

Chapter 4: Unified Stormwater Sizing Criteria

Section 4.1 Introduction

This chapter presents a unified approach for sizing SMPs in the State of New York to meet pollutant removal goals, reduce channel erosion, prevent overbank flooding, and help control extreme floods. For a summary, please consult Table 4.1 below. The remaining sections describe the four sizing criteria in detail and present guidance on how to properly compute and apply the required storage volumes.

Table 4.1 New York Stormwater Sizing Criteria	
Water Quality (WQ_v)	<p>90% Rule:</p> $WQ_v = [(P)(R_v)(A)] / 12$ $R_v = 0.05 + 0.009(I)$ <p>I = Impervious Cover (Percent) Minimum R_v = 0.2 P = 90% Rainfall Event Number (See Figure 4.1) A = site area in acres</p>
Channel Protection (Cp_v)	<p>Default Criterion: Cp_v = 24 hour extended detention of post-developed 1-year, 24-hour storm event.</p> <p>Option for Sites Larger than 50 Acres: Distributed Runoff Control - geomorphic assessment to determine the bankfull channel characteristics and thresholds for channel stability and bedload movement.</p>
Overbank Flood (Q_p)	Control the peak discharge from the 10-year storm to 10-year predevelopment rates.
Extreme Storm (Q_f)	Control the peak discharge from the 100-year storm to 100-year predevelopment rates. Safely pass the 100-year storm event.
<p><i>Note: Channel protection, overbank flood, and extreme storm requirements may be waived in some instances if the conditions specified in this chapter are met. For SMPs involving dams, follow Appendix A <u>Guidelines for Design of Dams</u> for safe passage of the design flood.</i></p>	

Section 4.2 Water Quality Volume (WQ_v)

The Water Quality Volume (denoted as the WQ_v) is designed to improve water quality sizing to capture and treat 90% of the average annual stormwater runoff volume. The WQ_v is directly related to the amount of impervious cover created at a site. Contour lines of the 90% rainfall event are presented in Figure 4.1.

The following equation can be used to determine the water quality storage volume WQ_v (in acre-feet of storage):

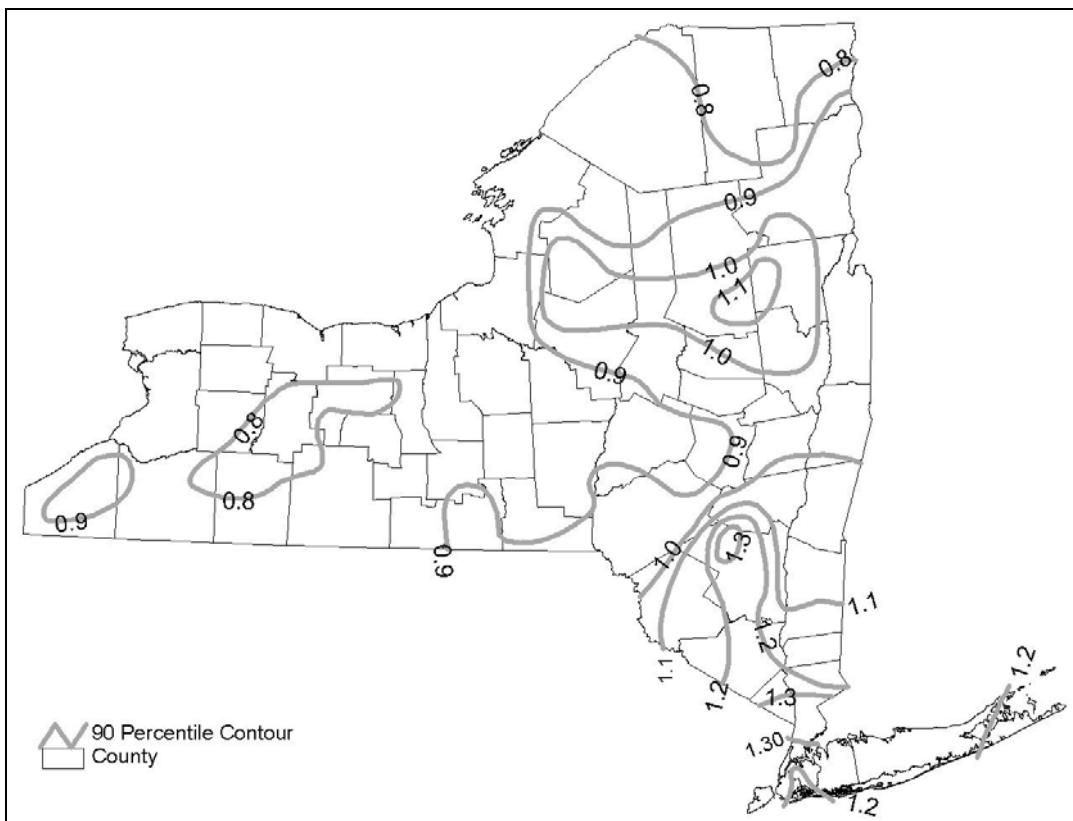
$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

where:

- WQ_v = water quality volume (in acre-feet)
- P = 90% Rainfall Event Number (see Figure 4.1)
- R_v = 0.05 + 0.009(I), where I is percent impervious cover
- A = site area in acres (contributing area)

A minimum R_v of 0.2 will be applied to regulated sites. (tributary area)

Figure 4.1 90% Rainfall in New York State



Basis Of Design for Water Quality

As a basis for design, the following assumptions may be made:

- Measuring Impervious Cover:* the measured area of a site plan that does not have permanent vegetative or permeable cover shall be considered total impervious cover. Impervious cover is defined as all impermeable surfaces and includes: paved and gravel road surfaces, paved and gravel parking lots, paved driveways, building structures, paved sidewalks, and miscellaneous impermeable structures such as patios, pools, and sheds. Porous or modular block pavement may be considered 50% impervious. Where site size makes direct measurement of impervious cover impractical, the land use/impervious cover relationships presented in Table 4.2 can be used to initially estimate impervious cover.

Table 4.2 Land Use and Impervious Cover (Source: Cappiella and Brown, 2001)	
Land Use Category	Mean Impervious Cover
Agriculture	2
Open Urban Land*	9
2 Acre Lot Residential	11
1 Acre Lot Residential	14
1/2 Acre Lot Residential	21
1/4Acre Lot Residential	28
1/8 Acre Lot Residential	33
Townhome Residential	41
Multifamily Residential	44
Institutional**	28-41%
Light Industrial	48-59%
Commercial	68-76%
<p>* Open urban land includes developed park land, recreation areas, golf courses, and cemeteries. ** Institutional is defined as places of worship, schools, hospitals, government offices, and police and fire stations</p>	

- Aquatic Resources:* More stringent local regulations may be in place or may be required to protect drinking water reservoirs, lakes, or other sensitive aquatic resources. Consult the local authority to determine the full requirements for these resources.

- *SMP Treatment*: The final WQ_v shall be treated by an acceptable practice from the list presented in this manual. Please consult Chapter 5 for a list of acceptable practices.
- *Determining Peak Discharge for WQ_v Storm*: When designing flow splitters for off-line practices, consult the small storm hydrology method provided in Appendix B.
- *Extended Detention for Water Quality Volume*: The water quality requirement can be met by providing 24 hours of the WQ_v (provided a micropool is specified) extended detention. A local jurisdiction may reduce this requirement to as little as 12 hours in trout waters to prevent stream warming.
- *Off-site Areas*: Provide treatment for off-site areas in their current condition. If water quality treatment is provided off-line, the practice must only treat on-site runoff.

Section 4.3 Stream Channel Protection Volume Requirements (C_{p_v})

Stream Channel Protection Volume Requirements (C_{p_v}) are designed to protect stream channels from erosion. In New York State this goal is accomplished by providing 24-hour extended detention of the one-year, 24-hour storm event. Trout waters may be exempted from the 24-hour ED requirement, with only 12 hours of extended detention required to meet this criterion.

For developments greater than 50 acres, with impervious cover greater than 25%, it is recommended that a detailed geomorphic assessment be performed to determine the appropriate level of control. Appendix J provides guidance on how to conduct this assessment.

The C_{p_v} requirement does not apply in certain conditions, including the following:

- Recharge of the entire C_{p_v} volume is achieved at a site.
- The site discharges directly tidal waters or fourth order (fourth downstream) or larger streams.

Within New York State, streams are classified using the following:

New York State Codes Rules and Regulations (NYCRR)
 Volumes B-F, Parts 800-941
 West Publishing, Eagan, MN

However this classification system does not provide a numeric stream order. The methodology identified in this Manual is consistent with Strahler-Horton methodology. For an example of stream order identification see section 4.7.

Detention ponds or underground vaults are methods to meet the C_{p_v} requirement (and subsequent Q_{p10} and Q_f criteria). Schematics of typical designs are shown in Figures 4.2. and 4.3. Note that, although these practices meet water quantity goals, they are unacceptable for water quality because of poor pollutant removal, and need to be coupled with a practice listed in Table 5.1. The C_{p_v} requirement may also be provided above the water quality (WQ_v) storage in a wet pond or stormwater wetland.

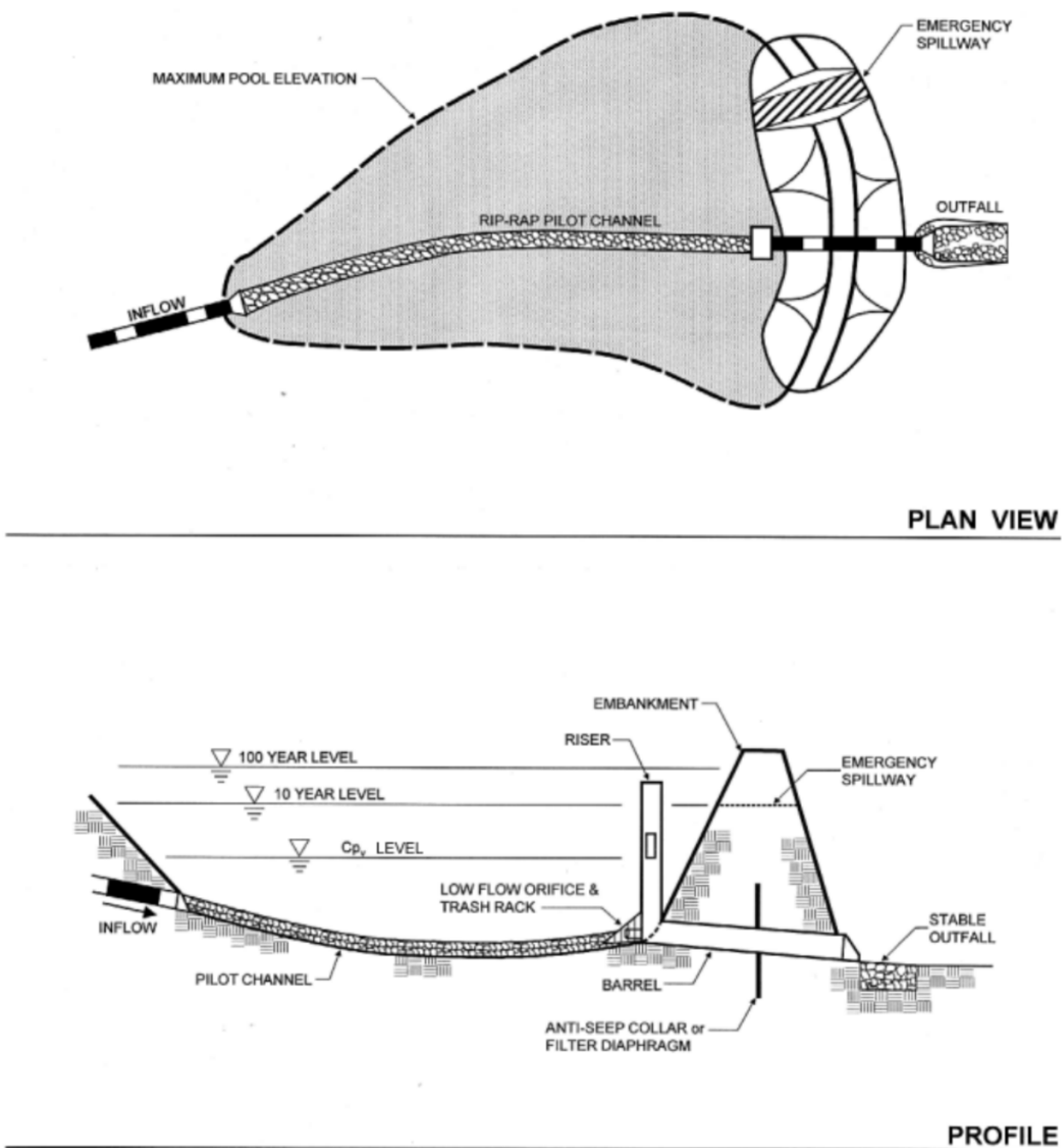
Basis for Determining Channel Protection Storage Volume

The following represent the minimum basis for design:

- TR-55 and TR-20 (or approved equivalent) shall be used to determine peak discharge rates.
- Rainfall depths for the one-year, 24 hour storm event are provided in Figure 4.4.
- Off-site areas should be modeled as "present condition" for the one-year, 24 hour storm event.

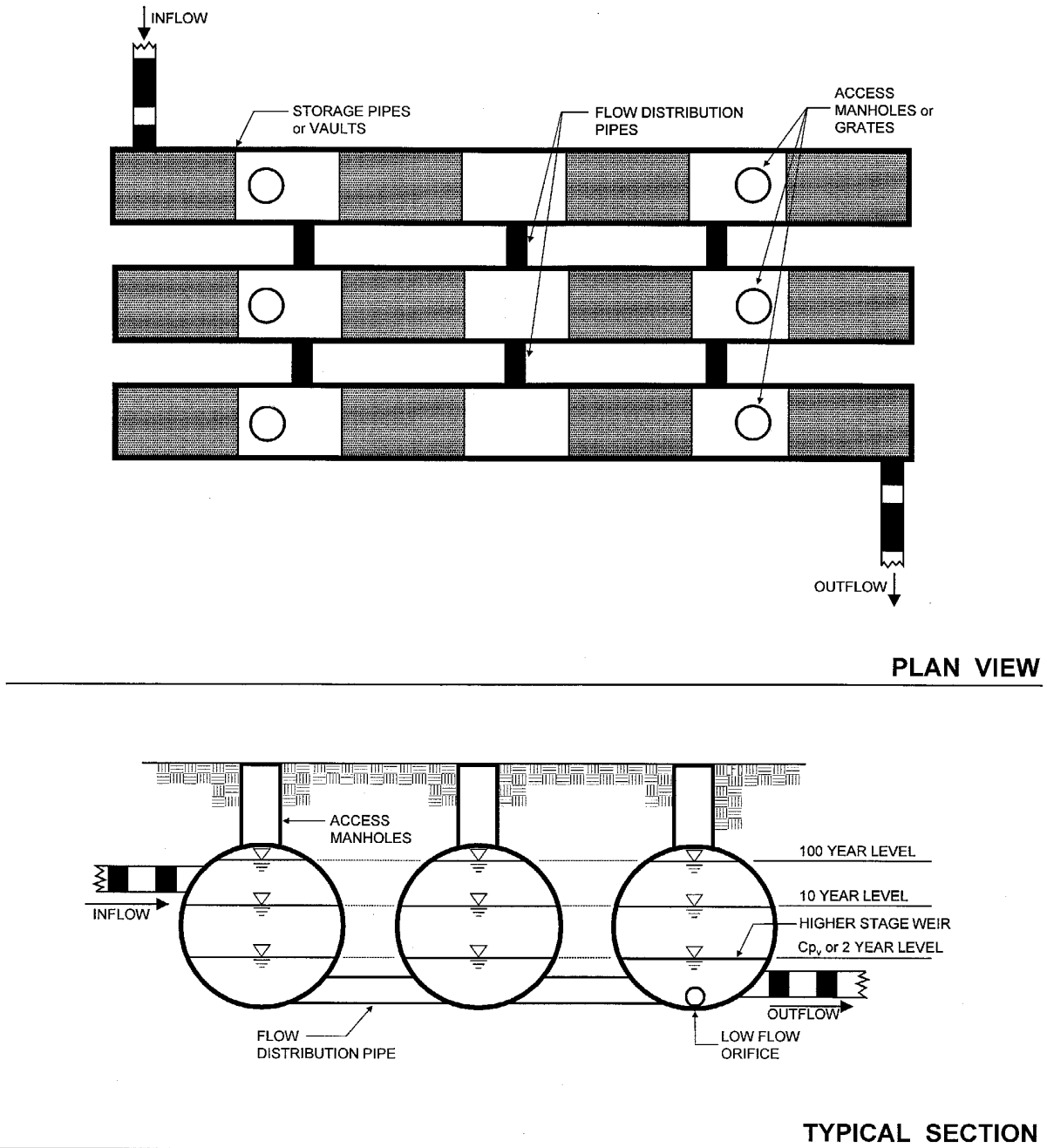
- The length of overland flow used in time of concentration (t_c) calculations is limited to no more than 100 feet for post development conditions.
- Cp_v is not required at sites where the resulting diameter of the ED orifice is too small, to prevent clogging. (A minimum 3" orifice with a trash rack or 1" if the orifice is protected by a standpipe, having slots with an area less than the internal orifice are recommended to prevent clogging. See Figure 3 in Appendix K for design details).
- Extended detention storage provided for the channel protection (Cp_v -ED) does not meet the WQ_v requirement. Both water quality and channel protection storage may be provided in the same SMP, however.
- The CP_v detention time for the one-year storm is defined as the time difference between the center of mass of the inflow hydrograph (entering the SMP) and the center of mass of the outflow hydrograph (leaving the SMP). See Appendix B for a methodology for detaining this storm event.

Figure 4.2 Example of a Conventional Stormwater Detention Pond



A typical detention facility provides channel protection control (C_p) and overbank control (Q_p) but no water quality control (WQ_v). If this practice is used, WQ_v must be provided in a separate facility listed in Table 5.1.

Figure 4.3 Example of Stormwater Detention Provided by an Underground Pipe System



An underground pipe system or vaults may be used to provide C_{p_v} , Q_p and Q_f controls but not WQ_v .