DISCHARGE MONITORING

VELOCIMETRY METERING OTT MF PRO

PACIFIC SALMON FOUNDATION

Velocity metering is a method used to measure stream discharge (flow rate) that utilizes the velocity-area approach. It relies on the principle that discharge is the product of the average velocity of stream flow and the cross-sectional area of the flow. Velocity metering is generally intuitive and can be used in a variety of stream conditions. A current meter is used to measure the average velocity. The OTT MF Pro is considered one of the most advanced current meters available for stream flow monitoring. It is portable, provides results in real-time, and is highly accurate in many stream conditions. The SonTek FlowTracker2 (see related summary) is a good alternative to the OTT MF Pro, with each having specific advantages.

SUMMARY OF METHOD

There are four main steps involved with discharge measurement using the OTT MF Pro:

1. **Site selection:** Identify suitable stream cross-section for metering. This step is critical to obtaining accurate and representative flow measurements. The ideal cross-section is on a straight section of stream with adequate flow depth and width, has steady and unobstructed flow, has a uniform flow profile across the stream, and can be accessed safely. Typically, a survey pin is installed on each side of the stream for establishing a permanent cross-section.

2. **Set-up:** Divide the cross-section into smaller panels (i.e., water columns) (typically 20, depending on desired data grade) for measuring velocity in each panel. Ideally, individual panels should account for no more than 10% of the total flow.

3. **Measurement:** Use the current meter to measure velocity mid-way across each panel and at a specific depth below the water surface (depends on the total flow depth; 60% below surface in a 1-point measurement when depth <0.75 m; 20% and 80% in a 2-point measurement when depth >0.75 m).

4. **Data processing:** Calculate the average velocity for each panel, multiply by the cross-sectional area of the panel (width x mean depth), then sum these values for all panels to obtain the total discharge. OTT MF Pro executes this step internally.

Photo credit: Ott Hydromet

IMPORTANT CONSIDERATIONS

The OTT MF Pro measures water velocity using electromagnetic induction, detecting a voltage induced by conductive water flowing through a magnetic field. This voltage is then converted into velocity. Accuracy can be impacted when operating in close proximity (~1 m) to iron material (e.g., culvert, metal grate, rebar).

Accuracy also decreases with decreasing electrical conductivity (EC) of the stream water. The velocity error is ~1% at EC values of 40 µS/cm, and ~4% at 10 µS/cm. Most streams in British Columbia have much higher EC. The main exceptions are watersheds with granitic bedrock (common in the Lower Mainland), and glacier-fed streams during the summer.

For safety, it is recommended to avoid wading across a stream wherever the product of depth (m) and velocity (m/s) exceeds 0.8 (USGS 2008, WSC 1981). Additionally, safe stream access may be impeded by a muddy bed.

The method can be used for measuring discharge under ice cover, requiring holes to be cored through the ice. Complete removal of the ice across the stream should be considered where contact between the ice and the water surface is discontinuous.

STREAM CHARACTERISTICS

- Can measure velocities from 0.001 to 6.0 m/s
- Requires minimum flow depth of 0.03 m
- Works well in high sediment conditions and highly turbulent flow, and near aquatic vegetation
- Performance can be impacted in close proximity to iron material and in low electrical conductivity water (low dissolved solids)
- Can be implemented under ice cover

MEASUREMENT CHARACTERISTICS

- Manual data acquisition
- Summation of multiple point measurements across stream
- Point measurement along stream network

SITE ACCESSIBILITY FACTORS

- Suitable for remote foot access
- Limited by safety of wading across stream
- Minimal equipment for initial set up
- Ongoing monitoring involves medium-sized equipment (e.g., 1.2-1.8 m wading rod)

SCALE OF EFFORT: INITIAL SET UP

Equipment cost: moderate
Field time: low; <2 hrs
Field expertise: moderate

SCALE OF EFFORT: ONGOING MONITORING

Equipment cost: negligible
Field time: low; ~1 hr
Field expertise: moderate
Analysis time: negligible
Analysis expertise: negligible

PRODUCTS TO CONSIDER

Current meter: OTT MF Pro

ADDITIONAL RESOURCES

Community Flow Monitoring Network, 2023
Dobriyal et al., 2017
Lapp, 2023
OTT Hydromet, 2018
Resources Information Standards Committee, 2018
Water Survey of Canada, 2015a,b,c
World Meteorological Organization, 2010