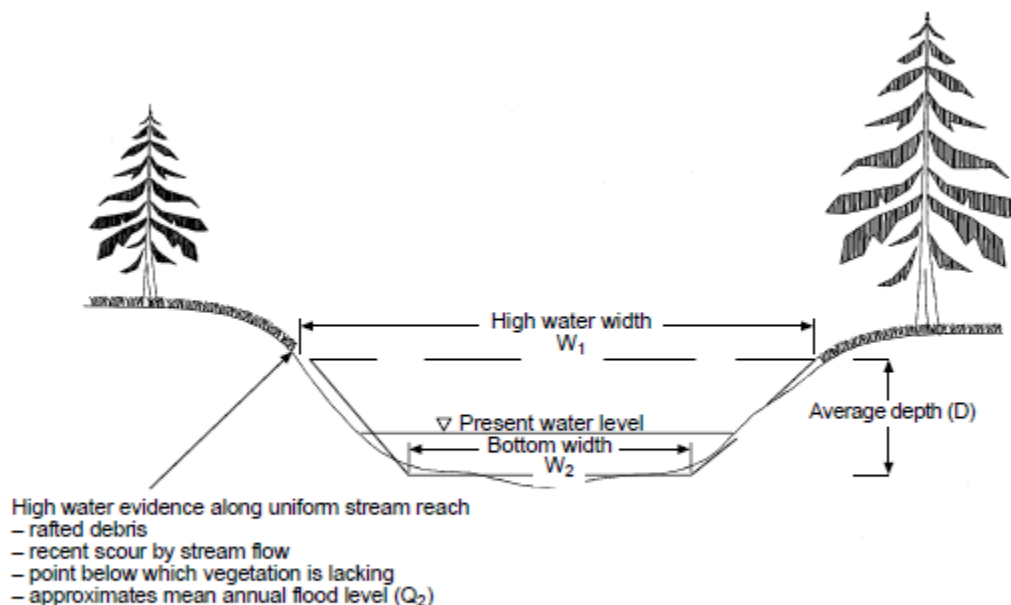


3 x Bankfull Hydrology Method Procedure

This method assumes that the high water width represents the mean annual flood cross sectional flow area (Q_2), and that the Q_{100} flow area is three times this value. It further assumes that discharge is not sensitive to pipe slope, pipe roughness, or similar contributing factors.

The high water width is defined as the horizontal distance between the stream banks, measured at right angles to the general orientation of the channel. The reference point on each bank is identified by a visible transition in vegetation and sediment texture. Above this point, the soil and terrestrial plants show no evidence of recent stream erosion. Below this point, the banks commonly show signs of scour or deposition. This point does not necessarily coincide with the top of bank, especially in incised channels.



$$\text{High water width cross-sectional area} = \frac{(W_1 + W_2)}{2} \times D$$

Figure 1 High Water Width Cross-Sectional Area

Procedure

- Identify a uniform stream reach upstream of the proposed crossing location. The selected reach should have a consistent cross section, bed material, and channel slope, and should be relatively straight. This assessment is distinct from the averaging process used to determine channel width for habitat purposes.
- Estimate the high water width and cross sectional area, see Figure 3-8:
 - Measure the high water width (W_1) in meters.

- Measure the width at the streambed (W_2) in meters.
- Measure depth at several points across the channel to determine the average depth (D) in meters.
- Calculate the cross sectional area of the stream using $A = (W_1 + W_2)/2 \times D$.
- Compute the required culvert opening area using $A_c = A \times 3.0$.
- Select the appropriate pipe size from Table 3-8 from the Engineering Manual, using the smallest available pipe area that exceeds A_c , or select a log culvert opening that provides an area greater than A_c .
- Record empirical velocity measurements at the reach immediately upstream of the by a floating object over a known distance and timing it.

Example:

- $W_1 = 1.2$ m
- $W_2 = 0.8$ m
- $D = 0.5$ m

$$A = (W_1 + W_2)/2 \times D$$

$$A = (1.2 + 0.8)/2 \times 0.5 = 0.5 \text{ m}^2$$

$$A_c = A \times 3.0$$

$$A_c = 0.5 \times 3.0 = 1.5 \text{ m}^2$$