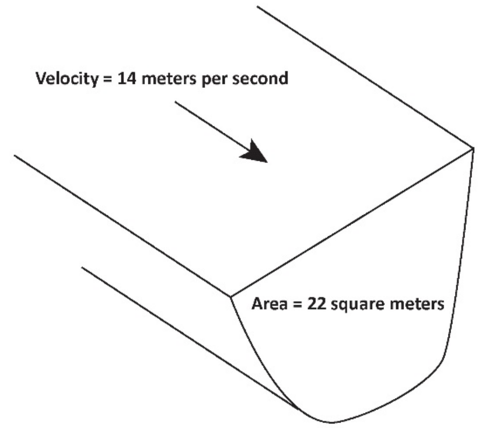
GEOL 106: Earthquake Country
Activity 08: Discharge Measurements

Name: ____ **Date:** ____________________

Discharge Calculation

Discharge = Velocity X Area or Q = VA

Calculate the Discharge for the measurements shown at the right. Q = __________________



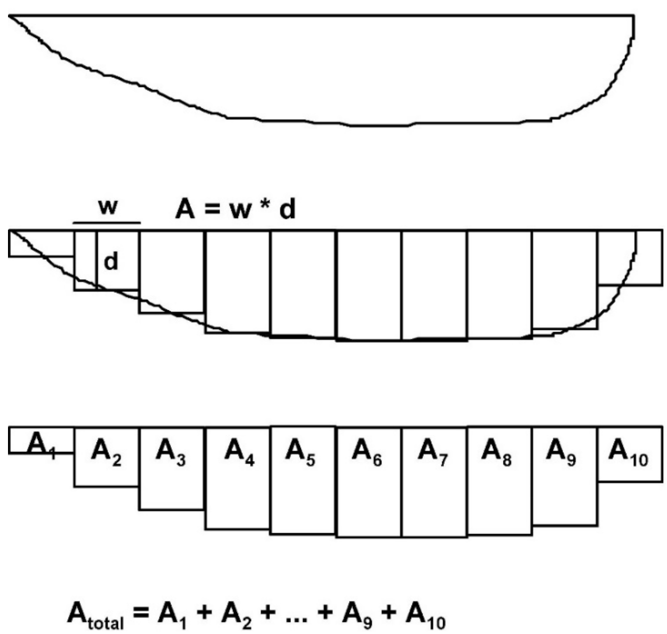
Discharge Measurement

Do not collect water samples in the area disturbed during a flow measurement. At sites with a USGS flow gage, observe and record the gage height to the nearest hundredth of a foot in the field logbook.

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.

A current-meter measurement is the summation of the products of individual subsection areas of the stream cross section and their respective average velocities. In the mid-section method of computing a flow measurement, it is assumed that the velocity sample at each vertical represents the mean velocity in the individual subsection areas.

Determining the Number of Flow Cross Sections



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. Determine the width of the stream by stringing a measuring tape from bank to bank at right angles to the direction of flow. Next, determine the spacing or width of the verticals. Space the verticals so that no subsection has more than 10 percent of the total discharge. 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 to 25. The preferred number of verticals is 20 to 30.

Determining the Mid-Point of the Cross Section

To determine the mid-point of a cross section, for example, divide the cross section width in half, if the total stream width is 26 feet with 20 cross sections and each cross section width is equal to 1.3 feet. Divide 1.3 feet in half and the mid-point of the first section is 0.65 feet. In this example, the tape at the water's edge is set at zero feet. By adding 0.65 to zero, the mid-point of the first section is 0.65 feet. Each subsequent mid-point is found by adding the section with (1.3 feet) to the previous mid-point. For example, the first mid-point = 0.65+0.0 = 0.65 feet; the second mid-point = 0.65+1.3 = 1.95 feet; the last midpoint = 24.05+1.3 = 25.35 feet.

Adjusting the Sensor Depth at a Cross Section

Adjust the position of the sensor to the correct depth at each mid-point. The purpose of the top setting wading rod is to allow the user to easily set the sensor at 20%, 60% and 80% of the total depth. The total depth can be measured with the depth gauge rod (see Figure 2). Each single mark represents 0.10 foot, each double mark represents 0.5 foot, and each triple mark represents 1.00 foot.

Depths < 2.5 Feet: If the depth is less than 2.5 feet, only one measurement id required at each measurement section. To set the sensor at 60% of the depth, line up the foot scale on the sliding rod with the tenth scale on the top of the depth gauge rod. For example, if the total depth is 2.0 feet, then line up the 2 on the foot scale with the 0 on the tenth scale.

Depths >2.5 Feet: If the depth is greater than 2.5 feet, two measurements should be taken at 20% and 80% of the total depth. To set the sensor at 20% of the depth, multiply the total depth by two. For example, the total depth is 2.7 feet the rod would be set at 5.4 feet. Line up the 5 on the foot scale and the 4 on the tenth scale.

To set the sensor at 80% of the depth, divide the total depth by two. For example, the total depth is 2.7 feet the rod would be set at 1.35 feet. Line up the 1 on the foot scale with the 0.35 on the tenth scale. The average of the two velocity measurements is used in the flow calculation.

Measuring Velocity

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 vertical and repeat the procedure until you reach the opposite bank.

Calculating Flow

Once the velocity, depth, and distance of the cross section have been determined, the midsection method can be used for determining the discharge (formula in fig. 1). Compute the discharge in each increment by multiplying the averaged velocity or single velocity in streams less than 2.5 ft deep in each increment by the increment width and averaged depth (or single depth in streams less than 2.5 ft deep). (Note that the first and last increments are located at the edge of the stream and have a depth and velocity of zero.) Add the discharges for each increment to compute total stream discharge. Record the flow in liters (or cubic feet or cubic meters) per second in your field book.

Note stage height: 3 feet

Stream	Jones Creek				
Station Description	This discharge measuring station is approximately 100 meters upstream of the summer low bridge of Jones Road which crosses Jones Creek east of Salem, Oregon.				
Time Begin	16:00	Time Ended	16:19	Meter Type	Price
Observers	Maria Hernandez (USGS) and Jim Page (HSU volunteer)				
Stream Width[1]	3.3 ft				
Observations: (m or **ft**) It was raining today, so we will take another cross section tomorrow.					

Station	Section Midpoint	Section Depth	Observational Depth[2]	Velocity		Area	Flow
				At Point	Average	W X D	Q
	m or ft	m or ft	m or ft	m/s or f/s	m/s or f/s	m^2 or ft^2	m^3/s or ft^3/s
1	0.3	0.3	0.195	0.5	0.5		
2	0.6	1	0.65	0.7	0.7		
3	0.9	1.5	0.975	0.9	0.9		
4	1.2	2	1.3	0.9	0.9		
5	1.5	2.5	0.5 2	1.3 1.1	1.2		
6	1.8	3	0.6 2.4	1.1 1	1.05		
7	2.1	2.8	0.56 2.24	0.9 0.7	0.8		
8	2.4	2	1.3	0.6	0.6		
9	2.7	1.5	0.975	0.6	0.6		
10	3.0	0.5	0.325	0.5	0.5		

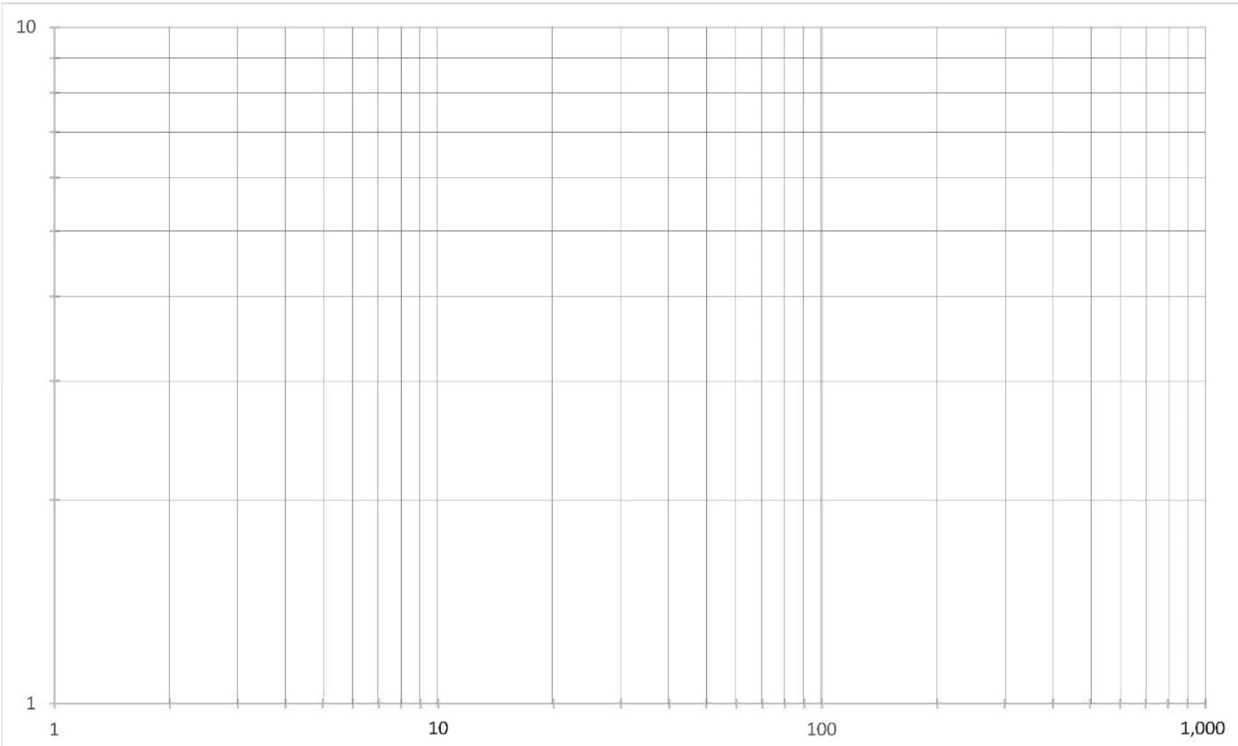
What is the total Cross Sectional Area (show units): _________________________

What is the total Discharge (show units): _____________

Show your work:

Plot on Stage-Discharge Rating Curve

Take your Total Discharge Data and Plot on the Rating Curve below (use a star symbol):



Plot entire table (to the right) on the Stage-Discharge Rating Curve above (use large dot symbols). Draw a correlation line through your data points. Label the horizontal and vertical axes.

Take a given stage number, what is the Discharge? List the discharges for these given stage heights:

Stage Height	Discharge
3.2	________
1.5	________
1.0	________
3.8	________
5.2	________
6.1	________
9.5	________

Flood Number	Stage	Flow
		Q
	m/ ft	m^3/s or ft^3/s
1	3	24.5
2	4	120
3	2	3.8
4	5	300
5	4.5	200
6	3.3	40
7	2.4	5
8	3.5	60
9	5.5	400
10	8	800