Record the total stream width on the datasheet.

e. Adjust the settings of your water velocity meter to require 40 second time intervals in the calculation of average water speed (refer to the meter's user manual).

2. Measuring Water Velocity, Width, and Depths of Subsections

a. Divide the stream width by 20 to calculate the width of each stream subsection. For example, if the stream is 40 feet wide, then each subsection will be 2 feet wide. Record this width on the datasheet ("Expected Subsection Width").

In some cases, the person measuring can decide to alter the subsection widths, under the following circumstances:

- In streams less than 8 feet wide, the subsections widths should be 0.4 feet. This will result in having less than 20 subsections, which is acceptable on these narrow creeks.
- If there is a lot of variation in the depth or water velocity of the cross section, it is appropriate to resize the subsection widths to be bigger or smaller. They can be wider if there is little change in depth or water speed in a particular place along the cross-section, or can be smaller if the depth or water speed changes greatly. In other words, it is not a hard rule that intervals all need to be the same size. (To get the most accurate results, each interval should contain at least 5% of the water flowing through the creek and no more than 10%, but because these percentages cannot be determined until after the measurements are done, this guideline is only something to keep in mind).

b. Starting at either bank, at the water's edge, record the reading on the measuring tape (to the nearest hundredth of a foot), the water depth (to the nearest hundredth of a foot), and the water velocity (feet per second). Often, the water depth and water speed may be zero or close to it at the water's edge, but streams with right angle banks (drop-offs) can have a depth and detectable water speed at the water's edge. Ignore the water underneath an overhanging bank.

c. Move the flow meter to the next subsection and repeat the measurements. Continue this process until all of the subsections have been measured. The final measurement will be at the water's edge on the other side of the stream.

- **NOTE:** In order to get X number of subsections, X+1 measurements will be required. This is because every subsection needs two sets of tape measure, depth, and velocity measurements. Examples: A narrow creek only big enough to have 14 subsections will require 15 measurements. A creek big enough to have 20 subsections will require 21 measurements.

d. Use the Stream Flow Monitoring Calculations Worksheet to automatically calculate subsection and total discharge based on the measured depths, widths, and water velocities. (https://micorps.net/wp-content/uploads/VSMP-StreamFlow-Calcs.xls)

3. Rules for measuring water speed

a. When measuring water speed, stand an arm's length away on the downstream side of the tape measure and hold the meter next to the tape measure. Stand far from the meter to ensure that eddies around your boots and legs are not interfering with the flow measurement.

b. Keep the meter's sensor or propellers facing perpendicular to the stream channel. (If it appears that the water flow is not coming straight down the channel, **do not** rotate it in the direction of where you perceive the flow coming from).

c. Keep the meter upright.

d. Measuring water speed takes time. The meter stays in the water current for 40 seconds. During this time, the meter calculates the average water speed, and when the time is up the meter will display the result.

e. The sensor of the water velocity meter needs to be kept at a particular depth during the 40 second period.

- **In water less than 1.5 feet deep**: Set the velocity meter sensor at 60% of the total depth. Formula: Depth of sensor = Measured Depth – (Measured Depth * 0.6).

  Example: At 1 foot water depth, 60% of the total depth is 0.4 feet. (Not 0.6 feet! This is a common mistake. Be sure to think of the 60% depth as 60% down from the surface.)

- **In water 1.5 feet deep or greater**: Two water velocities are measured, at 20% and 80% of the total depth. The two velocities are averaged to achieve a final velocity.

  Example: At 2.5 foot water depth, 20% of the total depth is 2 feet and 80% of the depth is 0.5 feet.

- Note: Topsetting rods are designed to easily position the sensor at the 60% depth. Meters without a topsetting rod (like the Global Flow Probe that the MiCorps grant provides) require the user to manually hold the meter at the proper depths. On the Global Flow Probe, put a bright colored rubber band where the meter touches the water surface, to help the user keep the meter steady.

E. Data Entry

For the 2016 field season, data entry via the online MiCorps Data Exchange will not be available. You must email all results to MiCorps Program Manager Paul Steen (psteen@hrwc.org) using the Stream Flow Monitoring Calculations Worksheet linked in the procedures above.