

Technical Memorandum

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Subject: Forebay Notch Sizing Criteria Update
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Purpose

The purpose of this memorandum is to provide supporting documentation for sizing a forebay and rectangular weir notch outlet. Section 5.2.2 of the Urban Storm Drainage Criteria Manual (USDCM), Volume 3, Chapter 4 (V3C4) includes guidance on designing forebays. These forebay sizing recommendations are incorporated into the SCM-Design workbook which assists with calculating the width of the rectangular vertical notch required to drain the forebay volume in 5 minutes (Equation 4-1). In August 2025, a calculation discrepancy was identified in the SCM-Design v4.02 workbook related to sizing the rectangular weir notch based on the minimum forebay volume (1% of the WQCV) versus the design forebay volume. While evaluating the calculation discrepancy, an issue with the discharge coefficient used in Equation 4-1 was also identified. Equation 4-1 is based on the integrated form of a weir equation and was originally adopted from a 2019 memorandum prepared by Ben Urbonas (Urbonas 2019¹). This 2026 memorandum is intended to replace the 2019 memorandum, provide a corrected Equation 4-1, and document updates to Section 5.2.2 of V3C4. V3C4 changes were also incorporated in SCM-Design v4.04.

Background

A forebay provides an opportunity for coarse sediment and debris to settle out in an area that can be easily maintained. Forebays are recommended for all concentrated SCM inflow locations but vary in size and complexity of design based on the magnitude of the inflows and sediment loads anticipated. For tributary areas with high sediment loads, forebays are essential for ease of maintenance and to protect infiltrating surfaces.

Table 4-12 in V3C4 provides criteria for forebay sizing depending on the impervious area in the contributing watershed. This table should be used as a guide as it does not consider the characteristics of the watershed and may not be appropriate for tributaries much larger than 20 acres. For small inflows (up to 2 acres of imperviousness) a concrete sediment pad may be used as a forebay. For larger contributing drainage areas with greater than 2 acres of impervious area, provide a minimum forebay volume of at least 1 percent of the WQCV. The associated forebay notch or weir should be sized to empty the brim-full design forebay depth and 1 percent of the WQCV in 5 minutes at a minimum regardless of the final design volume. Longer drain times will typically result in additional sediment capture in the forebay and potentially less maintenance in the basin.

¹ Urbonas (2019), *Examination of EDB/FSD Forebay Sizing*, Memorandum from Ben Urbonas (UWRI) to Richard Mulledy (City of Colorado Springs), September 10, 2019.

Equation 4-1 for calculating the width of the rectangular vertical notch is based on the integrated form of the standard weir equation and allows a designer to calculate the notch width needed to empty a specified volume over a desired drain time. Derivation of the updated Equation 4-1 is provided here to document how the equation was developed. The standard rectangular weir equation prior to integration is shown in Equation 1.

$$Q = \frac{2}{3} C_d W \sqrt{2g} H^{3/2} \quad \text{Equation 1}$$

Where:

Q = discharge through the rectangular weir (cubic feet per second)

C_d = weir discharge coefficient

W = width of the rectangular vertical notch (feet)

g = gravitational constant, 32.2 ft/sec²

H = design forebay depth (feet)

After integrating the rectangular weir equation with respect to the drain time, the equation takes the form shown in Equation 2.

$$t = \frac{3 A_{FB}}{C_d W \sqrt{2gH}} \quad \text{Equation 2}$$

Where:

t = emptying time of the brim-full forebay (seconds)

A_{FB} = surface area of the forebay (square feet)

Rearranging the equation to solve for the rectangular notch width and converting the width to inches, results in Equation 3. Note that upper-case W is in feet (Equations 1 and 2) and lower-case w is in inches (Equations 3 and 4).

$$w = 12 * \frac{3 A_{FB}}{C_d t \sqrt{2gH}} \quad \text{Equation 3}$$

Where:

w = width of the rectangular vertical notch (inches)

The equation can then be simplified by combining all of the constants including the weir discharge coefficient and gravitational constant. A weir discharge coefficient of 0.6 is used which best represents the forebay notch configuration because it is similar to a sluice gate without the top plate constriction (also similar to a rectangular orifice). A Broad-crested weir discharge coefficient is not appropriate because the invert of the notch is not elevated above the bottom of the forebay and the width of the notch is typically narrower than the flow depth through the notch. The simplified form of Equation 3 with the constants combined is shown in Equation 4.

$$w = \frac{7.48 A_{FB}}{t \sqrt{H}} \quad \text{Equation 4}$$

Equation 4 can be further simplified by setting the emptying time equal to 5 minutes (300 seconds) and by multiplying both the top and bottom of the equation by the design forebay depth, so that the equation is reduced to just the forebay volume and depth. Equation 5 shown below is the simplest form of the equation for the width of the rectangular vertical notch required to empty the minimum design volume (1% of the WQCV) from the brim-full design forebay depth to empty in exactly 5 minutes.

$$w = \frac{0.025 V}{H^{1.5}}$$

Equation 5

Where:

w = width of the rectangular vertical notch (inches)

V = 1% of the WQCV – minimum design volume (cubic feet)

H = design forebay depth (feet)

Updated Forebay Guidance in V3C4

Minor updates will be made to Section 5.2.2 Forebays in V3C4. The primary update is that Equation 4-1 will be replaced with Equation 5, shown above, to incorporate the correct weir discharge coefficient. Additional text updates include emphasizing that the notch width should be calculated based on draining the minimum forebay volume (1% of the WQCV) in 5 minutes regardless of the design volume. Oversizing the forebay volume and associated notch width allows smaller more frequent storms to drain out in less than 5 minutes providing less time for sedimentation to occur and thus a less than effective forebay. The minimum recommended notch width is 0.75 inches to assist in constructability.