

APRIL 2019

SECTION 4

DRAINAGE DESIGN REQUIREMENTS

4.18 – Moved 4.18 to 4.19 and adjusted.

4.18 – Added Stormwater Quality Treatment as 4.18.

4.18 Stormwater Quality Treatment

Refer to Landscape Ordinance Subsection 4.02 (Landscape Requirements) of Section 4 (Site Development Requirements) of the Zoning Ordinance to determine if Stormwater Quality Treatment is required. Stormwater Quality Treatment shall be designed based upon the following minimum criteria:

A. Quantitative Measures

1. Stormwater quality volume is based on the first 1" of rainfall.
2. All impervious areas to be treated unless otherwise approved by the Director of Engineering Services.
3. Extended detention, biofiltration, or mechanical separators shall be used to remove 80% of total suspended solids.

B. Water Quality Volume (WQ_v)

The water quality volume is calculated by using the 1" rainfall event, the volumetric runoff coefficient and the site area. When a development contains multiple outfalls, Water Quality Volume should be calculated and addressed separately for each outfall.

For each outfall:

$$R_v = 0.05 + 0.009I$$

I = Percent of impervious cover (expressed as percent value not fraction)

R_v = Volumetric runoff coefficient

WQ_v is calculated using the following formula:

$$WQ_v = \frac{1.0R_vA}{12}$$

WQ_v = Water quality volume (acre-feet)

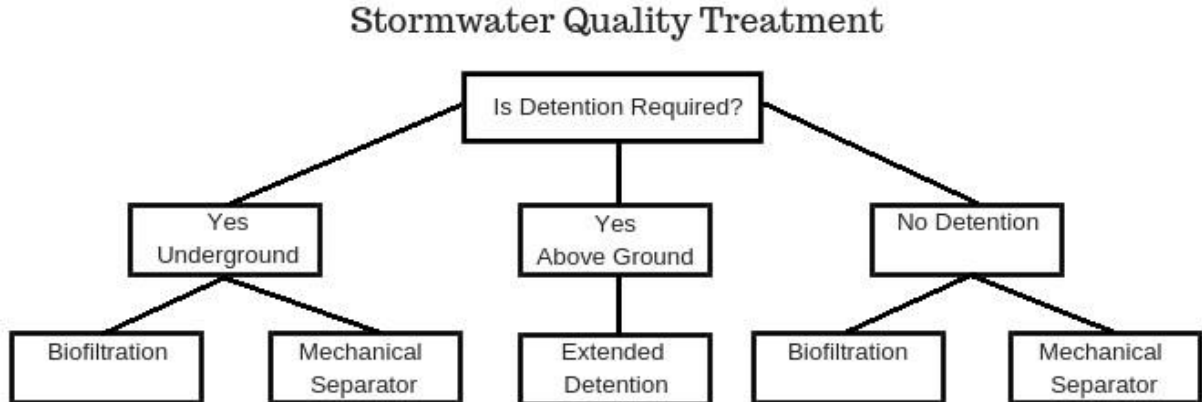
R_v = Volumetric runoff coefficient

A = Total drainage area (acres)

C. Best Management Practices (BMPs) -

Stormwater Quality Treatment shall be achieved through one or more of the following BMPs: extended detention, biofiltration, or mechanical separators. Figure 4.7 summarizes the process for selecting a BMP.

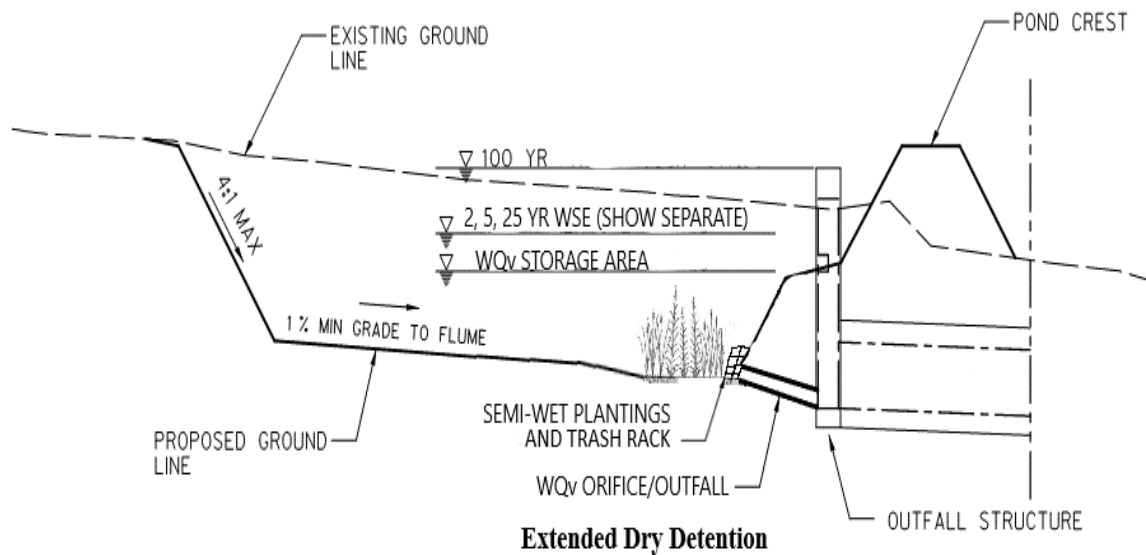
Figure 4.7: Stormwater Quality Treatment Flowchart



1. Extended Detention – Dry or Wet Pond
 - a. Detention ponds must meet design requirements of Section 4.09 for detention.
 - b. Water quality orifice shall be no less than 3” in diameter.
 - c. May be included within open space if open space ordinance Subsection 4.13.03 (Nonresidential Open Space Requirements) of Section 4 (Site Development Requirements) of the Zoning Ordinance is met.
 - d. Inflow must travel through the extended detention and not be directly connected to the outfall.
 - e. Outfall shall include a pond drain with headwall and gate valve allowing for fully drained pond within a 24-hour period to allow for maintenance and operation of the system.

- f. Dry pond requirements to achieve 80% TSS:
- Size orifice and WQv storage area to meet required WQv. WQv storage area should be located adjacent to the outfall.
 - Add trash rack to water quality outfall. Trash rack shall not limit water quality outfall flows.
 - Provide semi-wet plantings to increase vegetative filtration and uptake of stormwater pollutants around outfall structure. Reference Approved Plant Materials on the City Website for semi-wet planting guidance.

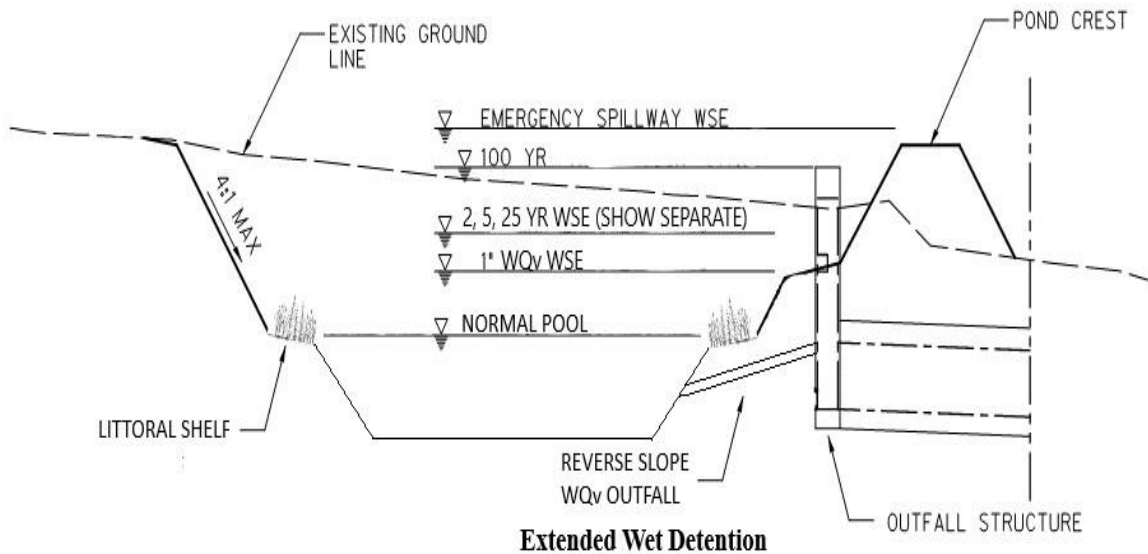
Figure 4.8: Extended Dry Detention



g. Wet pond requirements to achieve 80% TSS:

- Size orifice and WQv storage area to meet required WQv.
- The flowline of the water quality outfall should be set at the normal pool elevation. Wet pond should have submerged water quality outfall with reverse slope.
- Provide minimum 5' wide littoral shelf at 1' below normal pool perimeter. Reference the Approved Plant Materials on the City Website for littoral shelves planting guidance to increase vegetative filtration and uptake of stormwater pollutants.

Figure 4.9: Extended Wet Detention



h. Sizing for water quality outfall:

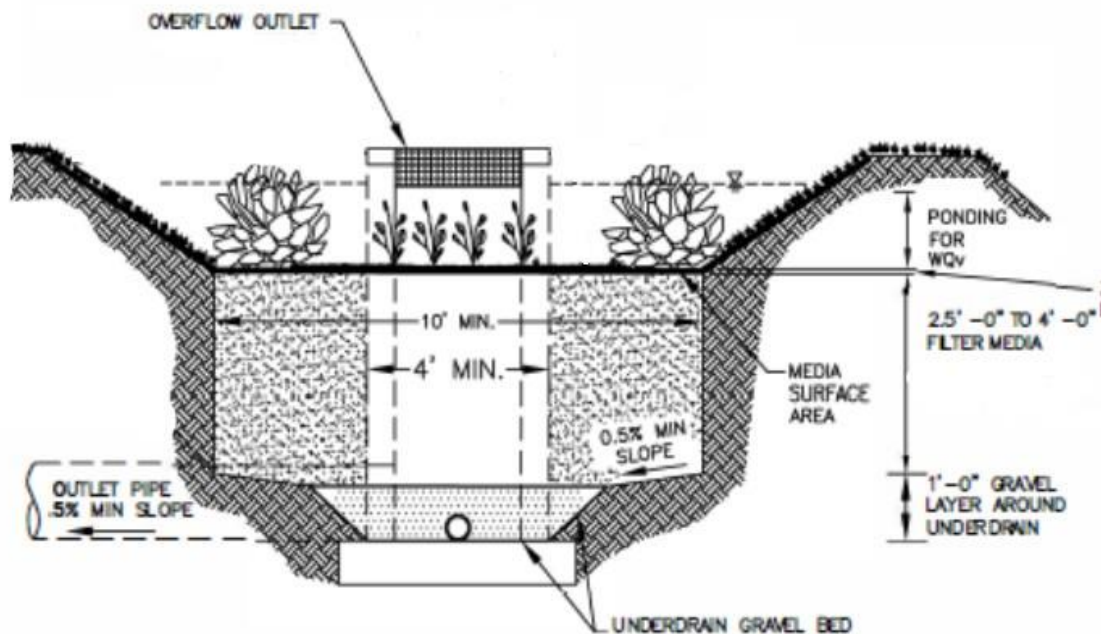
$$A = \frac{Q}{C\sqrt{2gh}} \quad Q = \frac{WQ_v}{t}$$

- A = Water quality orifice open area (ft²) Min. of 3" diameter
- Q = Flowrate (cfs)
- C = Orifice coefficient – (0.6)
- g = Gravity (32.2ft/s)
- h = Half maximum hydraulic head (ft)
- WQv = Water quality volume (ft³)
- t = Drain time (seconds) Orifice sized for 24-48 hours of detention

2. Biofiltration

- a. May be included within open space if open space ordinance Subsection 4.13.03 (Nonresidential Open Space Requirements) of Section 4 (Site Development Requirements) of the Zoning Ordinance is met.
- b. Reference landscape ordinance Subsection 4.02 (Landscape Requirements) of Section 4 (Site Development Requirements) of the Zoning Ordinance and the Approved Plant Materials on the City Website for plantings to increase vegetative filtration and uptake of stormwater pollutants.
- c. Maximum drainage area is 5 acres per biofiltration system. Multiple biofiltration systems may be required.
- d. Biofiltration system shall provide storage capacity for the WQv. The maximum ponding depth is 12" above finished grade and contained within the biofiltration system.
- e. Drain time shall not exceed 48 hours.
- f. Engineered media or manufacturer's product can be used to adjust coefficient of permeability. Design the coefficient of permeability to include a safety factor of 2. Minimum design permeability must be demonstrated after installation.
- g. Include an underdrain system and overflow outlet.
- h. Size overflow outlet for the 100-year storm event. Set outlet opening a minimum three inches above finished grade.
- i. Inflow must travel through biofiltration system and not be directly connected to the outfall.

Figure 4.10: Biofiltration



j. Sizing:

$$A_f = \frac{WQ_v * d_f}{k(h_f + d_f)t_f}$$

- A_f = Surface area of ponding area (ft²)
 WQ_v = Water quality volume (ft³)
 d_f = Filter bed depth (ft) 2.5 feet minimum
 k = Coefficient of permeability (ft/day) use 0.03 ft/day for clay
 h_f = Half maximum hydraulic head (ft)
 t_f = Design filter bed drain time (days) 2 days maximum

k. Mechanical Separators

- Sized based on quantitative measures in 4.18.A, 4.18.B, and manufacturer's recommendations. Calculations and specifications to be provided in construction plans. Provide laboratory analysis justifying manufacturer's recommendation.
- Head loss from mechanical separators must be included in the storm drain calculations.
- Mechanical separators must remove and retain trash from runoff and meet normal maintenance schedule.

D. Maintenance

1. Engineer shall provide an Operations and Maintenance (O&M) Plan that will detail BMP specifics. Plan shall be recorded with the county.
2. A copy of the recorded O&M Plan needs to be provided to the City and a note added to the construction plans referencing the existence of the O&M Plan with the county recording information.

4.19 Sustainable Development

The City encourages developments to implement sustainable designs, concepts, and practices on site. The Engineer shall notify the City of the design intent and provide the necessary information, data, and calculations on the construction plans.

The Engineer shall refer to published technical resources on the design of these sustainable designs, concepts, and practices. Such technical resources may be found on the North Central Texas Council of Governments' (NCTCOG) storm water website or the [Environmental Protection Agency's \(EPA\) website for Low Impact Development](#).