Recommendations of the Expert Panel to Define Removal Rates For disconnecting Existing Impervious Area Runoff From Stormwater

Presented to the WQGIT

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Virginia Tech
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Center for Watershed Protection

Chesapeake Bay Program
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The panel charge

- This panel will evaluate the nutrient and sediment removal and runoff reduction benefits associated with disconnecting existing acres of impervious cover through several engineering and/or field assessment methods as defined within this Charge.

Our esteemed panel of experts

Met 9 times from July, 2015 through April 2016.

Name	Role	Affiliation
Bill Stack	Panel Chair	Center for Watershed Protection
Greg Evanylo	Panel Member	Virginia Tech
Jason Papacosma	Panel Member	Arlington County, Dept. of Environmental Services
Ryan Winston	Panel Member	North Carolina State
David Sample	Panel Member	Virginia Tech
Franco Montalto	Panel Member	Drexel University
Justin Shafer	Panel Member	City of Norfolk (VA)
Panel support		
Jeremy Hanson	Panel and VT Coordinator	Virginia Tech, CBPO
Brian Benham	VT Project Lead	Virginia Tech
Greg Sandi	WTWG Representative	MDE
Jeff Sweeney	CBP Modeling Team Representative	EPA, CBPO
Liz Ottinger	Regulatory Support	EPA Region 3
Reid Christianson	CWP Staff Support	CWP
Lisa Fraley-McNeal	CWP Staff Support	CWP
Steve Stewart	Former Panel Member	Baltimore County, Dept. of Environmental Protection and Sustainability

Description of Protocols

Table E - 1. Recommended nutrient and sediment removal for the disconnection of existing impervious area runoff from stormwater drainage systems.

Amended Soils

Protocol	Units[1]	Pollutant Removal
Impervious area disconnection to amended HSG A or B soils that are not compacted	Pounds per year	TN, TP, and TSS removal calculated as simple impervious disconnection following recommendations of the Expert Panel to Define Removal Rates for Urban Filter Strips (UFS EP, 2014).
Impervious area disconnection to amended HSG C or D soils or compacted A and B soils	Pounds per year	TN, TP, and TSS removal calculated based on the runoff reduction from a 1.0 inch rain event, which is used as the water quality volume treated and the RR pollutant removal curves in SRP EP (2013).
Treatment in the conveyance system	Pounds per year	TN, TP, and TSS removal calculated based on the water quality volume treated and the RR and ST pollutant removal curves in SRP EP (2013).

[1]Note that relative reductions from the SRP EP (2013) curves must be multiplied by location specific TN, TP, and TSS yields (i.e. 50% reduction of 10 pounds per acre per year for one acre gives 5 pounds per year reduction).

Results expressed in inches of runoff treated per acre of impervious cover to be compatible with runoff adjuster curves

Default rate

TN	TP	TSS
12.3%	14.6%	15.6%
Default rates are from the RR curves in the Retrofit Expert Panel recommended protocols, using a value of 0.1 inches per impervious acre treated.		

Assumptions:

- impervious to pervious ratio (I:P) of 1 or lower
- at least 1 inch of compost (at 50% organic matter) is added
- at least 3 inches of incorporation into the native soil occurs
- and all other qualifying conditions are met.

Simple Method for Impervious Area Disconnection Coupled with Soil Amendments

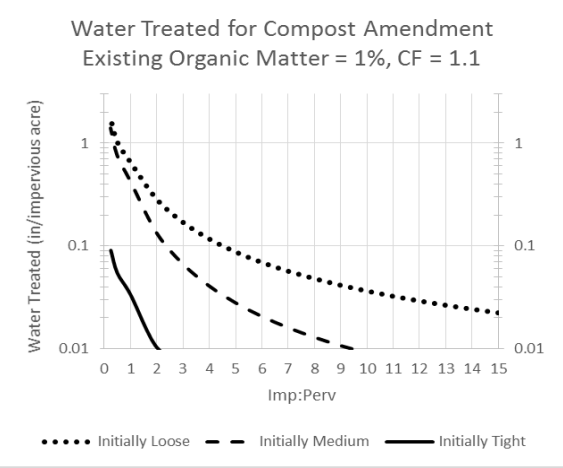
- Table 8. Soil types grouped by a sites existing organic matter and loose, medium, and tight existing soil conditions (can use SSURGO).

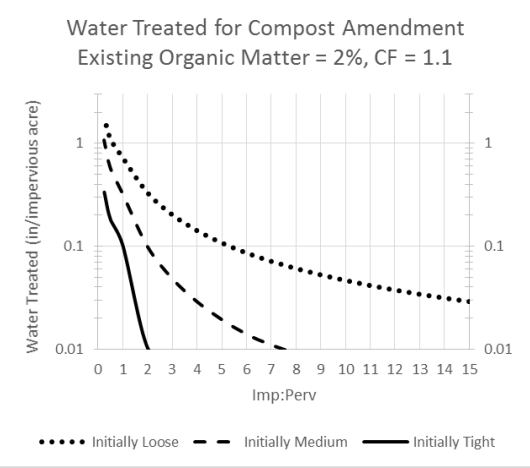
	Initial Soil Condition		
Organic Matter	Loose	Medium	Tight
1% or less	Loam	Silt Silt loam Sandy clay loam	Silty clay loam
greater than 1%	Loam Silt Silt loam	Sandy clay loam Silty clay loam	Clay loam Silty clay

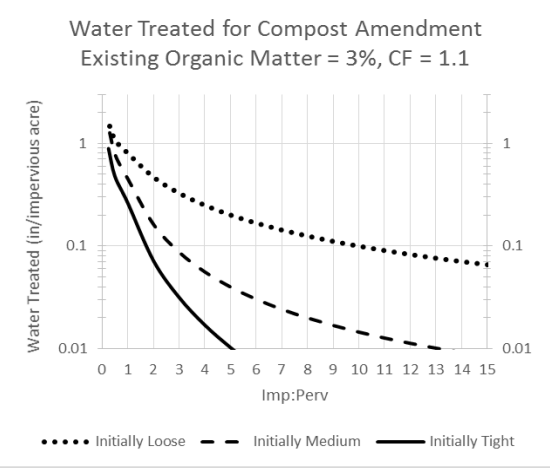
Curves or table for simple method

Water treated (in) per impervious acre based on initial soil conditions

Table 9	Initial Organic Matter = 1.0			Initial Organic Matter = 2.0			Initial Organic Matter = 3.0		
I:P*	Loose	Medium	Tight	Loose	Medium	Tight	Loose	Medium	Tight
15	0.022	0.005	0.002	0.029	0.004	0.002	0.066	0.008	0.002
14	0.024	0.005	0.002	0.032	0.004	0.002	0.071	0.009	0.002
5	0.088	0.028	0.006	0.108	0.019	0.006	0.201	0.040	0.010
4	0.117	0.041	0.007	0.142	0.029	0.007	0.249	0.056	0.017
3	0.171	0.067	0.008	0.203	0.049	0.008	0.326	0.087	0.032
2	0.287	0.134	0.010	0.331	0.100	0.010	0.466	0.161	0.072
1	0.659	0.428	0.034	0.723	0.323	0.102	0.793	0.447	0.262
0.5	1.039	0.765	0.054	1.106	0.580	0.182	1.067	0.775	0.477
0.25	1.737	1.409	0.091	1.805	1.070	0.335	1.542	1.395	0.890







Computational method

Step 1. Estimate Impact of Soil Amendments and Decompaction on Hydraulic Properties of Soils. Estimate Ksat **before** and **after** amendments.

What is sand, clay, organic matter, bulk density?

Sand + clay + OM + Bulk density → Saxton and Rawls equations = Saturated hydraulic conductivity (Ksat)

Computational Method

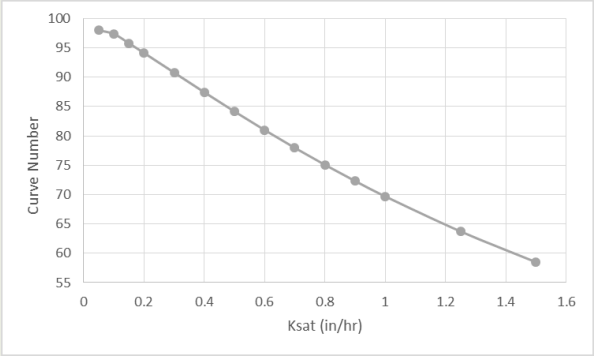
- Step 2: Adjust Ksat to account for the hydraulic loading based on the ratio of impervious area being introduced to the amended soils.

I:P	Infiltration Depth (L_f) (inches)
0.25	6
0.5	6
1	6
2	8
3	10
4	12
5	14
6	16
7	18
8	20
9	22
10	24
11	26
12	28
13	30
14	32
15	34

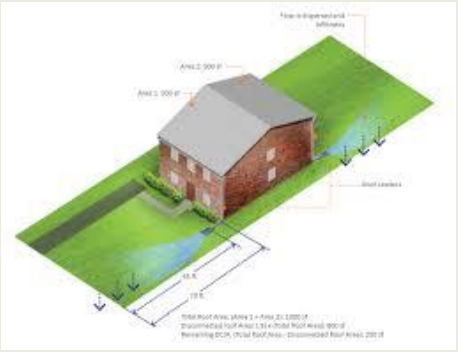
$$K_{SatEffective} = \frac{L_f}{\frac{D_{Cond}}{K_{SatCond}} + \frac{L_f - D_{Cond}}{K_{SatNative}}}$$

Computational method

Step 3. Convert Saturated Hydraulic Conductivity to a Curve Number



Step 4. Estimate Curve Number and Water Treated Due to Amended Pervious Area and Disconnected Impervious Area



Pre – Amendment: Q-site from 1.0” precip and existing RCN

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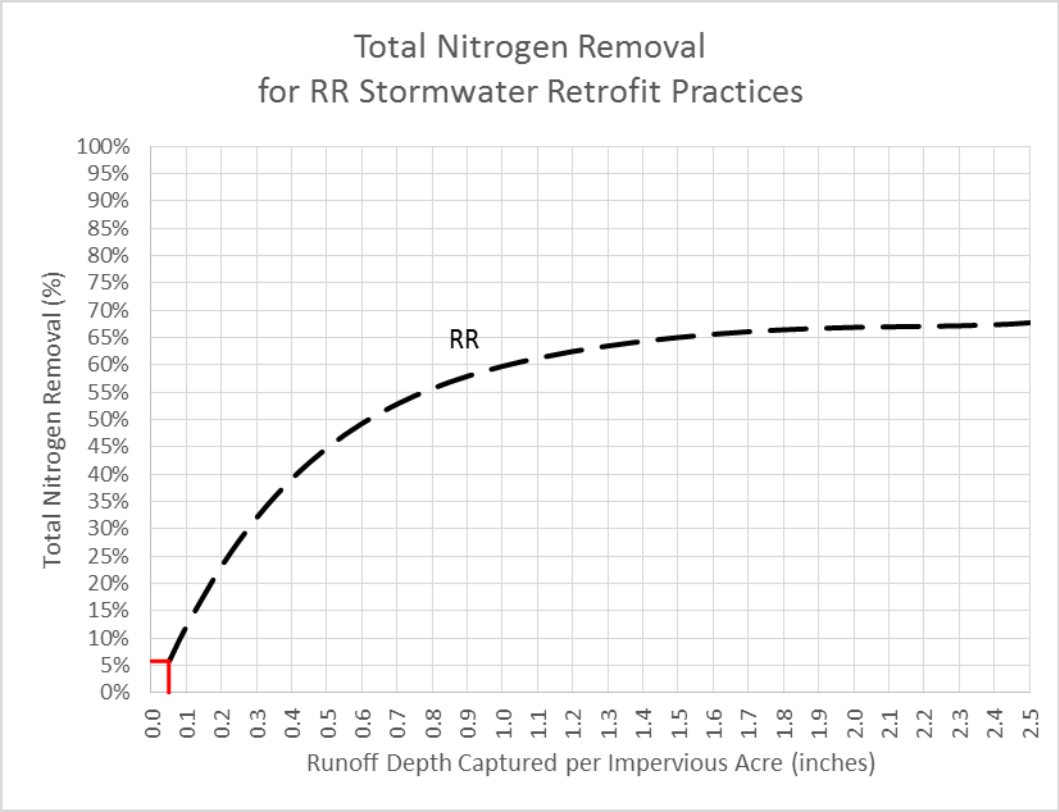
Post Amendment: Q-(site + Disconnected IC area) from 1.0” using weighted RCN

Runoff reduction due to amendments

Computational method

Step 5. Compute the annual TN, TP, and TSS Load Reduction (using adjuster curves)



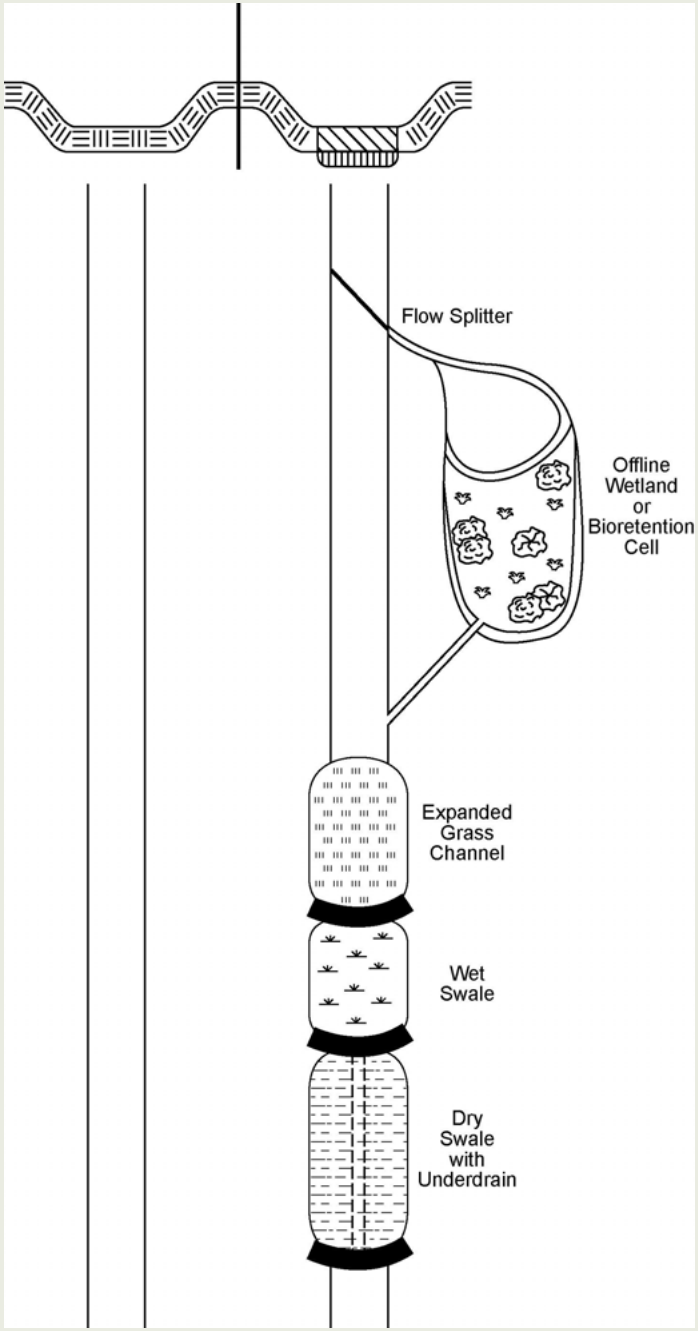
Treatment in the Conveyance System

Runoff Reduction

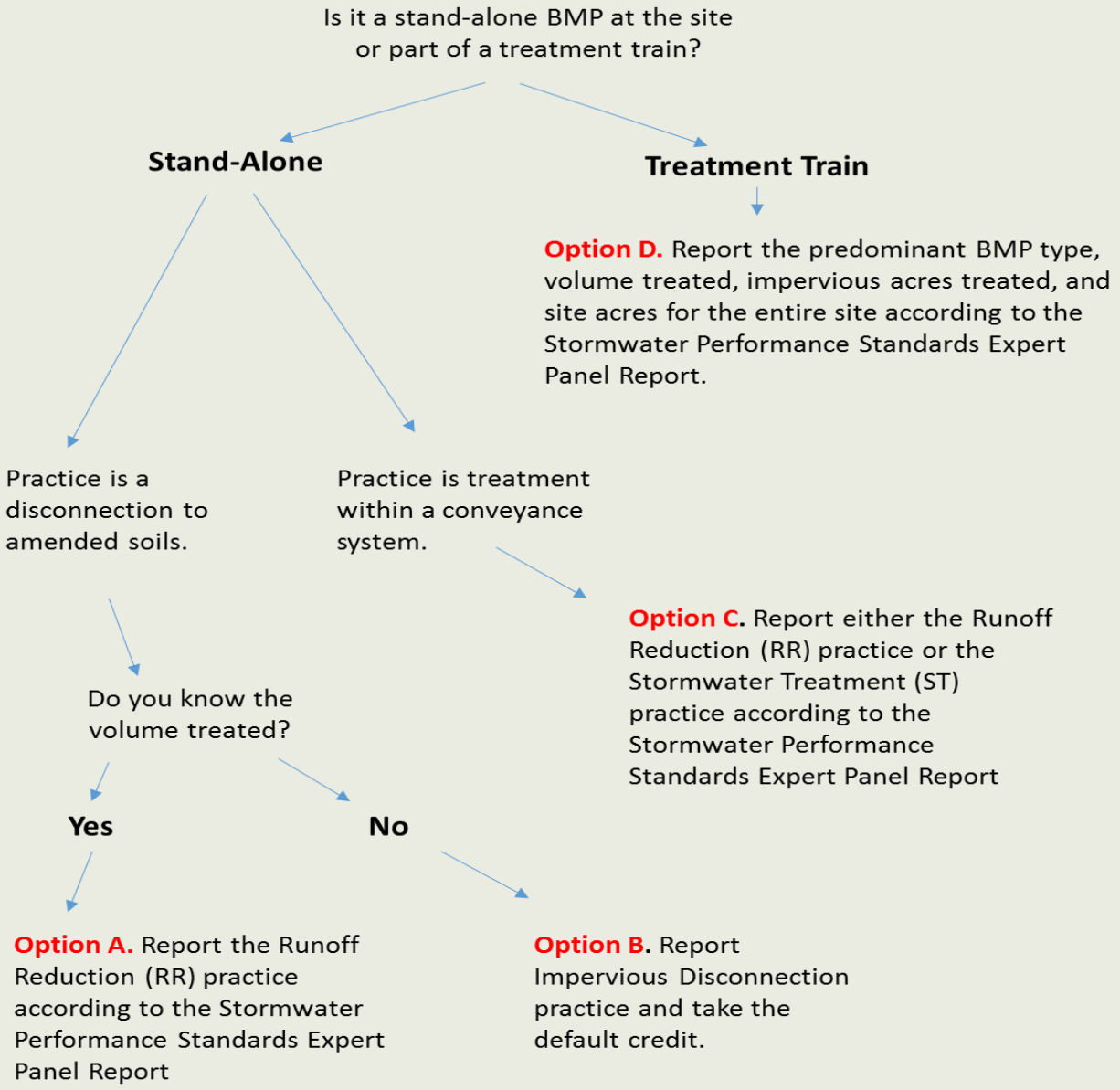
- Conversion of a Ditch into a Dry Swale
- Creation of Linear Bioretention Treatment Cells within a Ditch
- Extending the Flow Path of an Existing Ditch

Stormwater Treatment

- Installation of Weirs or Check Dams to Provide Storage (Stormwater Treatment)
- Conversion of a Ditch into a Wet Swale/Wetland (Stormwater Treatment)



Data Reporting

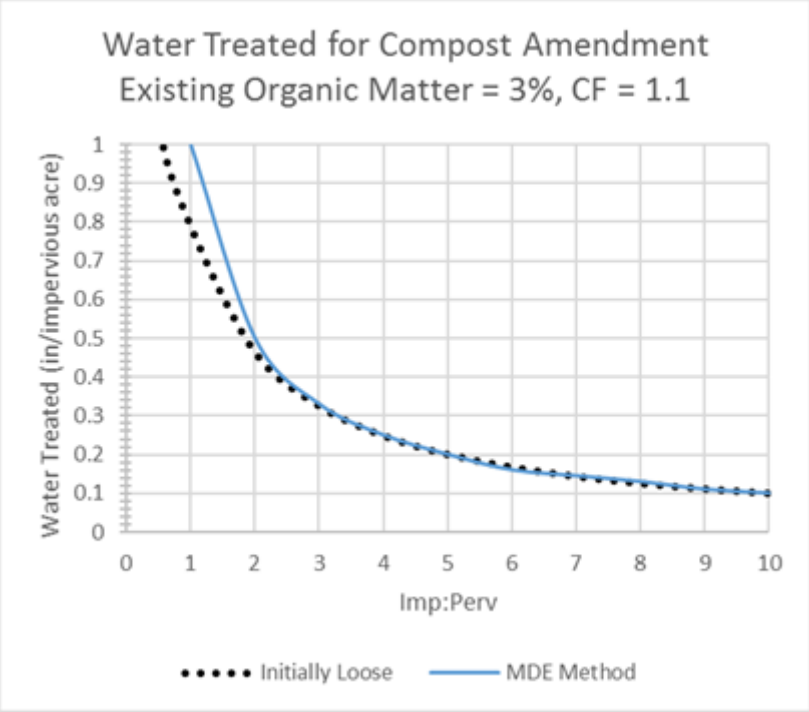


USWG Comments

- MDE had the following issues:
  - use of the curve number to predict runoff from storms 1.0 inches and less
  - disagreed with the model we used that relates saturated hydraulic connectivity to curve number.
- They consulted with their own experts who supported their concerns.
- Agreed to support the protocols providing Maryland users will use the method they developed that is included in Appendix G.

Extra Slides

MDE's method compared to Expert Panel's curve for loose soil



Qualifying Conditions

- How IC is directed to amended soil
- Tillage specs.
- Nutrient testing for soils
- Soil testing for parameters used in computational approach
- Compost specs
- Fertilization specs for groundcover

Panel charge cont.

- Impervious disconnection to pervious areas amended with compost and/or vegetative plantings.
- The potential to retrofit existing drainage networks on a site to achieve full or partial impervious disconnection.
- Modeling to determine the degree of disconnection based on a disconnection benchmark established by the Panel.
- The existing retrofit adjustor curves and their suitability to assess the sediment and nutrient reduction potential for this new category of stormwater retrofit or whether some other methodology is preferable.

Simple Method Steps

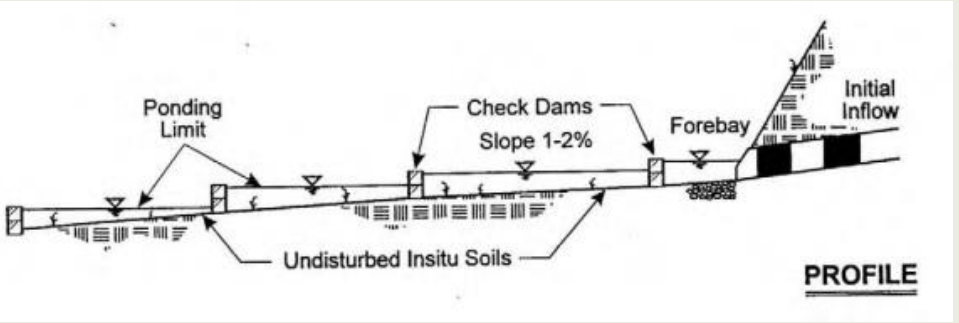
- Step 1. Identify whether the initial soil conditions are loose, medium, or tight.
- Step 2. Determine water treated (inches) per impervious acre. (From Table 9.)
- Step 3. Compute the annual TN, TP, and TSS load reduction.
- Assumes 1 inch of compost is added and incorporated 3 inches into the existing soil.

Computational method

- Step 1. Estimate Impact of Soil Amendments and Decompaction on Hydraulic Properties of Soils
- **Pre-amendment**
  - Determine pre-amendment sand, clay and organic matter (OM) content, and bulk density by collecting soil samples on-site.
  - Estimate saturated hydraulic conductivity (K_Sat), of the soil using methods provided in Appendix F Part 1 or the SPAW model.
- **Post-amendment**
  - Determine amendment details, including OM content of compost, depth to be applied (i.e. 2 inches over the site), and depth to incorporate into existing soil.
  - Re-estimate the K_Sat using the same process as above.

Computational method (cont.)

- Step 2. Determine Effective K_sat of amended soil
  - Determine infiltration depth from Table 12 (how far into the soil water will infiltrate)
  - depends on the impervious to pervious ratio (I:P)
- Step 3. Convert Saturated Hydraulic Conductivity to a Curve Number
- Step 4. Estimate Site Curve Number and Water Treated for Disconnected Impervious Area
- Step 5. Compute the annual TN, TP, and TSS Load Reduction (using adjuster curves)


Ponding
Limit
Check Dams
Slope 1-2%
Forebay
Initial
Inflow
Undisturbed Insitu Soils
PROFILE

Treatment in the Conveyance System

Treatment in the Conveyance System

- Treatment is the conveyance system is listed as an option in the Stormwater Retrofit Expert Panel Report. Nitrogen, phosphorus, and total suspended sediment reductions are calculated using “retrofit curves”
- The Retrofit Panel Report does not provide the specific options for treatment in the conveyance system or give examples.
- The goal of this Panel is to provide more details on the treatment options and show examples.