

Exercise 27: The Stream Channel Cross Section

Introduction

A stream flows in a channel, often bordered by a floodplain, both measurable features.

Question Set 47: Plotting a Channel Cross Section

Measurements were made at the Seneca Creek gaging station near Dawsonville, Maryland, located on Figure 60. The east-west cross-sectional data of the stream at that station are given in Table 3.

- i. On Figure 61, plot these data to show the Seneca Creek cross-channel section. The east point has been plotted.
- ii. What is the vertical exaggeration (see Exercise 4) of your cross section? Vertical exaggeration = X10
- iii. On the cross section, label the following features: a. The main channel; b. The floodplain; and c. The natural levee. (Note: The west bank is very steep.) SEE ATTACHED ✓
- iv. The **bankfull stage** of a channel is reached when waters fill the channel to its brim before spilling over its banks onto the floodplain.
 - a. Draw a line and label it at the bankfull stage on your plot (Figure 61). ✓
 - b. What is the bankfull width of the channel at this location? 80 ft
 - c. What is the elevation of the bankfull stage? 226 ft
- v. Determine the average depth of the bankfull channel by measuring the depth at 10-foot intervals across the channel. Begin on the west bank of the bankfull channel. Record your measurements below. The first value is given.

Distance from West Bank of Bankfull Channel	Depth (ft)
10	4.5 ✓
20	6.0
30	6.1
40	6.2
50	6.8
60	7.2
70	6.0
80	0.0 N/A
Average depth (ft)	= <u>6.1 ft</u> <u>AREA</u>

vi. The bankfull cross-sectional area of the Seneca channel is its bankfull stage width multiplied by the average depth. Determine the bankfull cross-sectional area.

$Width (ft) \times avg\ depth (ft) = area (ft^2)$
 $80\ ft \times 6.1\ ft = 488\ ft^2$

Area per GRID SQUARE
 $(1\ ft) \times (10\ ft) = 10\ ft^2$ NO. GRID SQUARES \times SQUARE AREA $= 400\ ft^2$

$3.5 + 7.1 + 6.8 + 6.1 + 6.0 + 5.8 + 3.8 + 0.2 = 39.3$

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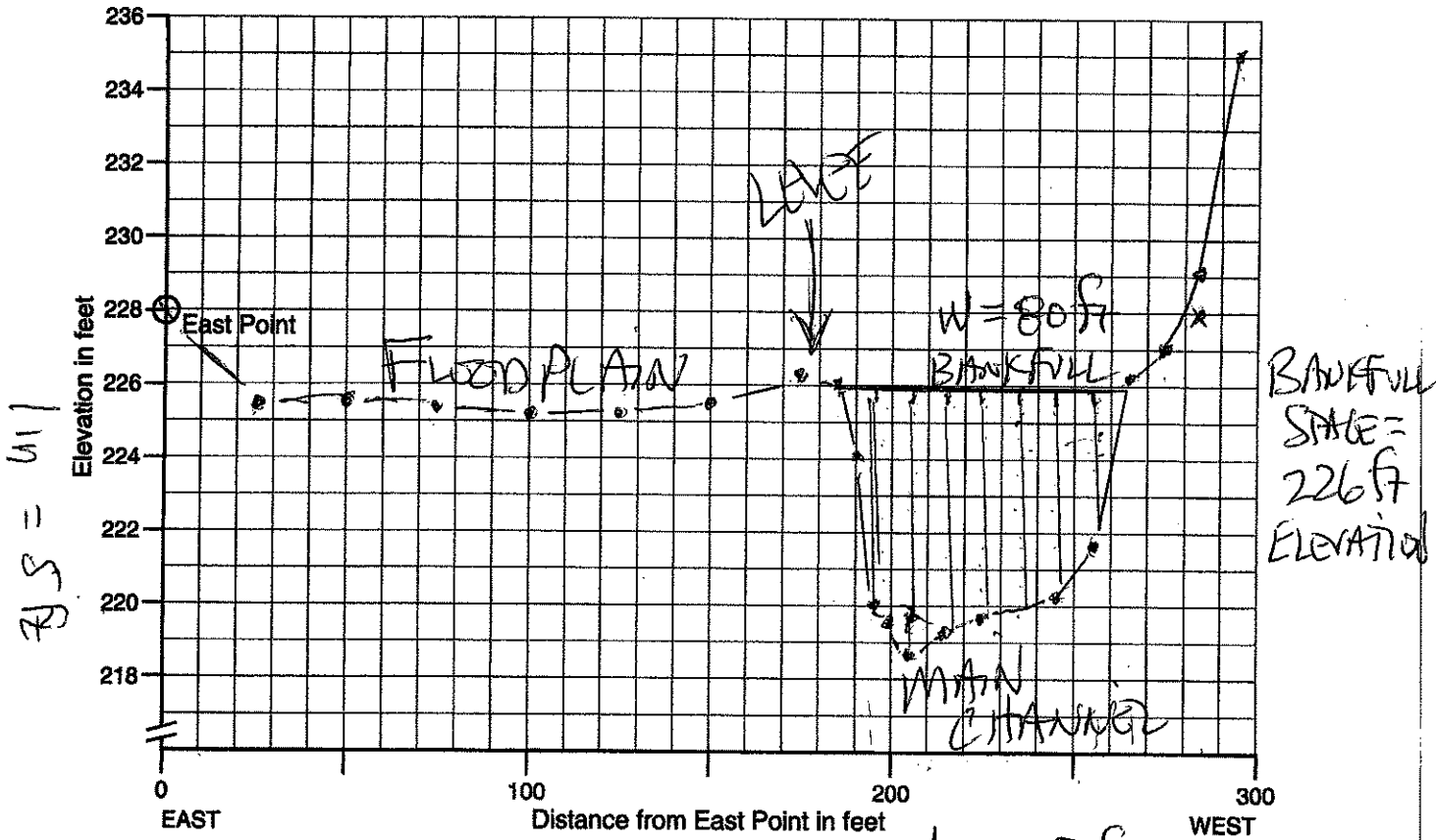


Figure 61. Graph for plotting cross-channel section, Seneca Creek Gaging Station, Dawsonville, MD.

1 in = 50 ft

$$\text{Vertical EXAGGERATION} = \frac{V}{H} = \frac{1 \text{ in} / 5 \text{ ft}}{1 \text{ in} / 50 \text{ ft}} = \frac{50 \text{ ft} \cdot 1 \text{ in}}{1 \text{ in} \cdot 5 \text{ ft}} = \times 10$$

Distance from the East Point (ft)	Elevation (ft)	Distance from the East Point (ft)	Elevation (ft)
0 ✓	228.0	200	✓ 218.8
25 ✓	225.3	205	✓ 218.8
50 ✓	225.5	215	✓ 219.1
75 ✓	225.3	225	✓ 219.6
100 ✓	225.1	245	✓ 220.2
125 ✓	225.1	255	✓ 221.7
150 ✓	225.5	265	✓ 226.2
175 ✓	226.2	275	✓ 227.0
185 ✓	226.0	285	✓ 229.0
190 ✓	224.0	295	✓ 235.0
195 ✓	220.0		

Question Set 48: Calculating Stream Discharge in Seneca Creek

You determined the bankfull cross-sectional area (width \times depth) of the Seneca Creek channel in Question Set 47 vi, in the preceding question set. In order to calculate the stream discharge, we need to know the velocity of the stream when it is bankfull. This requires a field measurement. Here we assume a reasonable value of 4.47 ft/sec.

- i. What is the bankfull discharge in cubic feet per second (cfs)?

$$\text{Area (ft}^2\text{)} \times \text{avg velocity (ft/sec)} = \text{discharge (cfs)}$$

$$488 \text{ ft}^2 \times 4.47 \text{ ft/sec} = 2181 \text{ cfs}$$

- ii. Under what conditions will Seneca Creek begin to flood?

Over BANK / Storm / Flood

- iii. The area drained by Seneca Creek at the gaging station is 101 mi². The average yearly rainfall is 42 in/yr.

- a. Using the National Average Formula, calculate the approximate annual discharge of Seneca Creek in cubic feet per year. Show calculations.

Discharge of Seneca Creek _____ ft³/yr

- b. Using the relation 1 ft³ = 7.48 gallons, give the discharge in gallons. Show calculations.

_____ gal/yr

- iv. We can evaluate the National Average Formula figure computed above by using data from the Seneca Gaging Station itself. The U.S. Geological Survey reports that the average annual flow of Seneca Creek at the gaging station over a 49-year period is 102 cfs.

- a. Using the USGS average of 102 cfs, what is the annual discharge in cubic feet per year at the gaging station? Show calculations.

_____ ft³/yr

- b. What is the discharge in gallons? Show calculations.

_____ gal/yr

- v. By what percentage is the USGS average annual discharge higher or lower than that determined by using the National Average Formula for discharge? _____ %