# 2.16 Water Quality Volume

The water quality volume or WQv is a technology-based approach to sizing a stormwater management practice. When coupled with its targeted drawdown time, the WQv optimizes both the volume of stormwater runoff captured annually in a management practice and the length of contact/residence time for pollutant treatment mechanisms to operate within the practice. Extended detention or infiltration of the WQv in a stormwater management practice also mitigates potential hydromodification and erosion of downstream channels often associated with increased runoff from land development.

The WQv is specific to the area that contributes runoff to a practice as well as its degree of imperviousness. Calculate the WQv for any post-construction stormwater management practice selected throughout Ohio using the equation

$$WQv = Rv \times P \times A \div 12 \qquad \text{(Equation 2.16.1)}$$

where

WQv = water quality volume (ac-ft),

Rv = volumetric runoff coefficient,

P =0.90 (in), and

A = area draining to the practice (acres).

Design criteria in Chapters 2.1 to 2.15 specify how to apply the WQv to each post-construction stormwater management practice. Note that supplying more storage volume than calculated by equation 2.16.1 does not increase the overall treatment and can even be detrimental. Do not compensate for untreated or undertreated area beyond a practice's contributing drainage area by oversizing the WQv.

## Volumetric Runoff Coefficient (Rv)

Use the Simple Method (Schuler, 1987) to convert rainfall volume to direct runoff volume. This method derives the volumetric runoff coefficient (Rv) in Equation 2.16.1 from the imperviousness of the drainage area to the practice through the relationship

$$Rv = 0.05 + 0.90(i) \qquad \text{(Equation 2.16.2)}$$

where

i = drainage area impervious fraction (percent impervious divided by 100 or impervious area divided by total area).

As used in Equation 2.16.2, impervious area includes all permanent landcover that alters the natural hydrology by preventing the infiltration and evapotranspiration of rainwater. This includes all unvegetated surface area such as roofs, roads, parking lots, sidewalks, and open water (WEF/ASCE, 1998). Impervious area also includes gravel, synthetic turf, and other types of landcover placed on a subgrade compacted to form a stable foundation. The infiltration capacity of the disturbed soil beneath these landcovers is diminished and most all precipitation is rapidly shed as runoff.

The impervious fraction of most developments is taken directly from the proposed site plan. Single-family residential subdivisions may require the designer to make assumptions on the dwelling unit footprints, driveways, and other surfaces to develop the impervious fraction which may be impractical in many circumstances. Refer to Table 2.16.1 for the typical impervious fraction of single-family developments given the average lot size (the total development area excluding street right-of-way and common space area divided by the number of individual lots). Do not include ponds, clubhouses, golf courses, and internal public areas that must be factored separately.

**Table 2.16.1 Impervious Fraction of Common Density Single-Family Residential Subdivisions (adapted from USDA, 1986)**

| Average Lot Size | Impervious Fraction (i)* |
|---|---|
| 0.50 acre | 0.25 |
| 0.33 acre | 0.30 |
| 0.25 acre | 0.38 |
| 0.20 acre | 0.45 |
| 0.12 acre | 0.65 |

* Includes the lots and streets within the subdivision.

## Precipitation (P)

A precipitation depth of 0.90 inches captures approximately 90 percent of the average annual runoff with an efficiently designed standard stormwater management practice. (Dorsey and Winston, 2018). This precipitation depth does not represent an individual storm event of certain return interval, duration, and distribution (for example, a 2-year, 24-hour type II storm) and cannot be flow routed through a stormwater management practice. The 0.90 inch precipitation depth accounts for the effect of flow routing on storage volume through the continuous simulation modelling of hourly rainfall records from which it was developed.

## Area Draining to the Stormwater Management Practice (A)

The WQv is a product of the actual area that contributes stormwater runoff to or drains through a stormwater management practice. The drainage area does not necessarily equal the project area. The drainage area can include area beyond the defined project boundary that drains into a practice or, where multiple practices serve a development, include only the sub-section of the project site that drains to that practice. The following example calculation demonstrates these circumstances.

**Example Calculation 2.16.1**

**Scenario:** A wet extended detention basin B is planned for a phase II of a new residential subdivision development. This phase will disturb 17.452 acres for the construction of 50 single-family homes on lots averaging one-quarter (1/4) acre.

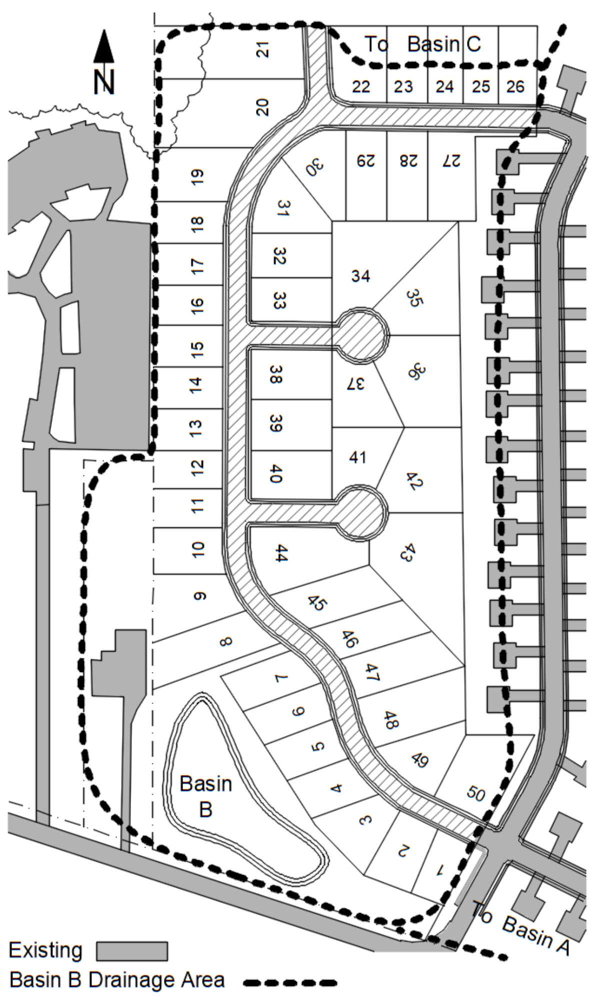
Existing and proposed ground contours (not shown) were used to determine the total contributing drainage area to basin B is 20.384 acres. This drainage area includes 4 subsections:

1) 1.802 acres (0.293 acres of impervious) of offsite run-on coming from an adjacent residential property to the southwest,
2) 1.542 acres (0.359 acres of impervious) of offsite run-on coming from an earlier phase of the subdivision to the east,
3) 14.340 acres of the proposed phase II lots, and
4) 2.700 acres of common space surrounding basin B.

In addition, a 0.412-acre subsection of the proposed phase II project site drains offsite to the north and is captured by basin C (not shown) of the subdivision. This section will be included in the design of basin C.

Find the WQv for basin B.

Note: This example shows a level of detail and situations that may not apply to all projects.




**Site Plan (not to scale)**

**Calculation**:

1. **Determine the impervious fraction of the 20.384 acre contributing drainage area to basin B.**

   Impervious area per section of basin B drainage area:
   1) 0.293 ac [measured from plan and given here]
   2) 0.359 ac [measured from plan and given here]
   3) 5.449 ac estimated from:

      Average lot size = (14.340 ac - 1.980 ac of ROW [measured from plan and given here]) ÷ 50 lots

      $\simeq$ 0.25 ac per lot

      $\therefore$ use i = 0.38 (from Table 2.16.1)

      Proposed lot impervious area = 14.340 ac x 0.38 = 5.449 ac

   4) 1.053 ac [pond at normal pool as measured from plan]

   Total impervious area = 0.293 ac + 0.359 ac + 5.449 ac + 1.053 ac = 7.154 ac

   i = 7.154 ac ÷ 20.384 ac = 0.351

2. **Calculate Rv for the drainage area to basin B using Equation 2.16.2.**

   $Rv = 0.05 + (0.90 \times 0.351) = 0.366$

3. **Calculate the WQv for the drainage area to basin B using Equation 2.16.1.**

   $WQv = Rv \times P \times A \div 12 = 0.366 \times 0.9 \text{ in} \times 20.384 \text{ ac} \div 12 = 0.560$ ac-ft

# References

American Society of Civil Engineers/Water Environment Federation. 2012. Design of Urban Stormwater Controls, WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87, Alexandria and Reston, VA.

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