Post-Construction Requirements of the NPDES Construction Storm Water General Permit

Ohio Environmental Protection Agency

Today's Webinar

Speaker

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Objective

Gain a general understanding of the current post-construction requirements.

Agenda

1. Background
2. How post-construction requirements are met
3. Questions

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What is the NPDES Construction Storm Water General Permit ?

- National Pollutant Discharge Elimination System
  - section 402 of 1972 federal CWA
  - Individual and general permits to discharge to surface waters
- General permits include HSTS, hydrostatic test water, pesticide application, storm water
- 5 year general permit term (1992, 2003, 2008, 2013, 2018)

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Why a NPDES General Permit for Storm Water?

Storm water runoff often contains pollutants in quantities that could adversely affect water quality. As such, an NPDES General Permit spells out criteria for discharging stormwater from:

- Industrial facilities

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- Small municipal separate storm sewer systems (MS4)

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- Industrial facilities
- Small municipal separate storm sewer systems (MS4)
- Construction activities

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Who needs coverage under a NPDES Construction Storm Water General Permit ?

Construction activities disturbing one or more acres of land or are part of a large common plan of development that will ultimately disturb one or more acres

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Who needs coverage under a NPDES Construction Storm Water General Permit ?

clearing, grading, excavating, grubbing, and/or filling

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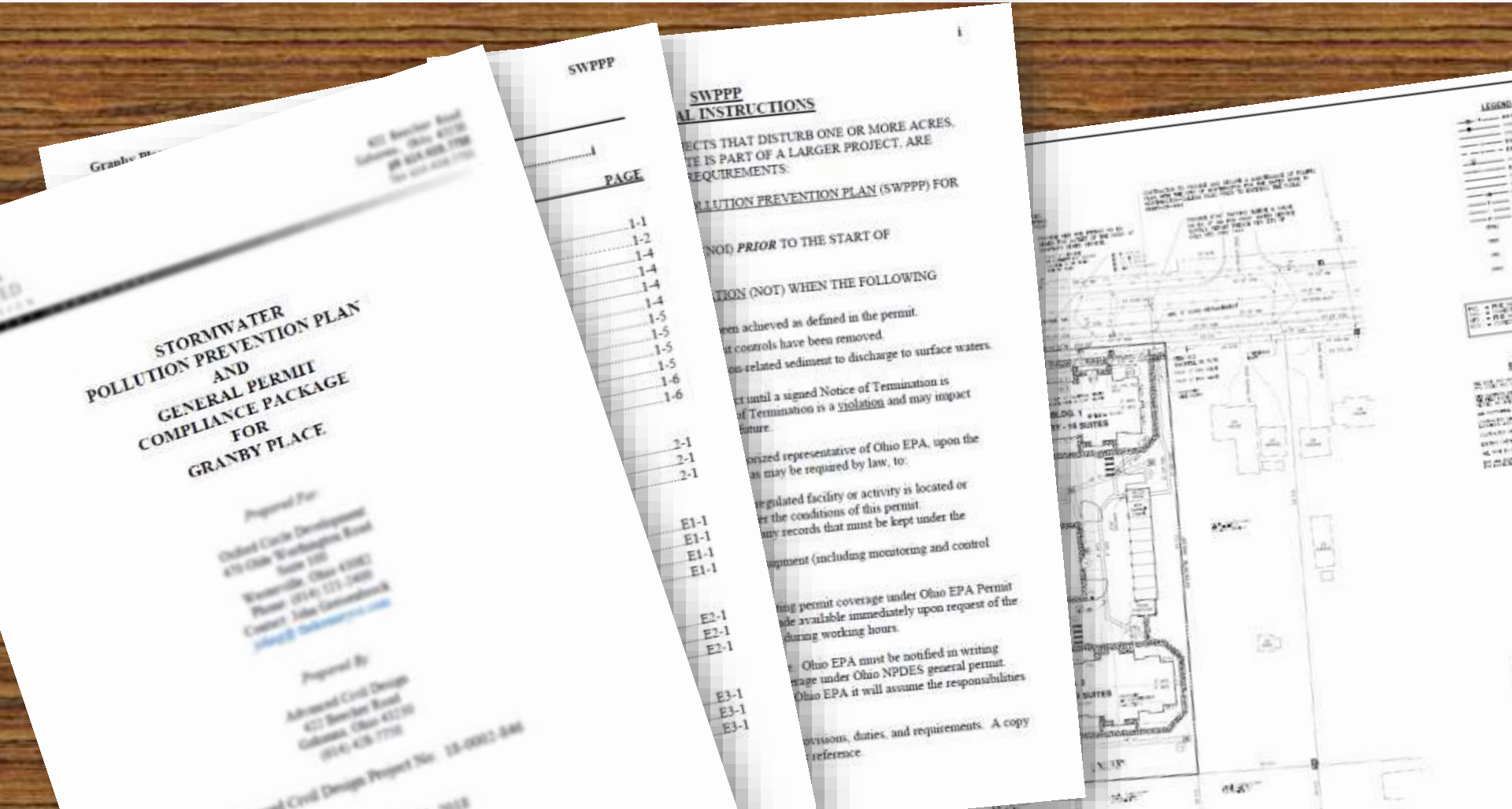
What does the NPDES Construction Storm Water General Permit require ?

Storm Water Pollution Prevention Plan (SWP3)



What does a SWP3 do?

- Non-structural preservation
- Runoff and erosion controls
- Sediment controls
- Surface water protection

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- Non-structural preservation
- Runoff and erosion controls
- Sediment controls
- Surface water protection
- Other controls

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What does a SWP3 do ?

- Non-structural preservation
- Runoff and erosion controls
- Sediment controls
- Surface water protection
- Other controls
- Post-construction storm water controls

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Post-Construction Tenet #1

"Total Suspended Solids (TSS) concentrations in urban runoff are fairly high in comparison with treatment plant discharges"
NURP (1983)

TSS in urban runoff:

- higher in mineral and man-made products
- more likely to have other contaminates adsorbed on them (Phosphorus, Nitrogen, Zinc, Copper, Lead, PAH, bacteria, etc.)
- Measurable/detectable

"Removal of 80% of Total Suspended Solids (TSS) is assumed to control heavy metals, phosphorus and other pollutants."
CZARA(1993)

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Why 80 percent?

Table 5-7. Structural BMP Expected Pollutant Removal Efficiency

BMP Type	Typical Pollutant Removal (percent)				
	Suspended Solids	Nitrogen	Phosphorus	Pathogens	Metals
Dry Detention Basins	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65	< 30	50 - 80
Constructed Wetlands	50 - 80	< 30	15 - 45	< 30	50 - 80
Infiltration Basins	50 - 80	50 - 80	50 - 80	65 - 100	50 - 80
Infiltration Trenches/ Dry Wells	50 - 80	50 - 80	15 - 45	65 - 100	50 - 80
Porous Pavement	65 - 100	65 - 100	30 - 65	65 - 100	65 - 100
Grassed Swales	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Vegetated Filter Strips	50 - 80	50 - 80	50 - 80	< 30	30 - 65
Surface Sand Filters	50 - 80	< 30	50 - 80	< 30	50 - 80
Other Media Filters	65 - 100	15 - 45	< 30	< 30	50 - 80

Source: Adapted from US EPA, 1993c.

USEPA. 1993. *Preliminary Data Summary of Urban Storm Water Best Management Practices*

MEP BAT

"Analysis has shown that constructed wetlands, wet ponds, and infiltration basins can remove 80% of TSS, provided they designed and maintained properly."
CZARA (1993)

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Post-Construction Tenet #2

"The quality of urban runoff is so much more complex than quantity that it would be misleading to indeed attempt to use a single rainfall event of any type for design or analysis. …requires the use of some effective form of continuous rainfall data."
Wenzel (1982)

- An rainfall event requires
  - Duration, total depth & distribution
  - Statistical return period

- Hydrograph does not necessarily equal the pollutograph

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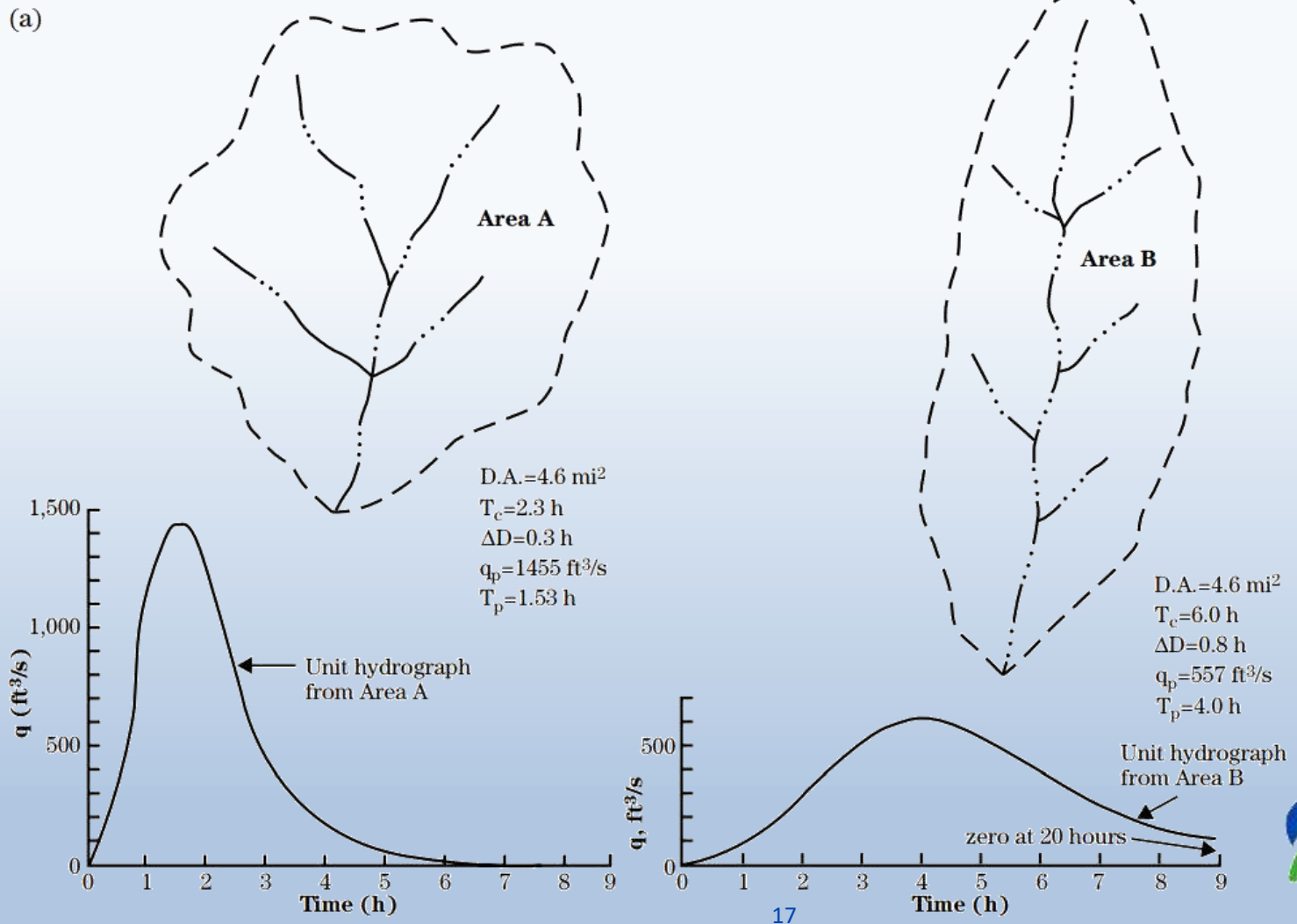
Average Annual Volume vs. Statistical Design Event



Source: USDA, NEH Part 630, Ch16 Hydrographs.

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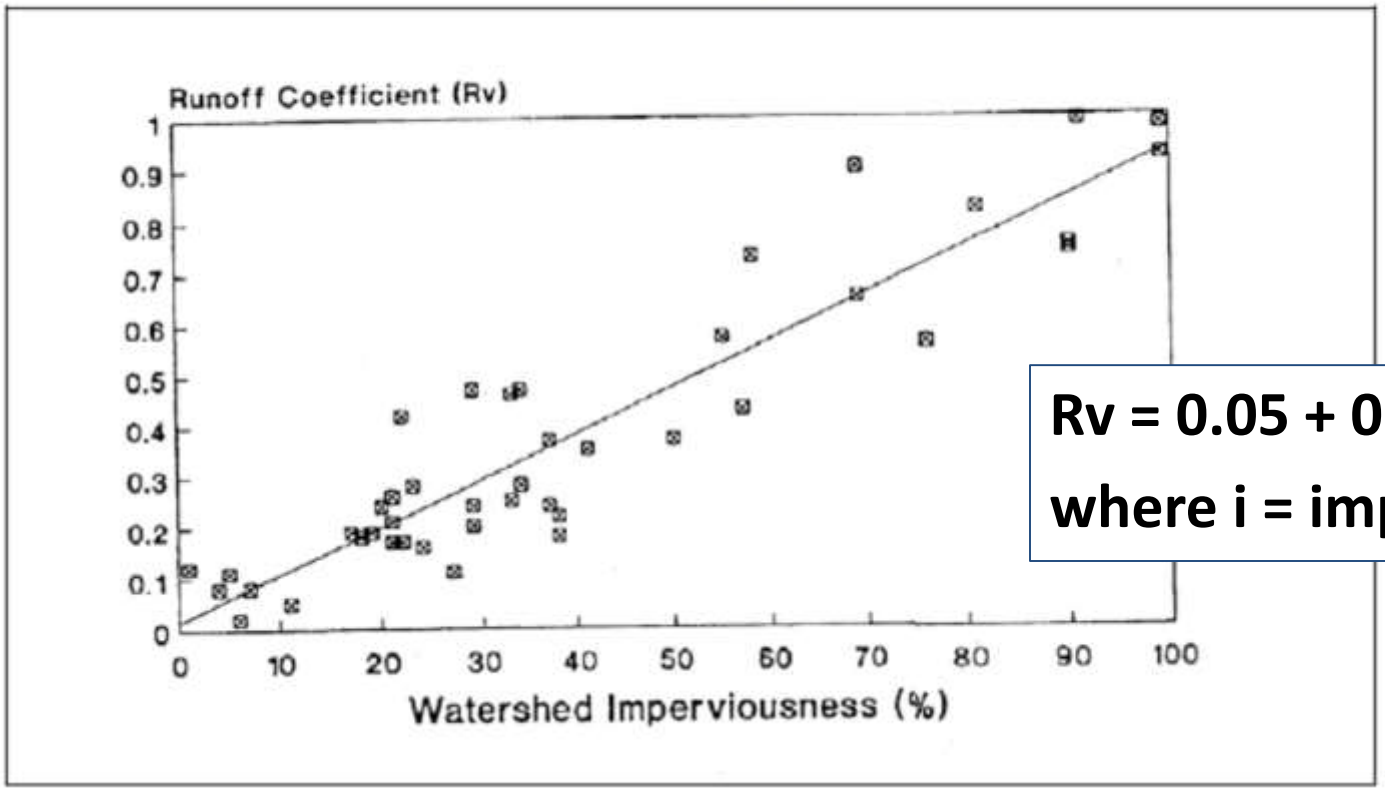
Post-Construction Tenet #3

The fraction of rainfall as runoff is directly proportional to the amount of impervious cover

Figure 2.2 Relationship Between Impervious Cover and Runoff Coefficient (Schueler, 1987)



Rv = 0.05 + 0.9(i)

where i = impervious fraction

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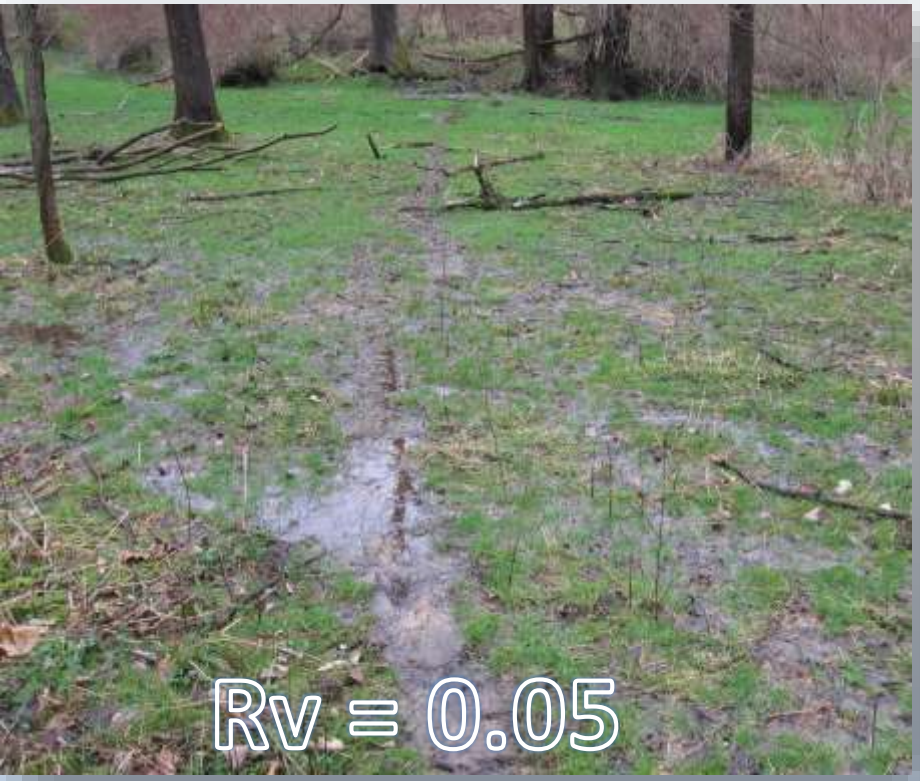
Post-Construction Tenet #3



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Post-Construction Tenet #3

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Post-Construction Tenet #4

"quantity and quality are closely related and cannot be separated for effective stormwater management"

ASCE/WEF (2012)

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Ohio's Post-Construction Approach

A. Capture the Water Quality Volume (WQv)
B. Treat the WQv with effective post-construction practice
C. Provide extended detention or infiltration of the WQv

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Water Quality Volume

$$WQv\ (ac\text{-}ft) = P \times Rv \times A \div 12$$

Where,

- P = 0.90 inches
- Rv = 0.05 + 0.90(i)
- A = area of construction disturbance / drainage area of practice
- $i = A_{impervious} \div A_{total}$

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Water Quality Volume

WQv P Depth (in)	Dry ED Basin %	Wet ED Basin EDv=0.75WQv %	Wet ED Basin EDv=WQv %	Perm-Pave %	Bio-retention %
0.75	86.8	85.0	91.2	85.8	88.9
0.85	89.4	88.1	93.0	87.9	90.6
0.90	90.7	89.0	93.4	88.9	91.3
1.00	92.5	91.2	95.2	90.5	92.7

Source: Dorsey & Winston (2018)

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Source: This Old House – YouTube Channel

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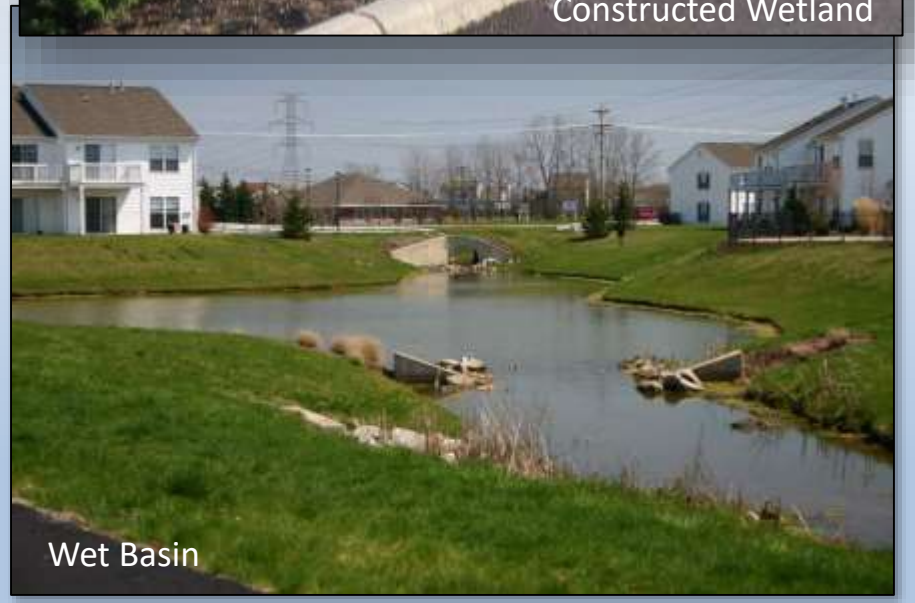
Extended Detention Basins

Dry Basin

Constructed Wetland



Wet Basin

Extended Detention Basins

- "pull-the-plug" or static draw down from the WQv elevation (zero inflow or dry hydrograph)
  - 24-hour minimum for wet, wetland & underground basins
  - 48-hour minimum for dry basins

- Shall not discharge more than the first half of the WQv in less than one-third of the drain time

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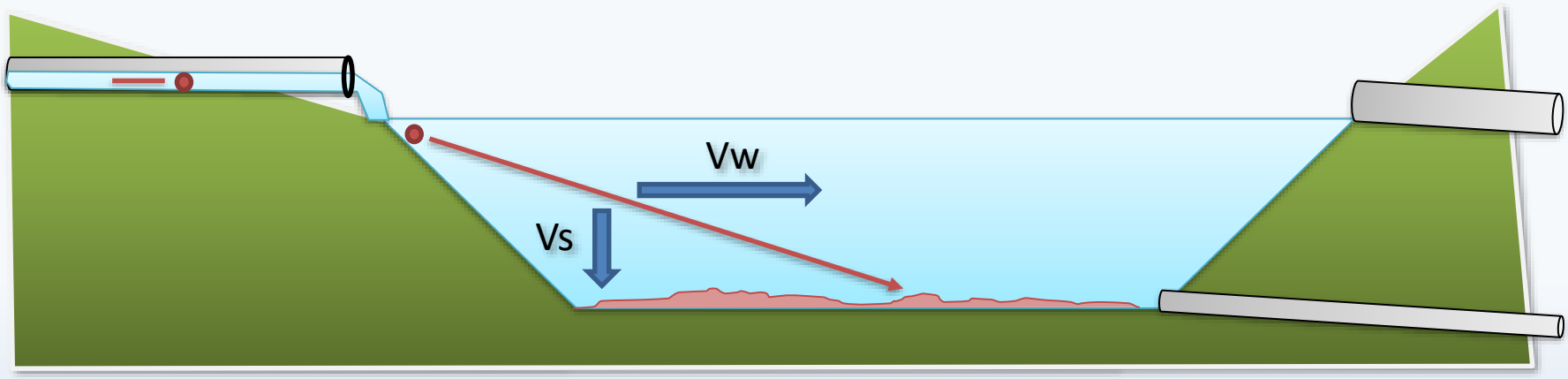
Extended Detention Basins



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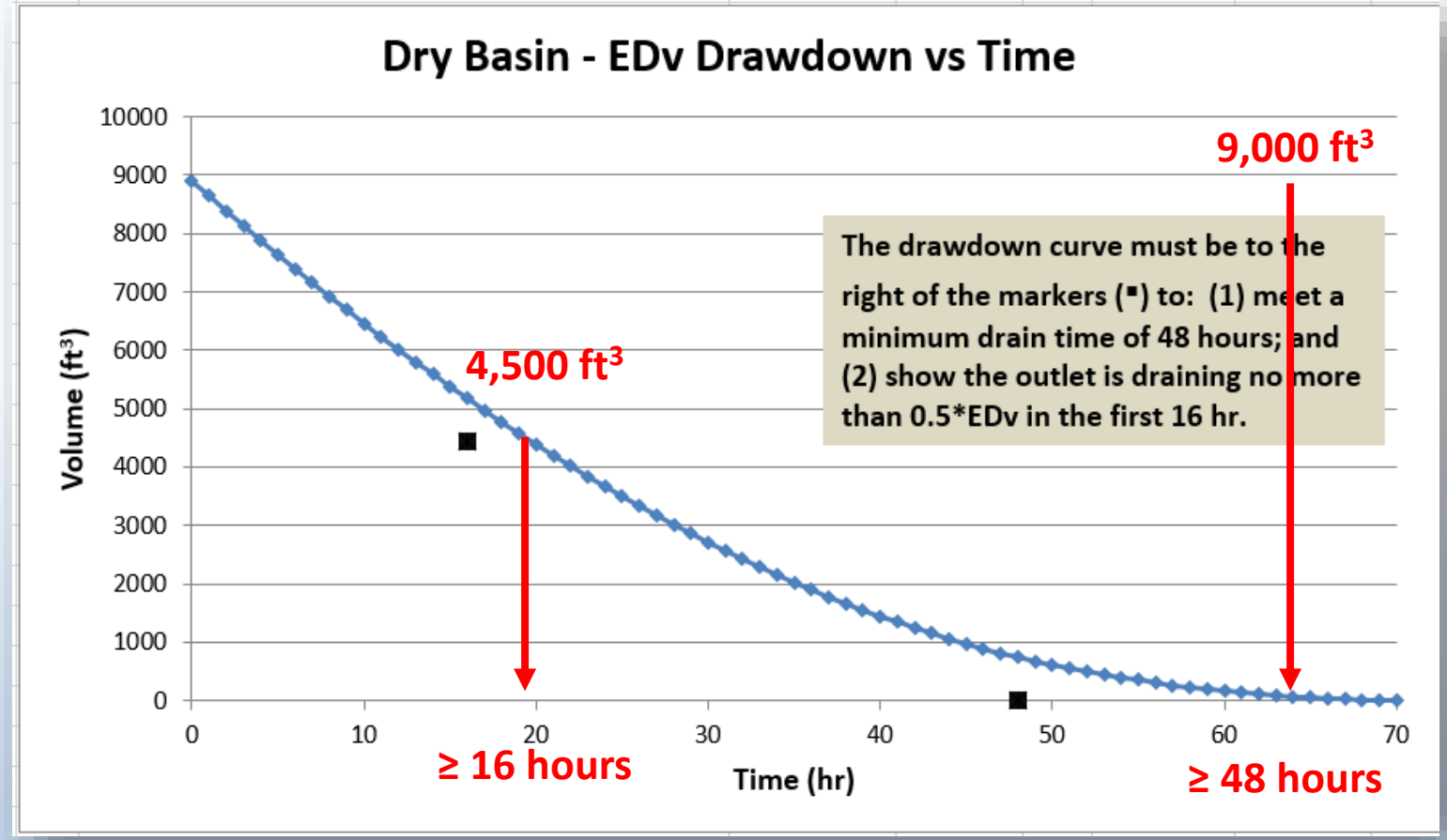
Extended Detention



Volume: 9,000 ft^3 × 1/2 = 4,500 ft^3

Time: 48 hours × 1/3 = 16 hours

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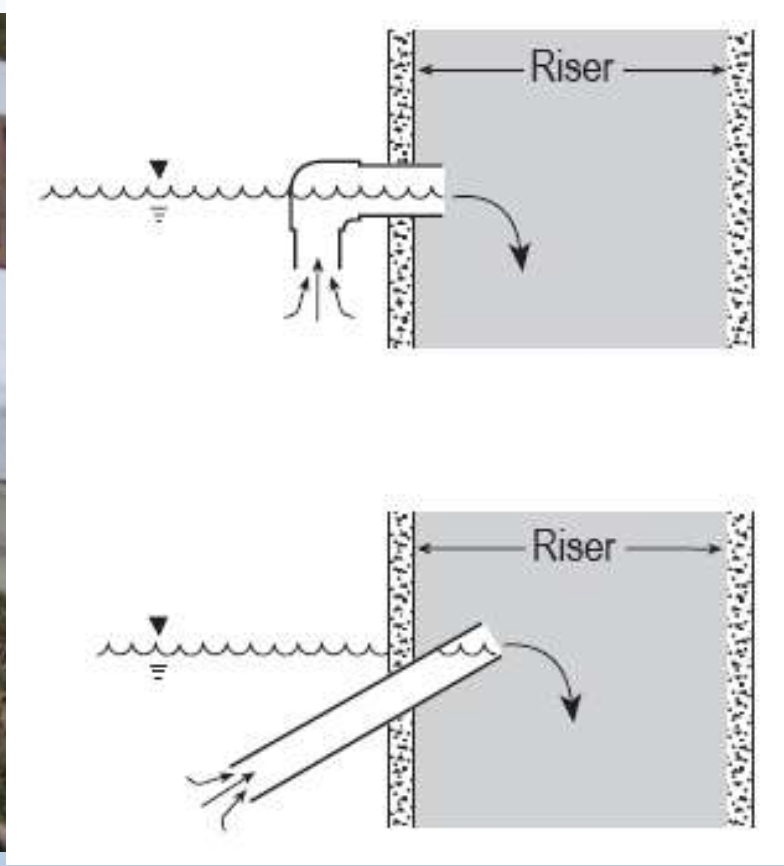
Extended Detention



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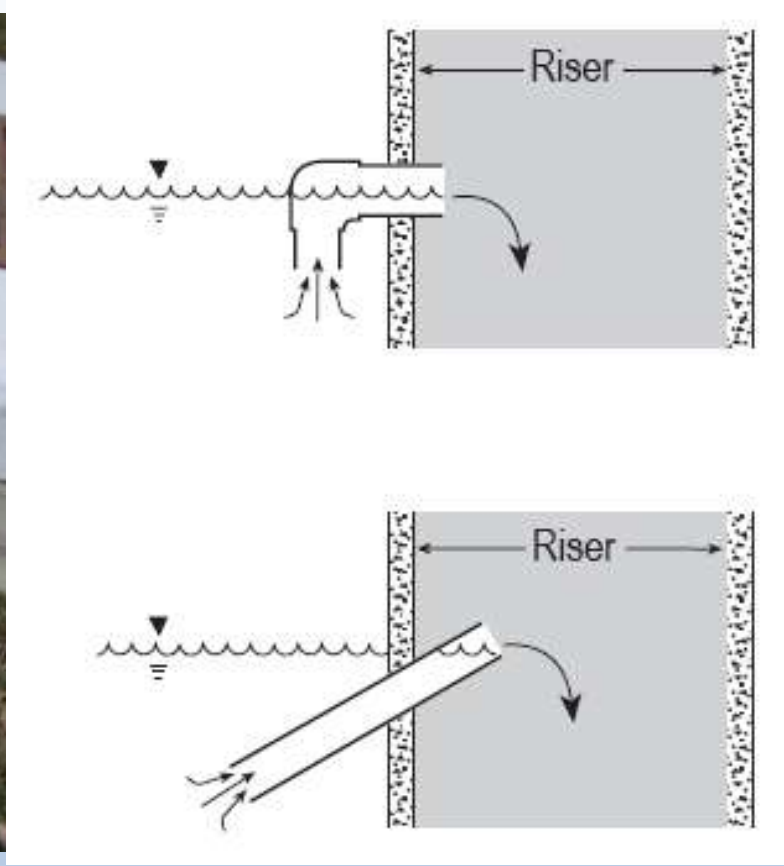
Extended Detention



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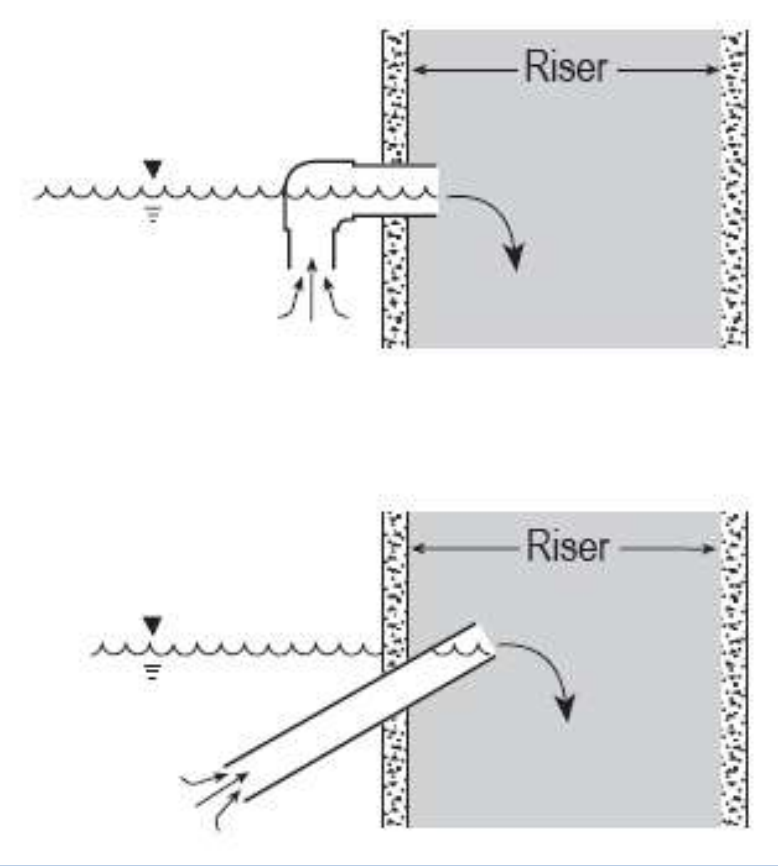

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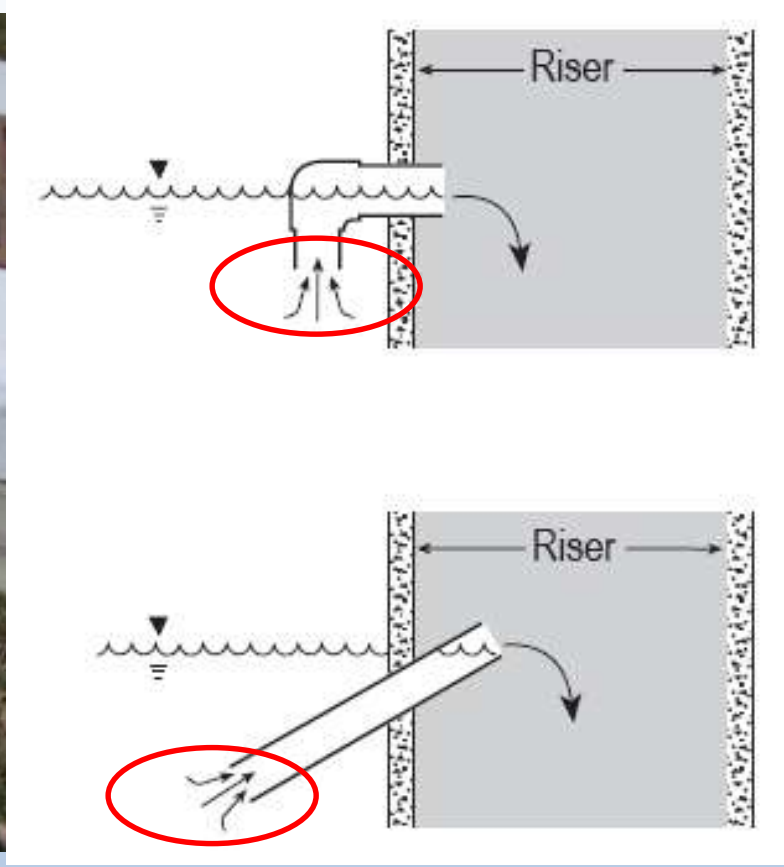
Extended Detention



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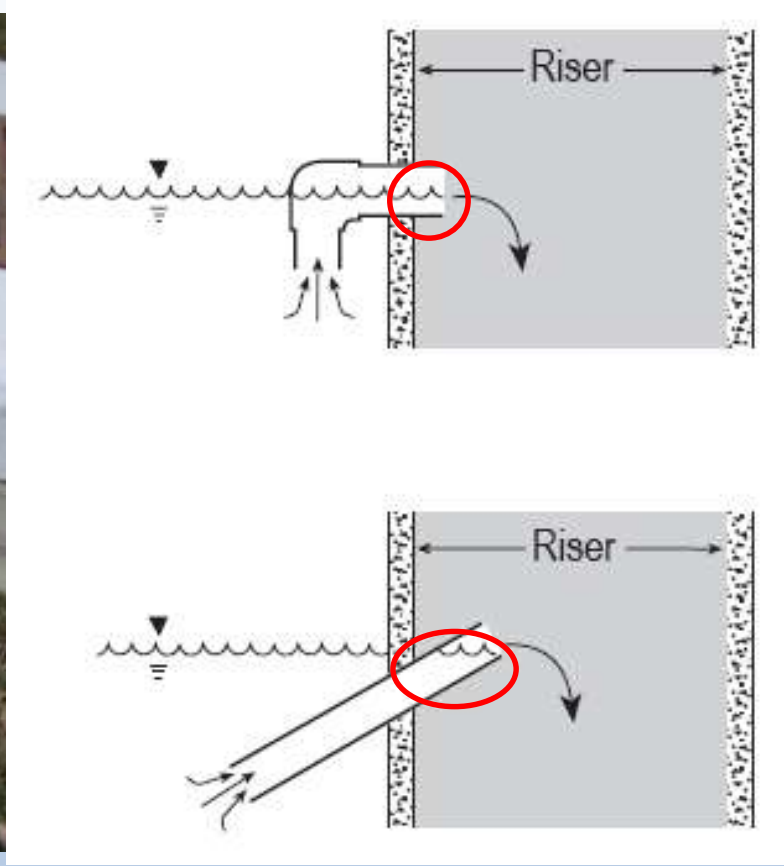
Extended Detention



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Infiltration Practices

- Suitable soils ($K_{sat} \geq 0.5$ in/hr)
- Infiltrate WQv under 48 hours to limit mosquito breeding & nuisances


Infiltration Trench


Infiltration Basin

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Infiltration

- Pretreatment required top protect/prolong infiltration surface
- Hydraulic loading:

  Minimum infiltration bed area ≥ 0.05 × $A_{impervious}$

  Permeable pavement ≤ 2 x pavement area

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Filtration Practices w/ Extended Detention

Possible to incorporate full or partial infiltration as well


Permeable Pavement/Pavers

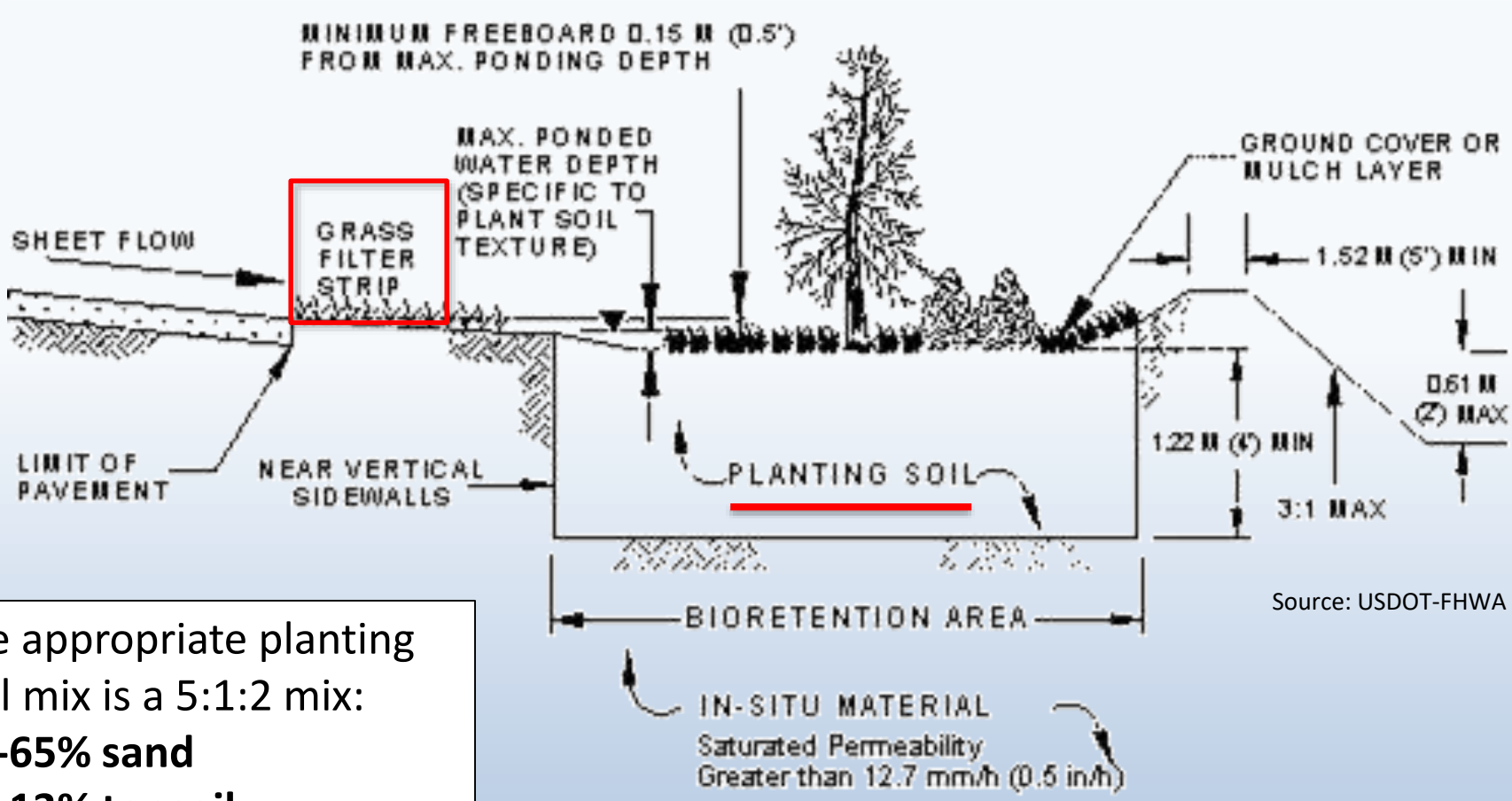
Underground Basin With Pretreatment


Source: semswa.org

Sand Media Filter

Bioretention

Bioretention



Source: USDOT-FHWA

the appropriate planting soil mix is a 5:1:2 mix:

60-65% sand

12-13% topsoil

~25% OM <u>by volume</u>

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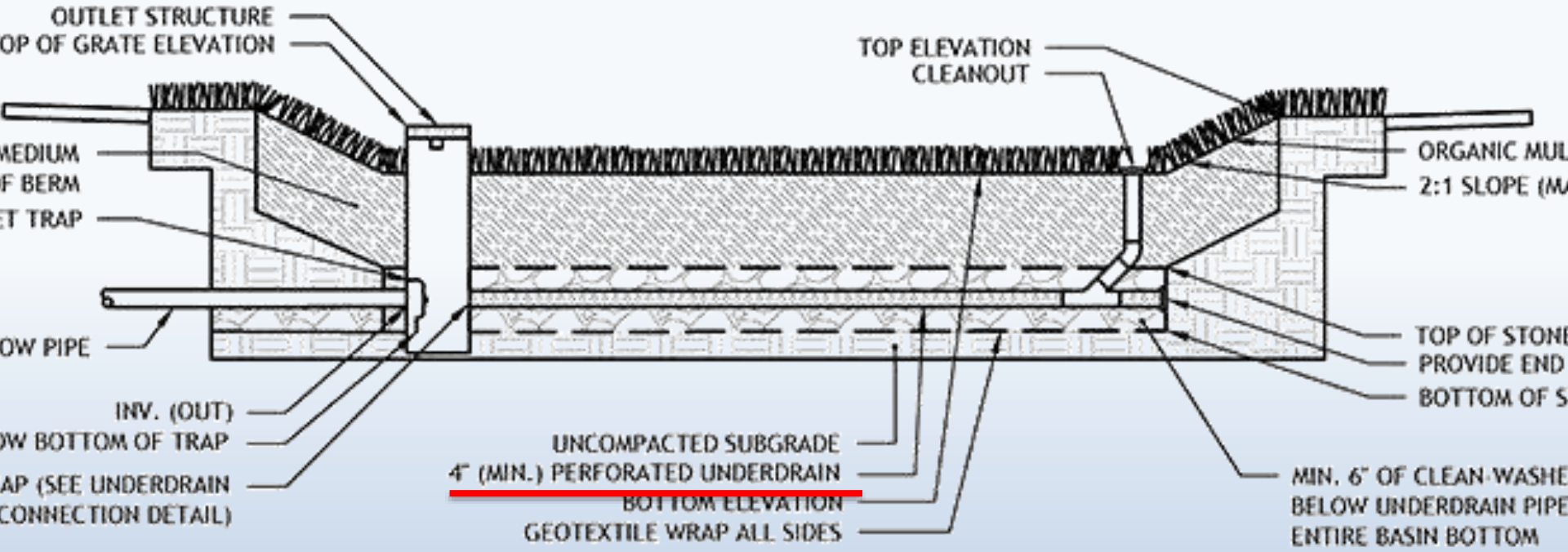
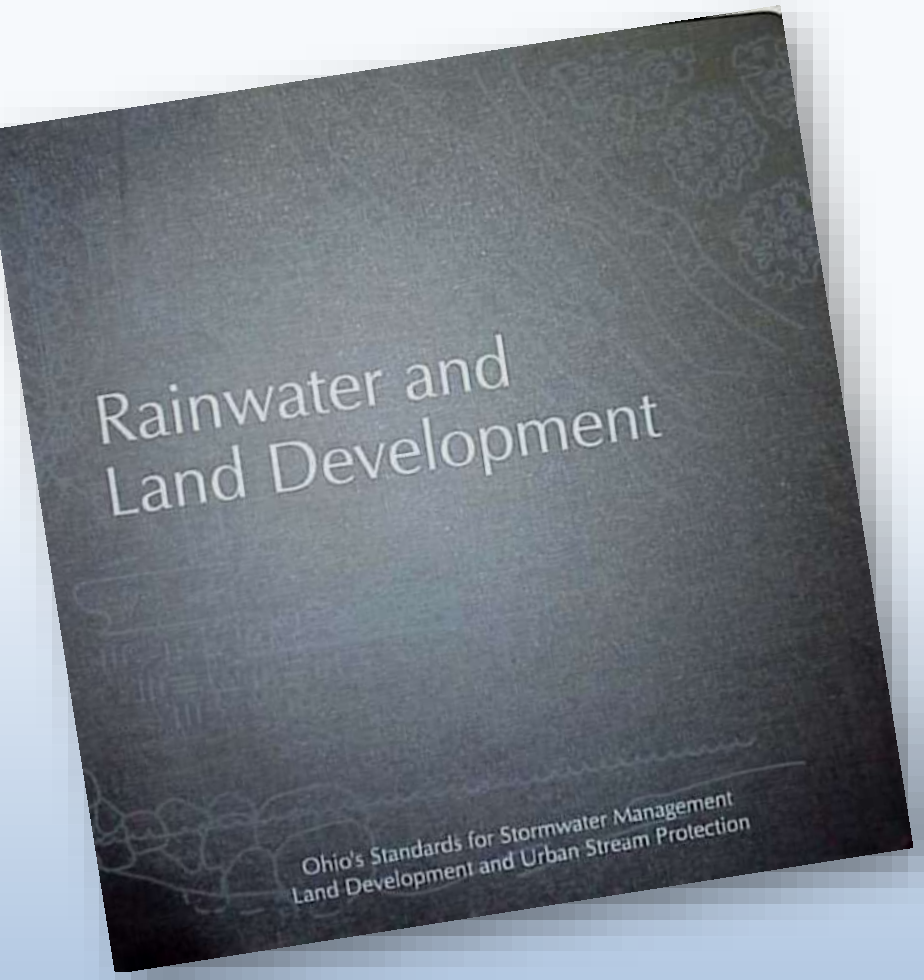
Bioretention



Source: Philadelphia Water Dept.

Practice Design Standards



Forms & General Permits | Issued Permits/Permittee Lists | Construction Activities | Industrial Activities | Municipal MS4 | Additional Information | Contacts

- Background
- Potential Waivers for 1- to 5-Acre Site Disturbances
- Technical Assistance & Permit Compliance Materials

POST-CONSTRUCTION Q&A DOCUMENTS

- Post-Construction Q&A – Water Quality Volume
- Post-Construction Q&A – Water Quality Volume Drawdown
- Post-Construction Q&A – Previously Developed Areas
- Post-Construction Q&A – Small Construction Activities (< 2 acres)

POST-CONSTRUCTION SPREADSHEETS

- WQv Compliance Spreadsheet
- Runoff Reduction Spreadsheet

CHECKLISTS

- Storm Water Pollution Prevention Plan (SWP3) Check List
- Construction Site Inspection Checklist

OIL & GAS

- Oil and Gas Exemption - U.S. EPA web page
- Storm Water Permitting for Oil- and Gas-Related Operations - Ohio EPA fact sheet

ADDITIONAL GUIDANCE DOCUMENTATION

- Ohio's Current Rainwater and Land Development Manual
  - Chapters and appendices
  - Critical Storm Method
  - Practice Data Sheets
- Ohio EPA Alternative Post-Construction BMP Submittal Form
- Guidance on Manufactured Treatment Devices as Pretreatment for Underground Storm

epa.ohio.gov/dsw/storm/index

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Practice Design Standards

Are there any exceptions?

- Projects that do not create impervious area
- Flexibility for linear transportation projects
  - refers to ODOT Location and Design (L&D) manual
- Reduced WQv requirement for redevelopment sites
  - based on the net change in Rv (impervious area)
- Flexibility for sites less than 2 acres
  - Possible to justify alternative to standard practice & design
- Runoff Reduction practices receive credit towards WQv

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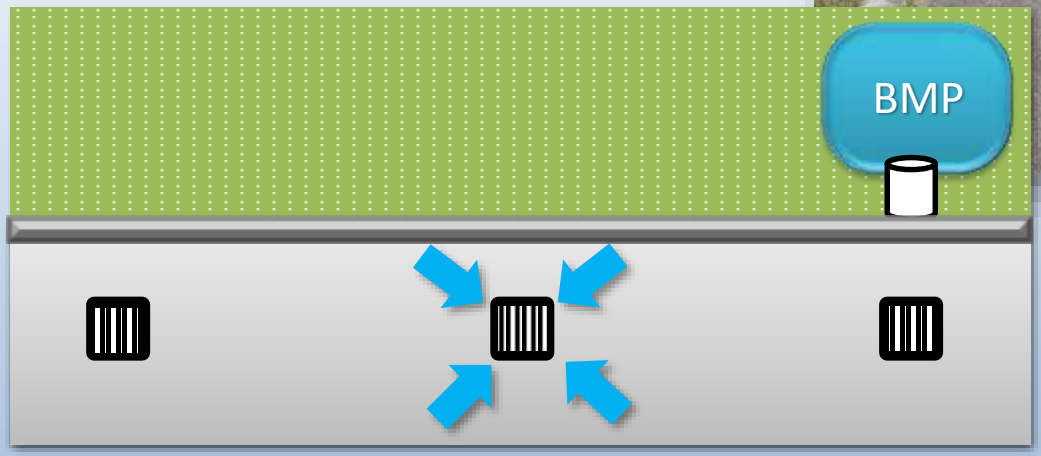
Runoff Reduction Concept

A typically designed 2 acre site with 1 acre of impervious surface and catch basins draining to a storm water practice



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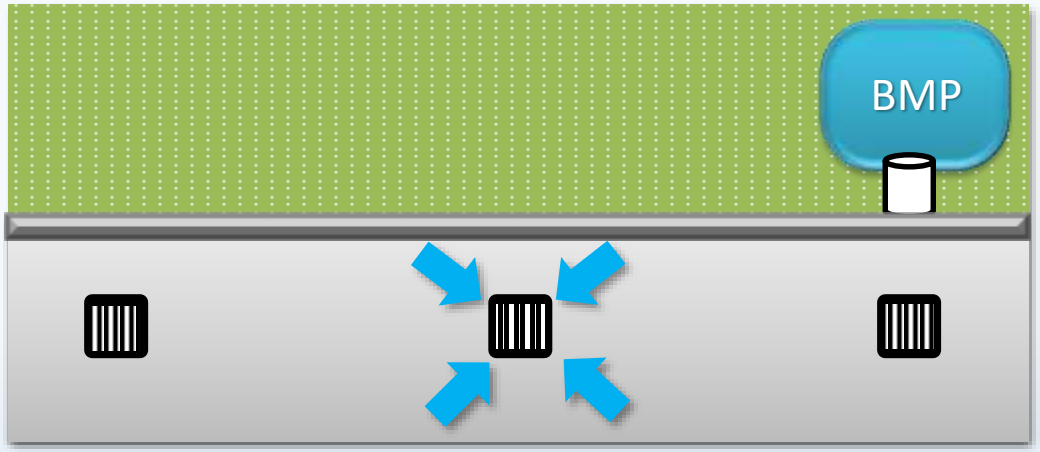
Runoff Reduction Concept



The WQv is calculated as:

$$WQv = P_{wq} \times R_v \times A_{disturbed} \div 12$$

$$WQv = 0.9 \text{ in} \times 0.50 \times 2 \text{ ac} \div 12$$

$$WQv = \underline{0.075 \text{ ac–ft}}$$

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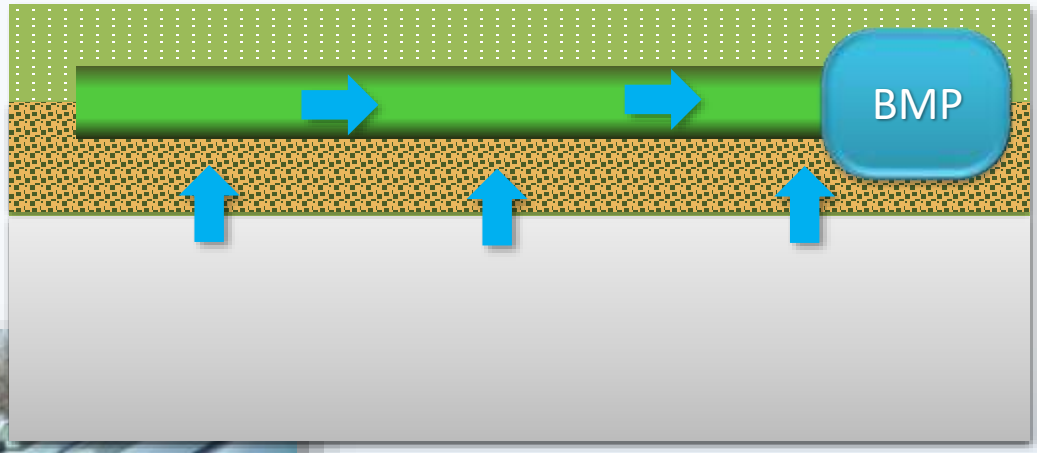
Runoff Reduction Concept



WQ treatment credit can be taken if impervious surface disconnection and a grass swale are used to convey stormwater to the practice

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Runoff Reduction Concept

Area A Runoff Reduction Volume (RRv) Calculator

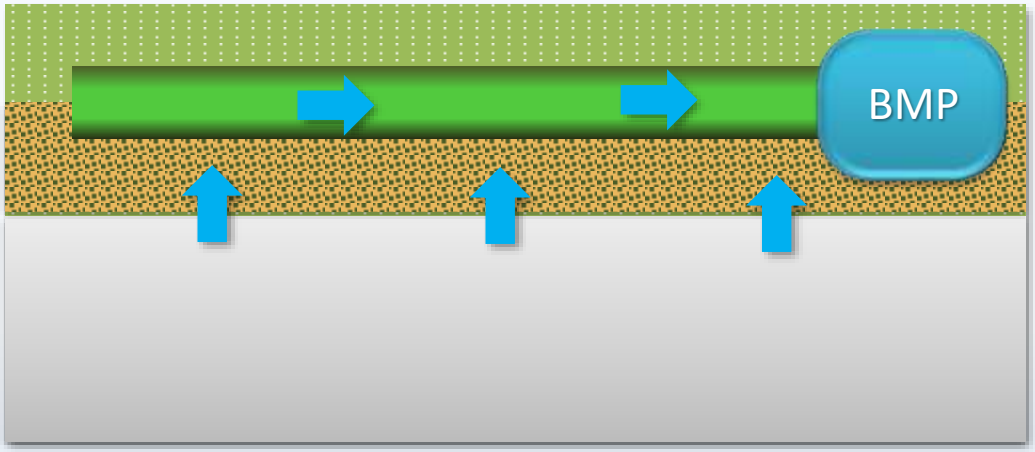
v1.1 2018-10-31

Drainage Area ID:				
Drainage Area, A_A =	2.00	acres	87,120	ft^2
Impervious Area, A_{Aimp} =	1.00	acres	43,560	ft^2
Pervious Area, A_{Aperv} =	1.00	acres	43,560	ft^2
Imperviousness Fraction, i_A =	0.50		50	%
Volumetric Runoff Coefficient, Rv_A =	0.50			
Water Quality Volume, WQv_A =	3,267	ft^3		

Apply Runoff Reduction Practices

Runoff Reduction Practice	Cover in Contributing Drainage (ft^2)	Cover in Contributing Drainage (ft^2)	Volume Received by Practice (ft^3)	Description of Credit	% Credit	Received from Upstream (ft^3)	Volume Received by Practice (ft^3)	Disconnection Area of Practice (ft^2)	Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	Remaining Volume (ft^3)	Downstream Practice
1. Green (Vegetated) Roof												
Green Roof		N/A	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	N/A
2. Rainwater Harvesting												
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
3. Impervious Surface Disconnection												
Simple Disconnection to A/B Soils or Amended C/D Soils	43560	N/A	3104	Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection	N/A	0	3104	21780	N/A	871	2232	Grass Swale C/D Soils
Simple Disconnection to C/D Soils		N/A	0	Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection	N/A	0	0		N/A	0	0	
To Rain Garden(s)			0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
To Stormwater Planter(s)		N/A	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
4. Sheetflow to Grass Filter												
Sheetflow to Grass Filter Strip with A/B Soils or Compost Amended C/D Soils			0	Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	0	0		N/A	0	0	
Sheetflow to Grass Filter Strip with C/D Soils			0	Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of filter strip area.	N/A	0	0		N/A	0	0	
5. Grass Swale												
Grass Swale A/B Soils or Compost Amended C/D Soils			0	Reduce volume conveyed through grass swale by 0.2 inches.	0.2"	0	0	N/A	N/A	0	0	
Grass Swale C/D Soils		10890	41	Reduce volume conveyed through grass swale by 0.1 inches.	0.1"	2232	2273	N/A	N/A	349	1924	
6. Bioretention												
Bioretention			0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
7. Infiltration Practice												
Infiltration Practice			0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
8. Permeable Pavement												
Permeable Pavement		N/A	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	
9. Sheetflow to Conservation Area												
Sheetflow to Conservation Area with A/B Soils			0	Reduce volume conveyed to conservation area by 0.03 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Sheetflow to Conservation Area with C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Totals	**43560**	**10890**						**21780**		**1221**		
									Water Quality Volume Remaining (ft^3):	**2046**		

Runoff Reduction Concept



$$WQv = 0.075 \text{ ac–ft}$$

$$\text{Disconnection credit} = 0.020 \text{ ac-ft}$$

$$\text{Swale credit} = 0.008 \text{ ac–ft}$$

$$WQv = 0.047 \text{ ac–ft}$$

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Impervious Surface Disconnection

Downspout Disconnection

Pavement Disconnection

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Enhanced Impervious Surface Disconnection

Stormwater Planter

Source: USEPA

Rain Garden

Source: Franklin SWCD

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Grass Swale

Source: VA DEQ Stormwater Design Specification No. 3

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Sheet Flow to:

Grass Filter Strip

Conservation Area

Source: WV DEP

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Summary & Take Home

The post-construction requirements are simple, but often unfamiliar

The permit creates flexibility for designers to minimize the effects of stormwater with careful site planning

Generally much smoother when included early in the design process

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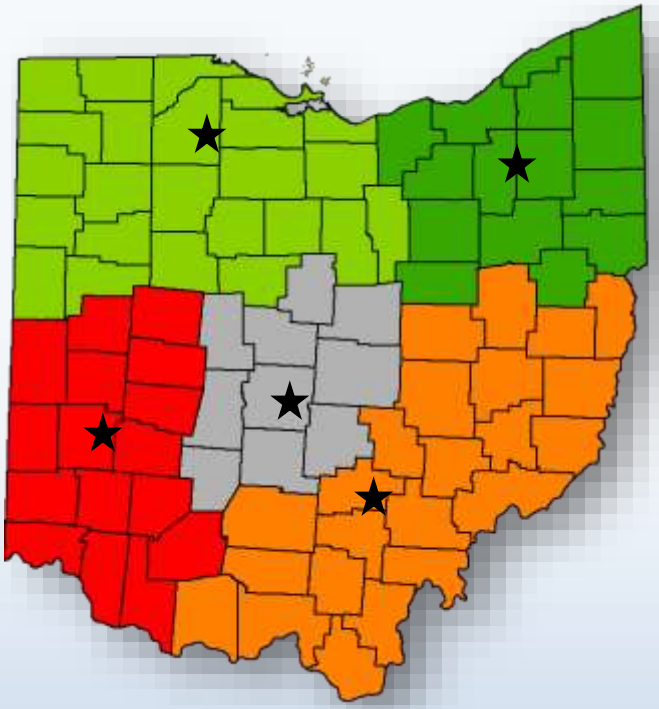

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