Measuring Stream Discharge Using the USGS Midsection Method

Equipment

Flow-measurement equipment required includes: (1) current meter or flowmeter, (2) top-setting wading rod (marked in tenths of a foot), and (3) tape measure or tagline (marked in tenths of a foot) (4) waders, (5) data sheet, (6) also bring a clipboard, notebook, and a calculator. The current meter or flowmeter brands or equivalent can be: Marsh-McBirney electronic, Montedoro-Whitney electronic, Flowmate Price pygmy (with timer and beeper), Price meter, or Type AA (with Columbus weight). Geology uses Marsh-McBirney.

Stream Measurements

The first step in streamflow measurement is selecting a cross section across the total width of the stream. Select a straight reach where the streambed is uniform and relatively free of boulders and aquatic growth. The flow should be uniform and free of eddies, dead water near banks, and excessive turbulence. Choose a point on the bank as your bank reference point. Fix the measuring tape at the reference point. Stretch a tape across the channel keeping that the tape perpendicular to the stream flow, and fix the tape on the opposite bank. Determine and **record** the width of the stream surface.

Determine the spacing or width of the verticals. If the stream width is less than 5 ft, use vertical spacing widths of 0.5 ft. If the stream width is greater than 5 ft, the minimum number of verticals is 10 or 25 (according to agency guidelines). The preferred number of verticals is 20 to 30. The location of the metering sites need not be equally spaced across the stream. The locations should be more closely spaced where water depth or velocity are changing most rapidly (near the center of the steam) to ensure that no more than 5 or 10 percent of the total discharge occurs within a single subsection (according to agency guidelines).

Starting at the first metering station in the stream (b_2) (see attached figure)

- record the tape distance from the bank reference point to the station.
- face upstream (stand at least 1.5 ft downstream and off to one side of the flow sensor) and lower the wading rod to the channel bottom; record its depth at the station (d_2).
- if the water depth is greater than 2.5 feet, then measure the velocity at two points 0.2 and 0.8 of the depth below the water surface. These two points will be averaged.
- if the water depth is less than 2.5 feet, then measure the velocity at one points 0.6 of the depth below the water surface.

The wading rod should be kept vertical and the flow sensor kept perpendicular to the tape rather than perpendicular to the flow while measuring velocity with an electronic flowmeter. When using a pygmy meter, the instrument should be perpendicular to the flow. Move to the next verticals (b_3, b_4, b_5, … b_n) and repeat the procedure until you reach the opposite bank.

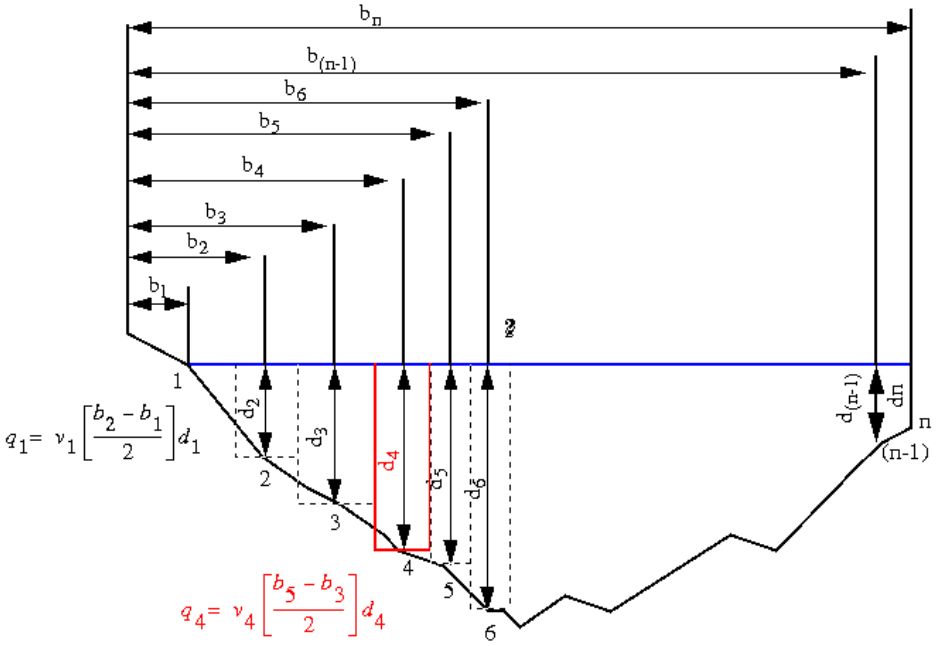
Data Analysis

After making you field measurements, complete the Stream-Discharge Data Sheet in Excel using the USGS midsection method (see below).

Midsection Method

The USGS uses the midsection method of computing stream discharge using current meter velocity measurements. In this method, the stream cross section is divided into rectangular subsections. At the center of each of these subsections (called a vertical), a depth and velocity measurement is made, and the distance from a datum point on the shore is determined.

Sketch of midsection method for computing discharge



Explanation

1,2,3 .....n --Observation verticals

$b_1, b_2, b_3, ...b_n$ --Distance from initial point to observation vertical

$d_1, d_2, d_3, ...d_n$ --Depth of water at observation vertical

Dashed lines --Boundaries of subsections

$$Q = q_1 + q_2 + ... q_n$$

Error: No more than 5 to 10% of the total discharge should occur in any one subsection. When reporting your cubic feet per second (cfs) values, use USGS precision, e.g.,

< 1 cfs	to nearest 0.01 cfs
1 to 9.9 cfs	to nearest 0.1 cfs
10 to 999 cfs	to nearest 1 cfs
> 1000 cfs	to nearest 3 significant figures

Stream Name:	**Date**	**Time**
Weather:		
Researchers' Names:		
Staff Gauge Water Level (to closest 0.01 ft.)		

	Distance from Bank (10ths of a ft)	**Stream Depth** (10ths ft)	**Velocity** (ft ^{3}/s, or cfs) At 0.6 of the depth	**Comments**
	Estimate to the closest 0.01 ft.	Estimate to the closest 0.01 ft.	20 or 40 second average	*Right bank, left bank, stone in stream affecting flow, etc.*
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